TRANSISTORIZED WIRELESS MIKE

JUNE 1956

# RADIO-ELECTRONICS

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, *Editor*

Simple Alignment of Broadcast Radios

•

All-Transistor Amplifier Has High Gain

•

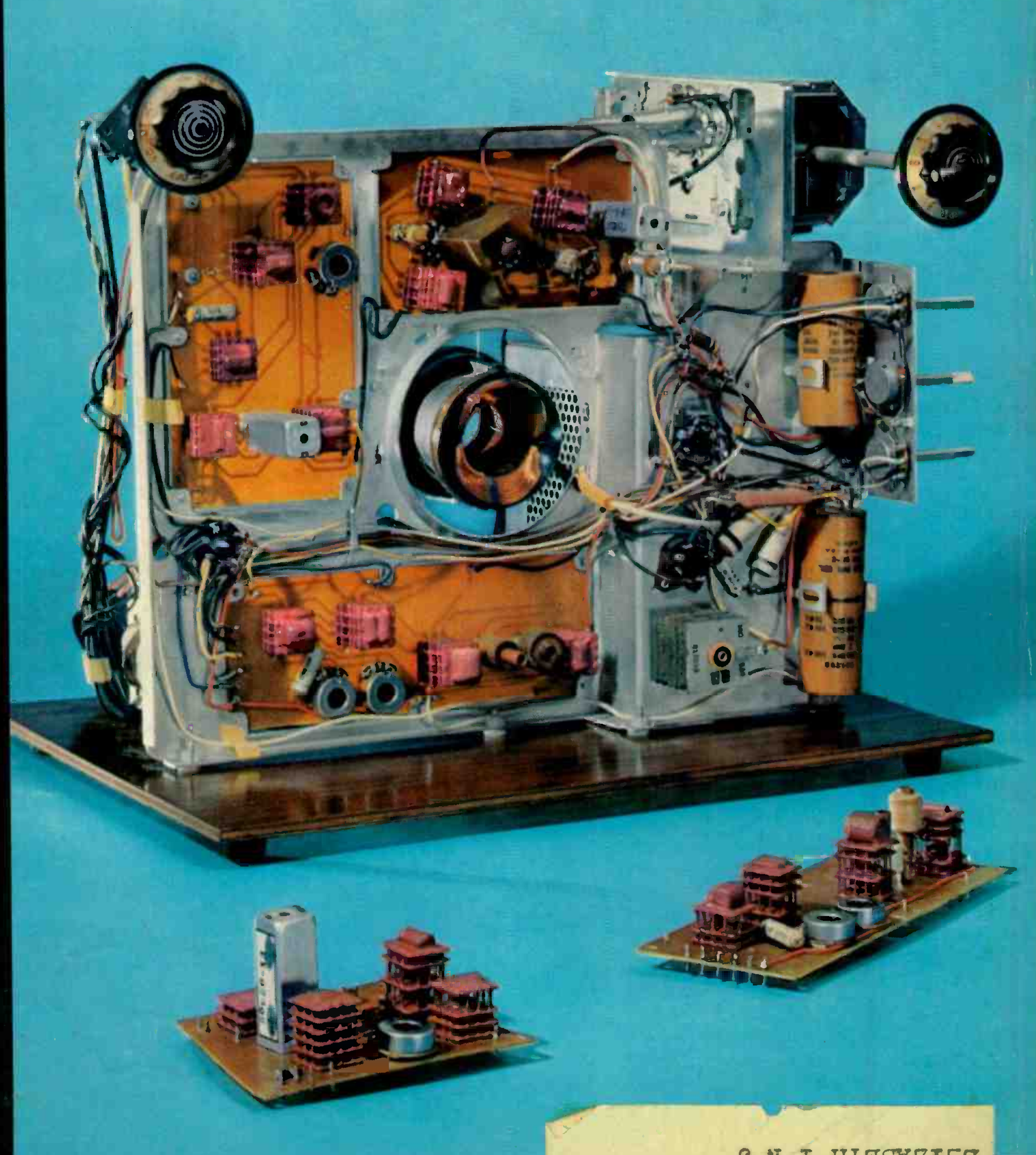
Radiation Meter for Civil Defense

•

Understand Your Color Bar Generator

•

Servicing Intercarrier Buzz



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# RADIO-ELECTRONICS

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ON THE COVER

(Story on page 37)

The new Emerson modular TV receiver, first of its kind to reach the public. In the foreground are two typical modular circuit boards.

*Color original by Habershaw Studios*


**JUNE 1956** **Vol. XXVII, No. 6**





Average Paid Circulation over 175,000

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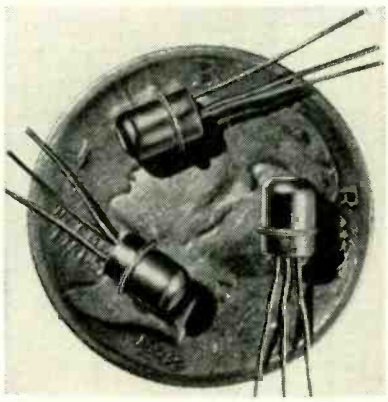
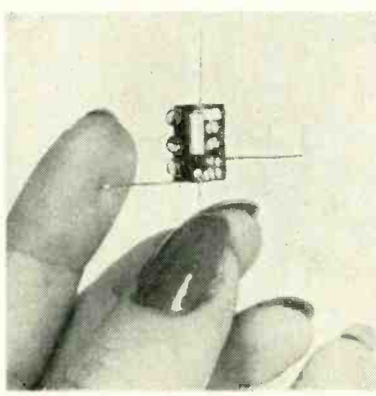
**SUBMINIATURE TRANSISTOR,** first unveiled by Philco at the recent Institute of Radio Engineers show and convention, is believed to be the smallest of its kind yet developed. The tiny



device (upper photo) is so small that more than 20 can be placed on a dime.

The new transistor, the M-1, is a p-n-p type having a 70-db gain, or a power gain of 10 million. Because of its tiny size—excess mass minimized—the M-1 can withstand an acceleration rate of 20,000 G's without change in characteristics. Power consumption is very low, with normal operation possible on as little as a ten-thousandth (.0001) watt.

Like most junction transistors, the basic operating portion of the M-1 consists of a wafer of germanium. In this case, however, the wafer is about the size of a pinhead. Leads are soldered to a dot of indium on each face of the wafer. Using M-1 transistors, a miniaturized amplifier about the size



of an ordinary pencil eraser (lower photo) has been assembled by Philco. Despite its tiny size, the M-1 is covered by a metal can which is hermetically sealed.

**THREE NEW TV STATIONS** have gone on the air since last month's report:

| | | |
|---|---|---|
| KSHO-TV | Las Vegas, Nev. | 13 |
| KETA | Oklahoma City, Okla. | 13 |
| WRVA-TV | Richmond, Va. | 12 |

WROW-TV, Albany, N. Y., channel 41, has changed its call letters to WCDA; WAST, Hagaman, N. Y., channel 29, to WCDB; WXEL, Cleveland, Ohio, channel 8, to WJW-TV; WIRI, Plattsburgh, N. Y., channel 38, to WPTZ, and KFXI-TV, Grand Junction, Colo., channel 5, to KREX-TV.

**MUSICAL TONE** may soon replace the familiar telephone bell. Undergoing major field trials this spring, telephones that radiate various tones through the louvered area at the base of the set (see photo) will be tested for customer reaction. The experi-

mental site, Crystal Lake, Ill., was selected for the variety of telephone equipment it affords—some 300 customers on 100 telephone lines, ranging from individual to 8-party rural service.

In this experiment the tones will be transmitted (using transistorized equipment) with the same amount of power required for a telephone conversation—considerably less than is needed to make a telephone ring. The ordinary telephone bell requires 85 volts; the transistorized device less than 1.

An advantage rated high by Bell scientists is that the new device is an aid to the partially deaf. This is because the musical tone contains more energy in the middle-frequency range where there is ordinarily less loss of hearing.

The tone stands out above general room noise and can be distinguished from the ringing of doorbells, alarm clocks or fire alarms.

**TRANSISTORIZED RADIO PAGERS** make private, individual paging of personnel possible. The new Handie-Talkie low-frequency radio paging system, announced by Motorola, does away with disturbing public-address, bell or


chime systems. No one except the pagee is aware that a message is being transmitted.

The system consists of a selector console with individual buttons for key personnel, an FM transmitter that radiates alerting tones and voice messages within a confined induction-loop area, and the individual Handie-Talkie radio pagers. The selective calling method used in this device consists of matched precision vibrating reed mechanisms—one in each pocket receiver to correspond with another activated by the transmitting console selector button.

The portable receiver (see photo) weighs only 10 ounces and is powered by a 4-volt mercury battery. The system permits paging of several hundred persons individually.

Another paging system, produced by Stromberg-Carlson, is the Pagemaster which uses a small radio decoder (see photo). Each decoder responds to a certain coded radio signal. When receiving that signal it emits an audible tone, alerting the individual carrier. The unit weighs only 7 ounces and the system provides up to 64 channels. In larger installations, servicing a large metropolitan area, approximately 4,000 channels can be utilized.

The Pagemaster encoder transmitter is a small console, on the front of which are dials with which the coded signals are set up. Only 3 or 4 seconds are needed to set a coded signal into the transmitter. As many as four signals can be set up at once, and the transmitter automatically sequences them and continues to transmit each one until it is removed from the encoder by the operator.

**NEW TV TAPE PROCESS** makes recording television programs on magnetic tape commercially practical. Developed by Ampex, the recorder will permit almost instantaneous playback through a normal TV system. Several other similar units have been demonstrated in the past, but the Ampex recorder is ready for use now and will be put into action by the Columbia Broadcasting System immediately upon delivery, which is expected in August.

The Ampex device records both the television picture and sound on a strip of magnetic tape about 2 inches wide. The tape speed is 15 inches per second, and 65 minutes of program material can be recorded on a 14-inch reel of tape. The high-frequency response at a low tape speed was obtained with a magnetic head assembly which rotates at a high speed and which records *across* the tape and thus gives a much higher effective tape speed. The present Ampex recorder can be used for black-and-white only.

**TECHNICAL IMPROVEMENTS** in radio broadcast services provided by its radio stations WWV near Washington, D.C., and WWVH in Hawaii have been announced by the National Bureau of Standards. Users may now make a better assessment of high-precision oscillators and clocks without waiting for correction data.

The broadcasts have been increased in accuracy from one part in 50 million to one part in 100 million. In addition, the broadcast frequencies at WWV are now normally held within plus or minus one part in a billion of the bureau's primary standard of frequency; this is done if necessary by making daily adjustments at 1900 Universal Time (2:00 p.m. Eastern Standard Time). The bureau's primary standard, which is now constant to one part in a billion, is derived immediately from standard quartz-crystal clocks which are evaluated over long intervals with reference to Standard Time from the U.S. Naval Observatory.

Time signals from WWV are kept in close agreement with Universal Time as determined by the Naval Obesrvatory. This is done by occasional step-adjustments in time, when necessary, of precisely plus or minus 20 milliseconds. These adjustments may be necessary several times per year. When required, they are made on Wednesdays at 1900 Universal Time simultaneously at WWV and WWVH.

**A NEW TWIST** in the used-tube racket was exposed with the sentencing of Joseph Lynch to two years in the Massachusetts House of Correction. The sentence was appealed and Lynch released on $20,000 bail pending hearing on the appeal.

Police reported that Lynch bought large numbers of burned-out tubes from dealers at junk prices. The date code numbers on the tubes were then changed to indicate that they had become inoperative while in warranty. These tubes were then, according to Sergeant Barrett of the Boston police force, turned in to dealers in exchange for new ones, and the new tubes sold to other dealers.

Two separate sentences of 1 year each, on the charges of counterfeiting code numbers and of counterfeiting labels on tubes, were imposed. END

# Correspondence

## BUILDS HARTLEY BOFFLE

*Dear Editor:*

I have constructed a Hartley Boffle from the article in the February issue with terrific results. I have an Electro-Voice SP12B in thin housing which measures 28 x 24 x 17½ inches. The screens are of 1¾ x ⅝-inch unplaned wood covered with rug padding. The first frame fits the speaker chassis; the second has a 15-inch opening, the third 13 inches, the fourth 11 inches, the fifth 9 inches, the sixth 7 inches, the seventh 5 inches, the eighth 3 inches, with a solid felt screen over its back.

The Boffle works so well and has such striking presence that I have to pass this setup along since it can be had at so reasonable a cost.

The Boffle is used with a TM15A Techmaster Ultra-Linear, a self-powered preamp and a Collaro changer with a G-E RPX-050A cartridge. I tried the system on *Slaughter on Tenth Avenue* as sort of a test, and the reproduction from the lowest bass to the triangles is really fine. I hope this will help some other money-strapped audiophile.

R. Mertz

*Akron, Ohio*

## BUSINESS VIEWS

*Dear Editor:*

I have for some time followed with interest the various letters in your magazine regarding screwdriver mechanics, publication of list and net prices and related topics. I suspect that if you publish this letter there will be repercussions, but I am sincere in my beliefs.

First, I am firmly convinced that much opposition to basement repairmen and part-time technicians by those engaged in the business at established locations is due to distrust of their own ability. Since when did a man's address add to his skill in a trade or profession? I have met many of the so-called established men and have noted that the loudest howl came from those whose own work was the sloppiest, highest priced and least satisfactory from a customer standpoint. Many of the men working at a regular service business have sufficient business to keep themselves and one or more hired technicians busy 15 hours a day, yet can't stand the often excellent competition offered them by these so-called *part-time* technicians. Tell me—did *all* of these worriers start in a modern, completely equipped shop, charging full "established" rates?

CORRESPONDENCE *(Continued)*

Second, the complaint about the ability of nearly anyone to get a considerable discount on tubes and other components. So what? The principle upon which business competition in this country was based is the initiative of the individual in offering products to a large number of consumers, banking upon volume to offset a lower profit margin.

What the main gripe seems to boil down to is this: "We want all the business, regardless of our ability to handle it, at charges which we wish to collect."

It seems to me that this is making the set owner, who knows nothing of wholesale outlets and part-time technicians, the victim of one of the most highly organized monopolies in the country. Yet the "established" people claim they do not want monopoly. Show me the business man who won't buy the products *he* wants where he gets the best price. Show me, if you can.

BRIAN S. WARD
*Gary, Ind.*

## THE FINISHING TOUCH

*Dear Editor:*

With reference to my article "A Low-Distortion Amplifier," RADIO-ELECTRONICS, May, 1955, I have obtained an Acrosound TO-330 output transformer and a pair of Tung-Sol 6550 output tubes and installed these. I can report very favorably indeed on the results.

The power output before clipping is 48 watts and at that level IM distortion is below 0.25%. I no longer have available the fine spectrum analyzer I used for checking distortion on the original unit, but my makeshift tests indicate that it is still somewhere below 0.25% at full output.

The only changes in the circuit were: an Acro TO-330 for the TO-300, KT66's to 6550's, adding a pair of 1,000-ohm resistors in the grid circuit of the 6550's (between each grid and the V3 cathode bias resistor connection with the grid), and finally the exchange of R8 (8,200 ohms) for a 12,000-ohm pot which was adjusted to give the −48 volts bias for the output tubes. Plate current is then about 75 to 80 milliamps for the pair of tubes.

I think that varying the 330-ohm feedback resistor a small amount to the optimum point may increase output power a few watts without increasing distortion. Personally, I don't feel the need for additional power at this point. I am, at last, satisfied.

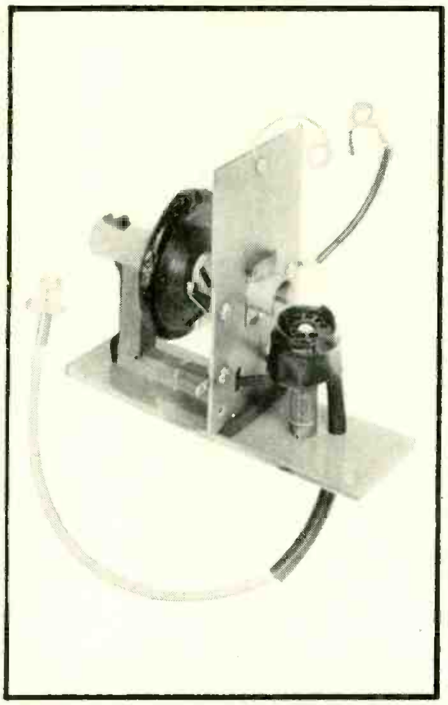
HERBERT MALAMUD
*New York City, N. Y.*

## THE WORM TURNS

*Dear Editor:*

Always interesting are the TV service articles by Art Margolis and now that he has roundly scored the "scarcely able" do-it-yourself TV repairer (RADIO-ELECTRONICS, April, 1956, page 56), perhaps a sequel could be devoted to this subject: after the TV technician has been paid, the "able" do-it-yourselfer sometimes has to do the work!

Following are examples, all from my personal—and unpaid—experience:





CORRESPONDENCE *(Continued)*

The first was on my own little TV set which, right out of the factory carton, had sound bars in the picture. On the advice of my retail dealer and after he had tried to correct the difficulty, I took the set back to the factory distributor who maintains an elaborate-looking service shop. But alas! their elaborate test equipment was not used on my set—all they did was to detune what I have since learned to call the *front end*. The sound bars were eliminated all right—but so was the clearest part of the picture! And the service charge for this shenanigan was $7.50!

There were two alternatives: either trade in the set on a new one or else look into the difficulty myself. The latter seemed to be the least costly and might be instructive. So, after reading all I could of the manufacturer's and other literature, I decided: that the original picture clarity could possibly be restored by retuning the front-end slugs (about 2 minutes' work); that the original difficulty could possibly be repaired by twisting the sound-trap slugs. Both of these hunches paid off handsomely, proving that, if the do-it-yourself man does a little preliminary investigation, he can also become a "learn-to-do-it-right" man. Maybe my TV technician would have profited by the same procedure.

This experience was told to one of my friends and she asked me to look at her set—on which a TV technician had also been paid and failed. It had a very high-pitched intermittent oscillation. When the TV technician had left the set as repaired, he had somehow temporarily checked the oscillation, but, when I started poking around in the back, I found that I could make the set howl like a stuck pig merely by pressing on the 6AX4 damper tube. Since I am not a TV technician I am not at all sure what was happening. And I am not at all sure that my "cure" (a new 6AX4) was the proper one. But at any rate my wealth of inexperience has paid off in "customer" satisfaction, for the set has never howled again.

The next set at which I was asked to look—*after* a TV technician had been paid and failed—also had (as it turned out) a bad 6AX4 damper, an unstable vertical sync and a bad vertical output tube. When the technician was called in there was no picture, due (as I found out later) to an open Slo-Blo fuse in the damper circuit. The technician had put in a conventional fuse of higher wattage, had adjusted the vertical hold to a point of temporary stability, apparently ignored the poor vertical height and linearity, but had collected his service fee and left.

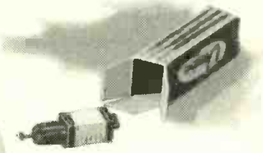
So this is the sad sad story to date of a poor do-it-yourselfer and I suggest to Art Margolis that not all of us are trying to beat the TV technician out of his service fees. Sometimes we are pressed into service *after* the TV technician has been paid and failed.

JOSEPH H. SUTTON
*Kansas City, Mo.*

END







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| 5605 | **5805** | **6805** |
| 5620 | **5820** | **6820** |
| 5621 | **5821** | **6821** |
| 5622 | **5822** | **6822** |
| ★ | **5824** | **6824** |


THE **RADIART** CORPORATION
CLEVELAND 13, OHIO

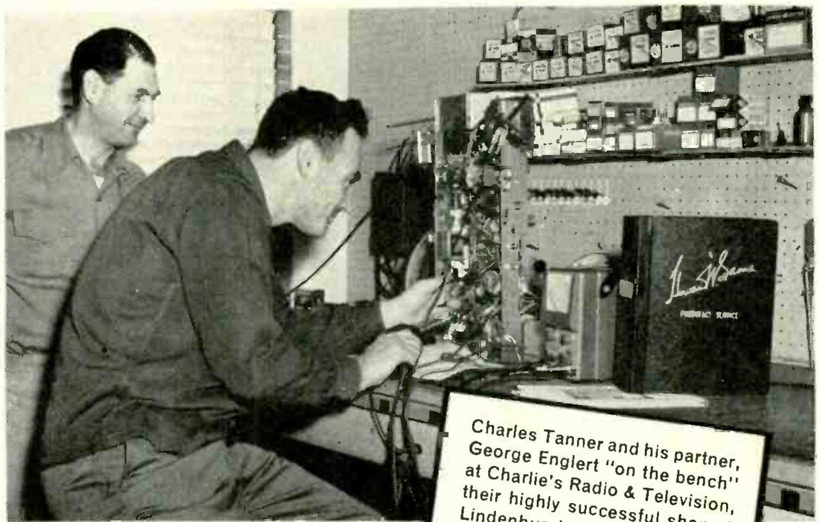
VIBRATORS • AUTO AERIALS • TV ANTENNAS
ROTORS • POWER SUPPLIES

# "best shop investment I've ever made...

## PHOTOFACT

**saves me time, helps me earn extra profits every day..."**

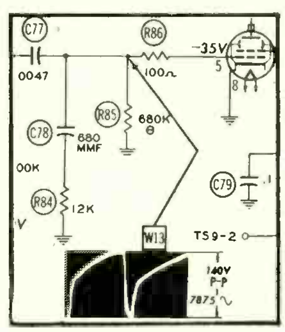
SAYS *Charles Tanner of Lindenhurst, L. I., N.Y.*

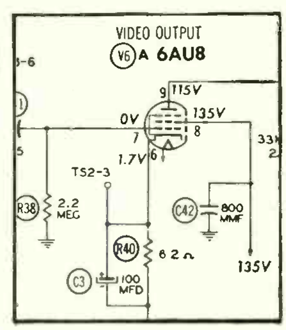


Charles Tanner and his partner, George Englert "on the bench" at Charlie's Radio & Television, their highly successful shop at Lindenhurst, L. I., New York.

Writes Mr. Tanner: "The use of Sams' PHOTOFACT data saves me time on bench jobs, and that means *extra* profits every day, profits I can really measure. The big time-savers I especially like are the convenient Voltage Data* and Waveforms* shown directly on every PHOTOFACT TV schematic diagram. Because of PHOTOFACT'S size, too, it's possible to work on a set with that very fine Standard Notation Schematic* lying easily accessible in front of the technician. In my opinion, PHOTOFACT is the best shop investment I've ever made."

George Englert stands near the shop's complete PHOTOFACT Library. Charles Tanner refers to his handy Sams PHOTOFACT Index for the time-saving Folder covering his next bench job.




**From start to finish, you solve your service problems in just minutes... you service more sets and earn more daily with PHOTOFACT by your side!**

**MONEY BACK GUARANTEE!**

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!

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Send for Sams' INDEX TO PHOTOFACT FOLDERS—your guide to virtually any receiver model ever to come into your shop; helps you locate the proper PHOTOFACT Folder you need to solve any service problem on any model. You'll want this valuable reference guide. Send coupon now.

*One of 32 features found exclusively in Sams PHOTOFACT—the world's finest service data covering over 20,000 TV and radio models

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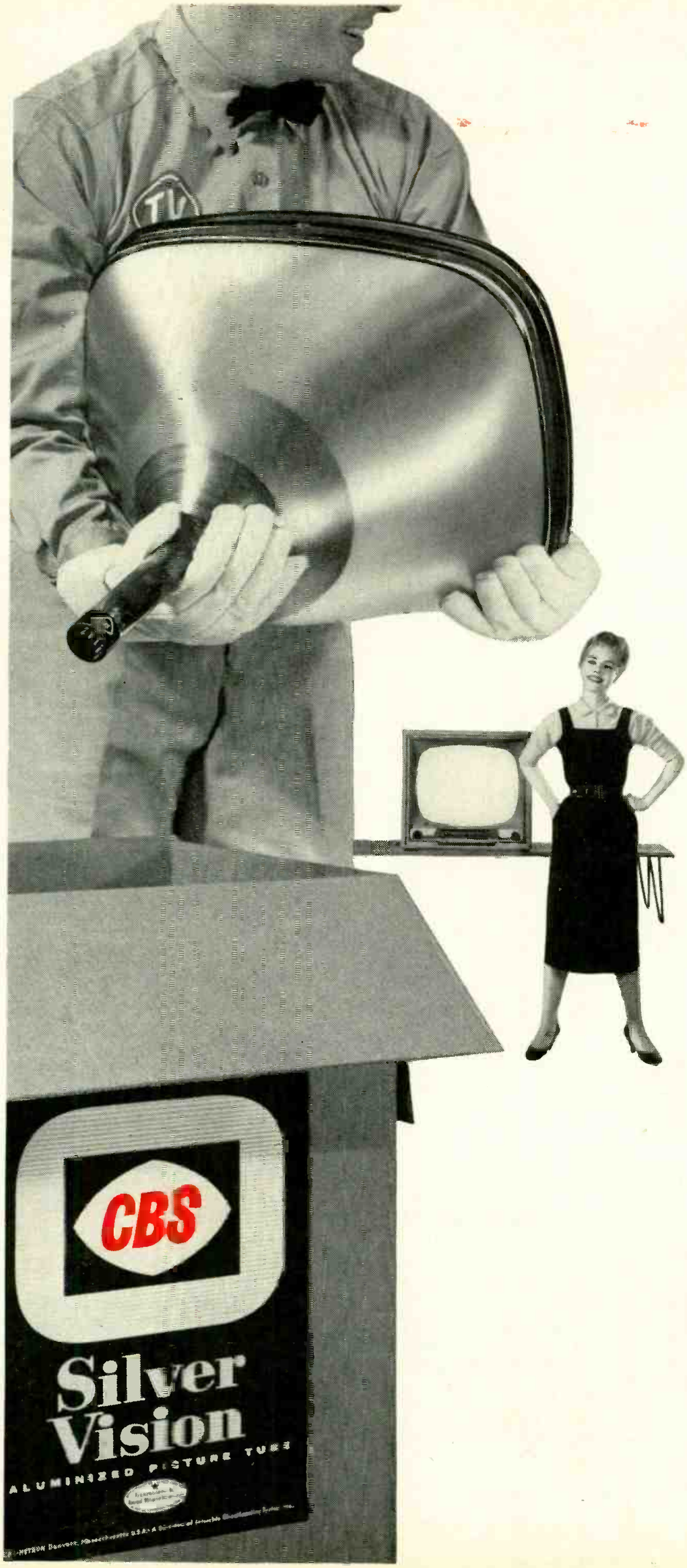
**It's easier to sell CBS**

# Silver Vision

**the**

## "High-Fidelity" Aluminized Tube



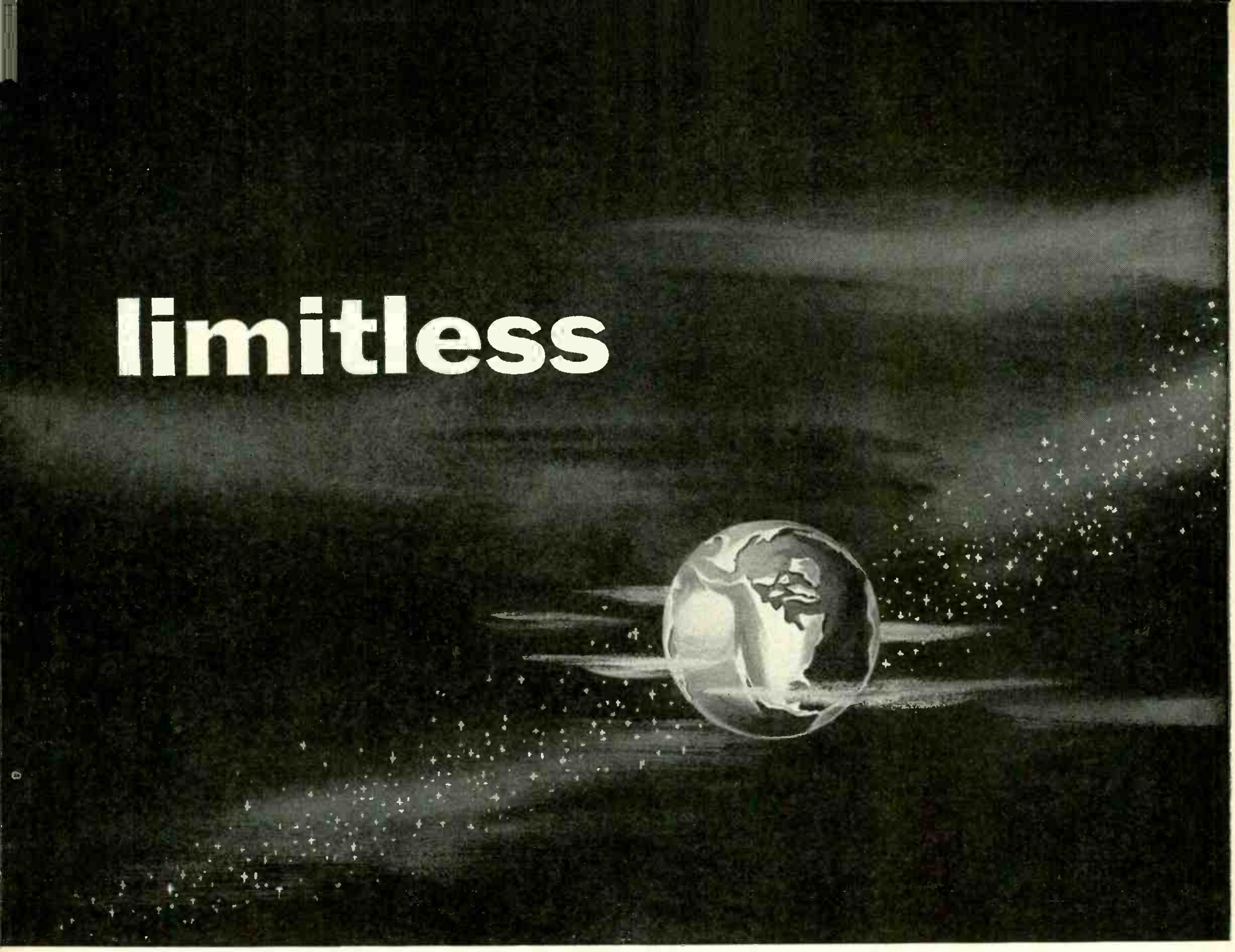

Your customer is aware that Hi-Fi does sound better . . . that it faithfully reproduces the original sound. And you can prove by demonstration that advanced-engineered CBS Silver Vision tubes can do for video what Hi-Fi does for audio.

You know Silver Vision's aluminization . . . silver-activated phosphors . . . and small-spot gun can accomplish this. But technical details do not interest the lady. She does appreciate Silver Vision's sparkling whites . . . deep blacks . . . and wide range of middle gray tones. She likes the way they can be blended to give her truly high-fidelity reproduction of the telecast picture.

Here's a tube whose performance sells it. And Garry Moore makes it still easier by convincing your women customers over the CBS Television Network: "There are no better tubes made than CBS tubes, the tubes with the Good Housekeeping Guaranty Seal." Sell the easy way, follow Garry's lead. Sell CBS Silver Vision . . . the "high-fidelity" aluminized picture tube.

*Always show her the CBS carton with the Good Housekeeping Guaranty Seal.*


**CBS-HYTRON,** Danvers, Massachusetts
A Division of
Columbia Broadcasting System, Inc.

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When planning your future, it is necessary to choose that company which presents the most complete program for you. The opportunity at Remington Rand Univac can only be limited by the individual. Excellent salaries, benefits and educational programs are yours to guarantee this limitless future.

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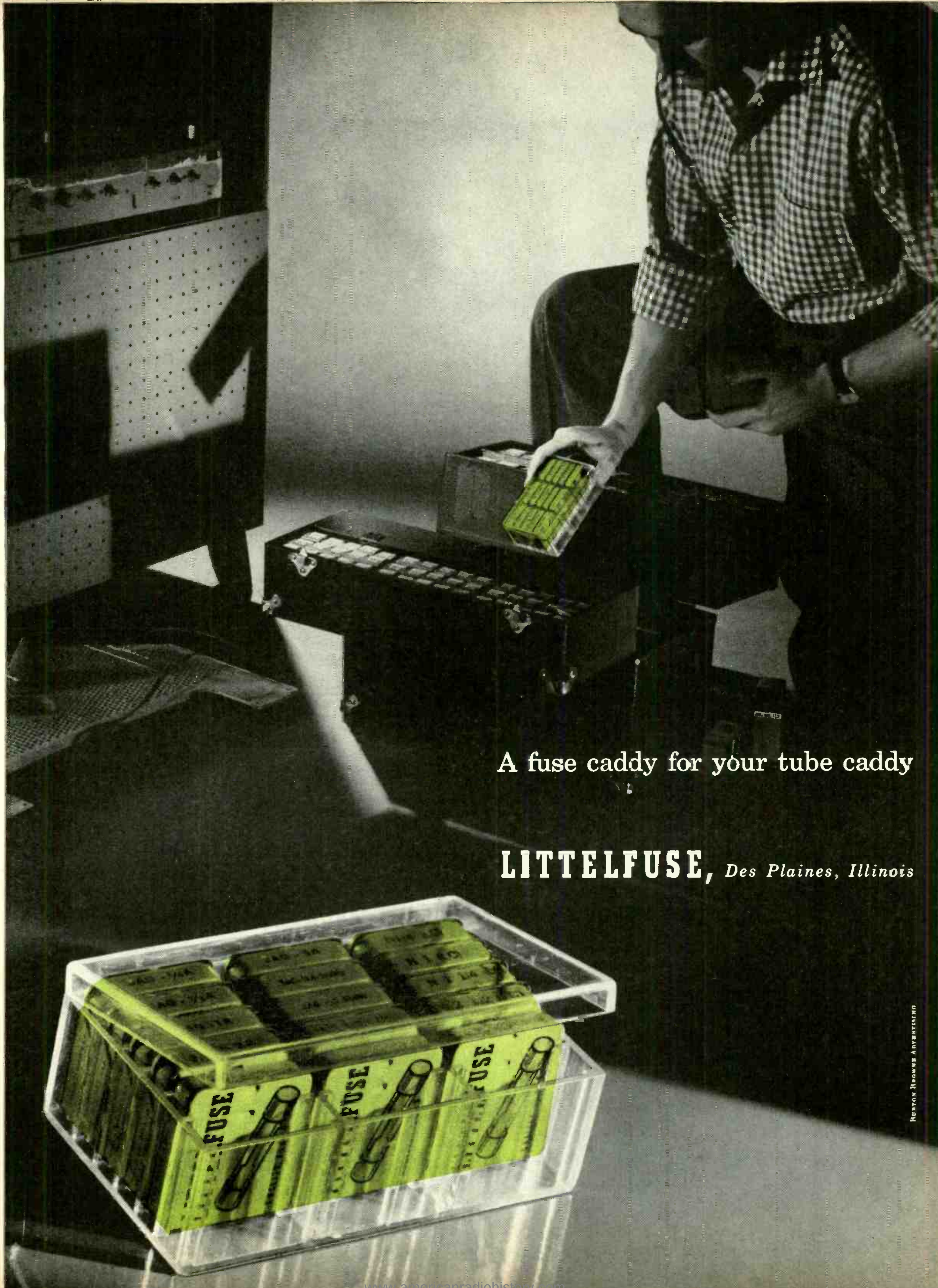
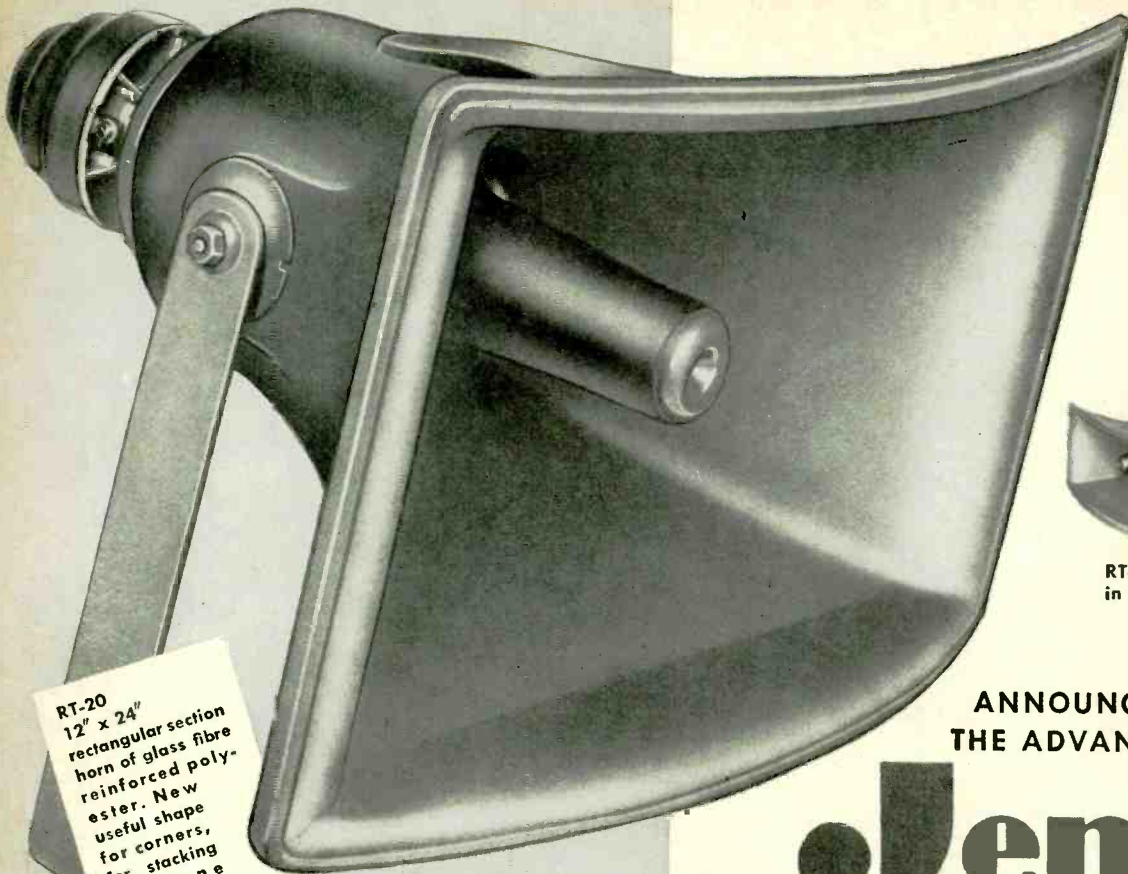

A fuse caddy for your tube caddy
LITTELFUSE, Des Plaines, Illinois
BURTON BROWNE ADVERTISING



RT-20
12" x 24" rectangular section horn of glass fibre reinforced polyester. New useful shape for corners, for stacking in plane or circular arrays.

RT-20's
in plane array

RT-20's
in circular array

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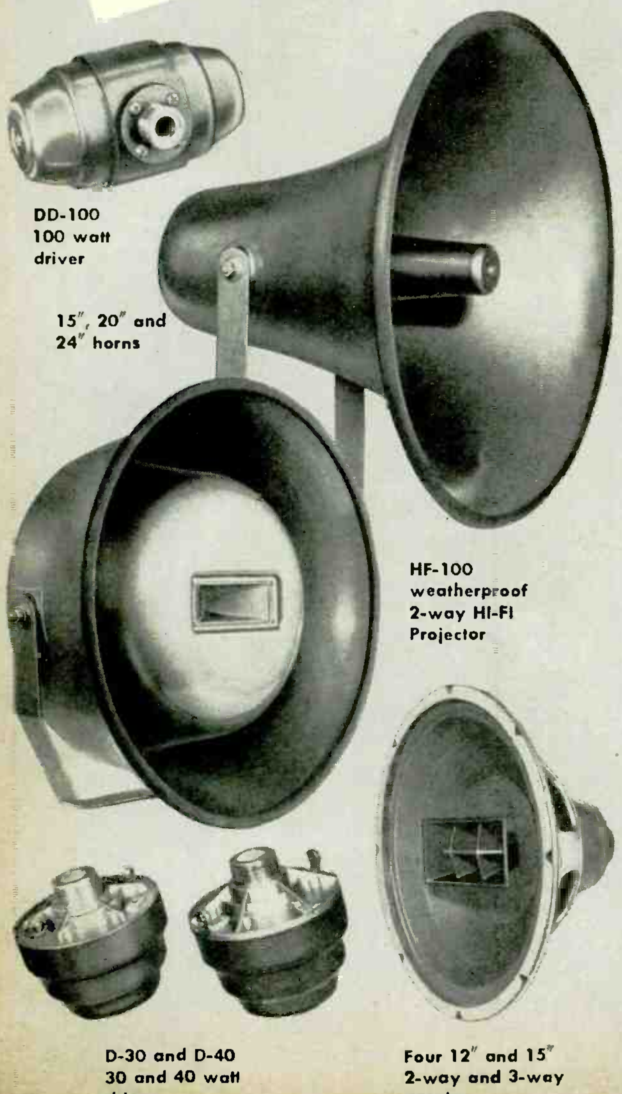
## FOR INDUSTRIAL, COMMERCIAL, INSTITUTIONAL, CIVIL DEFENSE, AND MILITARY SOUND SYSTEMS

If sound is your business, here is big news for you . . . a complete new line of loudspeakers to meet for the first time every sound system need for both entertainment and efficient, effective communication. From a fraction of a watt to 1600 watts or even more . . . for high fidelity or high efficiency coverage . . . for distributed or concentrated source projection . . . indoors or out—there is a Jensen Professional Series loudspeaker that will do the job *better, more dependably, and more economically* than ever before. Just as an example, the new Hypex Lifetime Driver Units are *guaranteed indefinitely against failure under normal use!*

Three years of product design and a background of nearly 30 years of field experience and manufacturing know-how come to you in Jensen Professional Series loudspeakers. We can't begin to illustrate or describe all the items here—nor tell you about all the new features for convenience and performance which we've built into them. Catalog 1070 tells the whole story, including valuable information on sound system design. Send for your free copy today.



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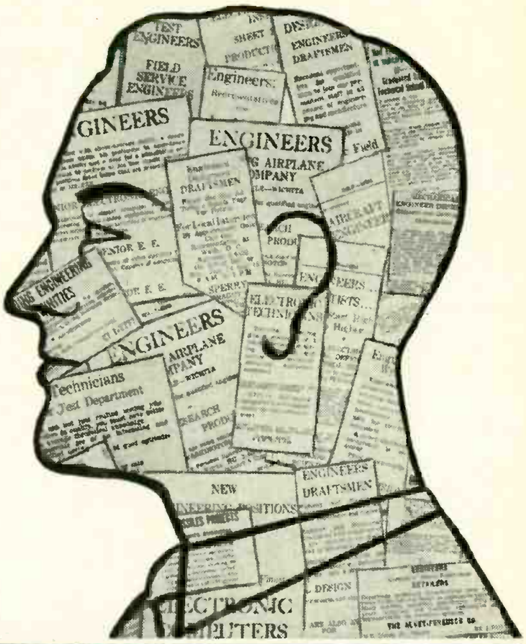


# RADIO—TELEVISION—ELECTRONICS

The want ads above are *real* ones . . . they appear almost daily in magazines and newspapers—all over the country. They show how desperately the electronic industry needs *trained* men. On the other hand, they give you a good idea of what opportunities await you—if you get advanced technical training *now*. And no wonder trained men are needed! Look what's happening in just a few phases of the booming world of electronics:

40,000,000 TV sets already in use—430 TV stations on the air—more coming. Color TV is coming ahead fast. More than 125,000,000 radios in use. More than 97,000 radio-equipped police cars. At least 87,000 radio-equipped American ships. Top manufacturers sold billions of dollars worth of electronic equipment in 1955. By 1960, the radio-electronic industry should do no less than 15 billion dollars of business per year, not counting military orders.

*What do these figures mean to you? They mean that thousands of new electronic jobs have been added to the great, expanding field of electronics.*

**LITERALLY THOUSANDS ARE NEEDED!**

*You* are needed—for development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting, servicing. But you can qualify only if you take time to advance your knowledge . . . if you take 2 minutes right now to write for the free CREI booklet, with no obligation.

**SHORTEST DISTANCE TO A GOOD CAREER IS CREI TRAINING**

If you follow the plan outlined in our free booklet, you will be in line for promotion and pay increases in short order. Read what a typical CREI graduate has to say:

"In this time of less than two years, I have almost doubled my salary and have gone from wireman to engineering assistant and now to junior engineer. I have CREI to thank."—Frank A. Eckert, 22 Clover Lane, Levittown, Pa.

**CREI TRAINING—JUST WHAT INDUSTRY ORDERED**

By method, experience, and personnel—CREI is equipped to teach you what you will need when you translate your study into work. As proof that CREI knows what industry wants, many leading companies choose CREI to train their own technical staffs. Among them: United Air Lines, Canadian Broadcasting Corporation, Columbia Broadcasting System, Glenn L. Martin Co., All-America Cable and Radio, Inc., Radio Corporation of America.

**TOP FIRMS LOOK FOR CREI MEN**

A CREI diploma itself is ample proof to many leading companies that a man is worth hiring. Moreover, employers contact *us* regularly for graduates to fill good jobs. Our placement bureau cannot keep up with the demands.

Typical recent request:

"In view of the fact that we have recently merged with the General Dynamics Corporation, we are entering a period of greatly expanded activity. Our need for the technical institute graduate is, therefore, greater than it has been, and we are interested in bringing our opportunities to the attention of your students."

Stromberg-Carlson Company
Rochester 3, New York

**NAME YOUR FUTURE—GO AFTER IT—GET IT**

What do you want? To pass FCC exams? Start your own business? CREI has helped others reach these goals, and can help *you*. Or, do you want to go after good-paying electronic jobs, secure, permanent careers like those advertised above? *Whatever* your choice, CREI can help you as it has helped thousands of men—provided you have the ambition to follow the plan.

**NO COLLEGE DEGREE NECESSARY**

If you have the equivalent of a high school education, and are good at mathematics, and have had some electronic experience—you can qualify for CREI and for the fruits which await you upon graduation.

**CREI ALSO OFFERS RESIDENCE TRAINING**

CREI Residence School in Washington, D.C. offers training at same high technical level. Classes start at regular intervals. Qualified residence school graduates earn degree: "Associate in Applied Science." Check coupon if you prefer residence study.

**KOREAN WAR VETERANS:**

If you were discharged after June 27, 1950, let the new G. I. Bill of Rights help you obtain resident instruction. Check coupon for full information.

**DON'T WASTE ONE MINUTE, INVEST TWO MINUTES . . .**

. . . and fill out the coupon—mail it right away. No obligation—you have nothing to lose but your present job in exchange for more money, a bright future and job security in a wide choice of electronics fields. Act today—and you'll receive your free booklet and the CREI plan by return mail. No obligation.

**MAIL THIS COUPON *Today!***

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CHECK FIELD OF GREATEST INTEREST
☐ Practical Radio Electronic Engineering
☐ Broadcast Radio Engineering (AM, FM, TV)
☐ Practical Television Engineering
Practical Aeronautical
☐ Electronic Engineering

G

To help us answer your request intelligently, please give the following information:

EMPLOYED BY........

TYPE OF PRESENT WORK........

SCHOOL BACKGROUND........

ELECTRONIC EXPERIENCE........

Name ........
Street ........
City ........ Zone ........ State ........

CHECK: ☐ Home Study ☐ Residence School ☐ Korean Veteran

# RADIO'S ONE-WAY STREET

Dr. S. Weisbaum assembles an isolator which he developed for use in a new microwave system. Dr. Weisbaum is a Ph.D. in microwave spectroscopy from New York University. He is one of many young men at Bell Laboratories applying the insight of the physicist to develop new systems of communication.

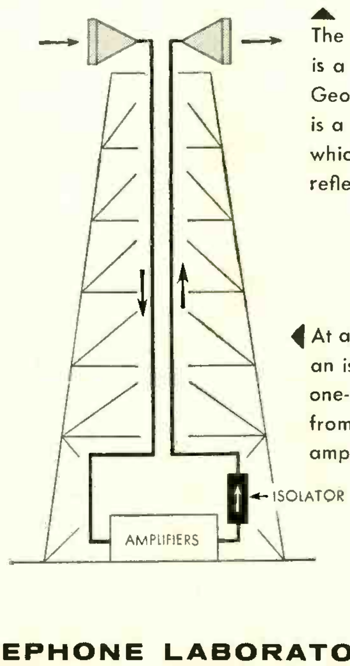
New radio relay systems for telephone and television now in the making will employ an ingenious device invented by Bell scientists. The device, known as an "isolator," senses which way microwaves are traveling through a waveguide, and stops those going the wrong way.

In the new systems a klystron wave generator sends signals through a waveguide to the antenna. The klystron must be shielded from waves reflected back along the waveguide by the antenna. The isolator stops reflections, yet allows the transmitted signals to go through clear and strong.

This isolator is a slab of ferrite which is mounted inside the waveguide, and is kept magnetized by a permanent magnet strapped to the outside. The magnetized ferrite pushes aside outgoing waves, while unwanted reflected waves are drawn into the ferrite and dissipated. This "field displacement" action results from the interplay between microwaves and a ferrite's spinning electrons. Bell physicists discovered this action during their fundamental studies of ferrites.

This is another example of how Bell Telephone Laboratories research works to improve American telephony and telecommunications throughout the world.

▲ The heart of the isolator is a ferrite slab. Geometric pattern is a carbon layer which dissipates reflected signals.




◀ At a radio relay station an isolator assures one-way transmission from the output of the amplifier to the antenna.

# *NEW!* COLOR and Black-&-White LAB & TV 5" OSCILLOSCOPE #460

## KIT $79.95. Wired $129.50

The FINEST professional 5 mc wide-band scope value. Ideal for research, h-f & complex waves, plus Color & Monochrome TV servicing. Flat from DC to 3.58 mc ±1 db (color burst freq.), flat DC to 4.5 mc +1, −3 db. Vert. sens. 25 rms mv/in. Vert. Z 3 megs. Has the following outstanding features not found in scopes up to several times its price, kit or wired:

**VERTICAL AMPLIFIER: direct-coupled (DC) thruout** to eliminate l-f phase shift; **push-pull thruout** for negligible distortion; **K-follower coupling** between push-pull pentode stages for extended h-f resp. (minimizes h-f phase shift, extends useful resp. to 10 mc); full-screen undistorted vert. defl; 4-step freq-compensated decade step attenuator up to 1000:1. **SWEEP CIRCUIT**: perfectly linear sweeps, 10 cps – 100 kc (ext. cap. for down to 1 cps); **pre-set TV vert. & hor. positions** (30 & 7875 cps); automatic sync. ampl. & limiter eliminates sync amplitude adj. **PLUS**: direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; anti-glare filter; bezel fits std photo equipt. **OTHER IMPORTANT FEATURES**: High intensity trace CRT. Finest sq. wave resp. (.06 usec rise time). Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in voltage calibration. Intensity mod. Sawtooth & 60 cps outputs. Astigmatism control. Retrace blanking. Instant, drift-free full-screen vert. positioning & 2X full-screen hor. positioning. **Bal., cal., astig. adj. externally accessible.** 5UP1 CRT, 2–6AU8, 2-6CB6, 1-12AU7A, 2-6J6, 1-6AX5, 1-1V2. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. Designed for easy building at home with no special equipment. 13" x 8½" x 16". 30 lbs.

**SCOPE DIRECT PROBE* #PD:** KIT $2.75. Wired $3.95. Eliminates stray pick-up & signal re-radiation.

**SCOPE DEMODULATOR PROBE* #PSD:** KIT $3.75. Wired $5.75. Demodulates AM carriers between 150 kc and 250 mc.

**SCOPE LOW CAPACITY PROBE* #PLC:** KIT $3.75. Wired $5.75. For signal tracing in high frequency, high impedance & wide-band circuits (as in TV) without distortion from overloading or frequency discrimination.

**150 kc to 435 mc with ONE generator!**

# *New!* RF SIGNAL GENERATOR #324

## KIT $26.95. Wired $39.95

**for COLOR and Monochrome TV servicing**

New wide-range, stable generator — better value then generators selling at 2 or 3 times its cost! Ideal for: IF-RF alignment, signal tracing & trouble-shooting of TV, FM & AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: **150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. Colpitts RF osc., directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 volts needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 volts. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. Tubes: 12AU7, 12AV7, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 8" x 10" x 4¾". 10 lbs.

*The specs are the proof...*

# 4 NEW BEST BUYS by EICO

**for COLOR and Monochrome TV servicing**

# *New!* PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

## KIT $29.95. Wired $49.95

**UNI-PROBE:** exclusive with EICO! Terrific time-saver! Only 1 probe performs all functions—a half-turn of probe-tip selects DC or AC-Ohms.

The new leader in professional peak-to-peak VTVMs. Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't-burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. 8½" x 5" x 5". Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 7 lbs.

**Calibration without removing from cabinet.**

# *New!* DELUXE PEAK-to-PEAK VTVM #249 with 7½" METER & UNI-PROBE (pat. pend.)

## KIT $39.95. Wired $59.95

All the advanced & exclusive features of #232—PLUS the extra convenience and readability of its big 7½" meter. Your ideal bench instrument.

**VTVM RF PROBES* #PRF-11 or PRF-25:** KIT $3.75. Wired $4.95. Accuracy ±10%. Use with any 11 or 25 megohm VTVM.

**VTVM HV PROBE #HVP-2:** Wired $4.95. Complete with multiplier resistor. Measures up to 30 kv with any VTVM or 20,000 ohms/volt VOM.

*Only EICO Probes have all these features: fully shielded; **rugged terminal board parts mounting;** shock-mounted floating construction; swivel-action; color-coding; easy parts accessibility.

**COMPLETE with Preamplifier, Equalizer and Control Section**

# *New!* 20-WATT Ultra-Linear Williamson-type HIGH FIDELITY AMPLIFIER #HF20

## KIT $49.95. Wired $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. Every detail, down to the etched, brushed solid brass control plate, is of the fine quality EICO is famous for.

**Rated power output:** 20 watts (34 w peak). **IM distortion (60 cps: 6 kc/4:1) at rated power:** 1.3%. **Mid-band harmonic distortion at rated power:** 0.3%. **Maximum harmonic distortion between 20 and 20,000 cps at 1 db under rated power:** approx. 1%. **Power response (20w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Frequency response (¼w):** ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps.

5 feedback equalizations for LP's & 78's including RIAA. Variable turnover feedback tone controls do not affect volume & permit large boosts or cuts at either end of audio spectrum with mid-freqs. unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. 4 hi-level switched inputs: tuner, tv, tape, auxiliary (xtal/ceramic phono or 2nd tuner); 2 low-level inputs for proper loading with all leading magnetic, FM & quality xtal cartridges. Hum bal. control. Extremely fine output transformer has interleaved windings, tight coupling, careful balancing & grain-oriented steel. 8½" x 15" x 10". 24 lbs.

These amazing EICO values are NOW IN STOCK at your nearest distributor. Examine them side-by-side with ANY competitor. You'll see for yourself why indeed EICO is your **BEST BUY.** Fill out coupon on reverse page.

EICO®

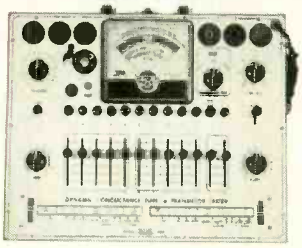
TURN PAGE FOR MORE EICO VALUES...



**84 Withers Street, Brooklyn 11, New York**

Prices 5% higher on West Coast.

## the specs are the test that tells who's best!

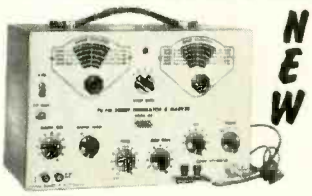


for COLOR & Monochrome TV servicing

### NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

**KIT $69.95 WIRED $109.95**

Unexcelled testing thoroness & accuracy. **Checks transistor collector current & Beta** using internal dc power supply. **Tests all receiving tubes** including subminiatures (& Color & Monochrome tv pic tubes with accessory adapter). **Composite indication of mutual conductance, plate conductance, & peak emission.** Simultaneous sel. of any 1 of 4 combinations of 3 plate, 3 screen, & 3 ranges of control grid voltage. Grid voltage variable over 3 ranges with 5% accurate pot. **New series-string voltages** for 600, 450 & 300 ma types. 5 ranges meter sens. with 1% precision shunts & 5% accurate pot. 10 SIX-position lever switches for free-point connection of every tube pin or cap. 10 pushbuttons for **rapid** insert of any tube element in leakage circuit & **speedy** sel. of individual tube sections. **Direct reading of inter-element leakage *in ohms*.** New gear-driven rollchart. Steel case with cover & handle. Sensitive 200 ua meter.



NEW

for COLOR & Monochrome TV servicing

### TV-FM SWEEP GENERATOR & MARKER #368

**KIT $69.95 WIRED $119.95**

The FINEST service instrument of this type ever offered in either kit or wired form at ANY price! Outstanding ease & accuracy in FM & TV (including Color) alignment. **Entirely electronic sweep circuit** with accurately biased Increductor: **superb linearity** on both sides of selected center freq. **Newly-designed AGC circuit** automatically adjusts osc. for max. output on each band with min. amplitude variations. Sweep gen. range 3-216 mc in 5 OVERLAPPING FUND. BANDS. Sweep width continuously variable from 0-3 mc lowest max. deviation to 0-30 mc highest max. deviation. **Variable marker gen.** range from 5-75 mc in 2 FUND. BANDS plus a calibrated harmonic band (54-225 mc). Variable marker calibrated with **int. xtal marker gen. 4.5 mc xtal included.** Ext. marker provision. Double pi line filter. **Edge-lit hairlines** eliminate parallax.

*Turn page for other EICO ad*

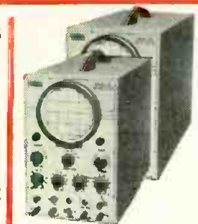

## FREE 1956 EICO CATALOG!

Tells you how to SAVE 50% on your test equipment costs!

**TUBE TESTER #625**
*KIT $34.95*
Wired $49.95
• tests 600 mil series string type tubes
• illuminated roll-chart
Pix Tube Test Adapter ............ $4.50

**New! GEIGER COUNTER #803**
*KIT $19.95* Wired $29.95

(less batteries)
Professional, all-electronic, sensitive, rugged—at lowest cost! Indicates by neon lamp & headphone clicks.



**5" PUSH-PULL OSCILLOSCOPE #425**
*KIT $44.95*
Wired $79.95
•
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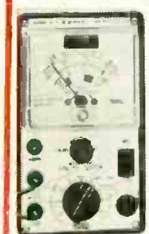

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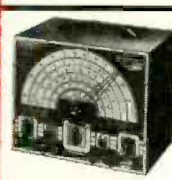

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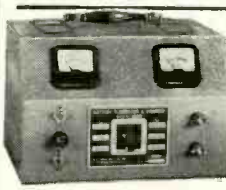

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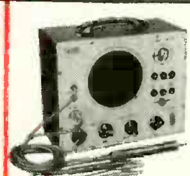

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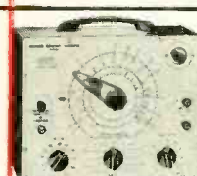

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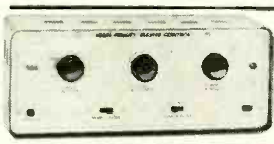

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RADIO-ELECTRONICS
Hugo Gernsback, Editor

# ELECTRONICS IN SPACE FLIGHT

*. . . Without electronics, space exploration is impossible . . .*

THE *International Geophysical Year* of 1958 will witness the first major effort in the field of true space flight. The United States Government will launch between 6 and 10 space satellites, now in the building stage. They will gravitate around the Earth at altitudes from 200 to 1,500 miles above sea level. Unmanned, they will be in constant touch with Earth scientists through a variety of telemetering electronic instruments while the 20-odd-inch-diameter satellites completely circle our planet in about 2 hours.

The main purpose of these tiny experimental space globes is purely exploratory — spatial probes to investigate the great outer void of the interplanetary vacuum —and enrich our knowledge of the physical universe.

Mankind, from the beginning of its billion-year existence, has always lived at the bottom of a dense — and protective — sea, the atmosphere. So far he has never ventured above it into outer space. Therefore our knowledge of the airless world is mostly theoretical. If we are to conquer it, we must know it thoroughly, lest we run afoul of its unknown dangers.

Our manless spaceships of the immediate future will probe free space with great efficiency. Soon we will have actual physical knowledge of a number of outer-space radiations from which we have always been shielded by our thick atmospheric blanket. These radiations comprise some from the sun: X-Rays, infrared and ultraviolet, corpuscular and electromagnetic. Others, the socalled cosmic radiation, come from the depths of space.

There are also radio waves originating from our Milky Way and other galaxies, though some come from our sun and from the planet Jupiter. In addition to these there may be as yet undiscovered varieties of stellar radiation hitherto unsuspected.

One thing we have learned during the past century— space is by no means empty, as we once thought. It is crowded with electrons, radiation, gravitational flux, hydrogen gas, solid particles such as cosmic clouds and meteoric dust.* Yet, curiously enough, all these names in the final analysis mean one and the same thing — the building blocks of the universe. It was Einstein who first proved that mass and energy were the same — they are interchangeable.

It is more than likely that our space laboratories will greatly assist man in unraveling many of the universe's secrets. The time is coming when we can demonstrate at will that *everything* in our physical world is one— interchangeable into solids, waveforms, radiations, gravitation and now-unknown forces. It may be known in the future under an all-inclusive name such as *Ultimatter* or *Ultimele* (ultimate + *ele*, Greek for matter.)

The intimate knowledge gained from our experimental satellites will, within a few short years, make it possible for us to proceed to the next stage of space exploration: unmanned spaceships to the moon. This will be a much more ambitious project, a pilot flight by an atomic-powered rocket to be guided by radio and television*

This pioneer interplanetary flight, as foreseen by the writer, may take place about 1970 or before. From a technical standpoint it could take place much sooner, but its high building cost, running into the tens of millions of dollars, will prove an obstacle.

Such a television-controlled spaceship to circumnavigate the Moon and return to make a safe landing on the Earth after its 250-hour trip is unthinkable without the most intricate array of electronic instrumentation, both on shipboard and on Earth. Scientists on Earth track the ship by radar during its entire flight (except for the short time when it disappears behind the moon). Television cameras on board continuously scan the test animals in their cages, so we can see how they fare and behave in their weightless state throughout the trip. TV cameras attached to a number of special telescopes continuously scan the heavens so the watching astronomers on Earth can see the planets, stars and nebulae as they really are, without the interference of a thick, obscuring atmosphere. A vast array of telemetering instruments report the temperatures from minute to minute in outerspace or inside the ship, radiations of every kind, frequency of meteoric dust impact on the ship's outer skin, gravitational flux and solar corona phenomena.

Microphones in various strategic parts of the ship report a constant stream of important information to the listening Earthpost scientists. Sounds from the animal quarters, sounds from the atomic engines, the hail-like bombardment sounds from the outer skin of the ship, from the impinging meteoric dust traveling at 5 to 15 miles *a second*, the stress sounds of the ship's metallic skin as it expands and contracts under the enormous temperature differences in outer space, from the 300°F heat on the sunny side to the —200°F cold on the dark side of the ship.

If the rocket ship gets off course, this can be automatically corrected by an electronic navigator on board, which then fires corrective rocket blasts. If the ship's automatic navigator should fail, a standby electronic navigator on Earth takes over via microwave. Nothing is left to chance. Likewise, on its return to Earth, the spaceship is landed at a specially selected and prepared landing field by scientists via radio impulse. In addition, for future study and research, *all* telemetered signals are recorded on tape on board ship and on Earth.

After a few such remote-control unmanned lunar flights, sufficient scientific experience and knowledge will have accumulated to make possible the third and final stage of man's conquest of the great universal void: *manned outer-space flight*, to the Moon, the planets and beyond. —*H. G.*

* See also "How Empty Is Space" by H. Gernsback, March 1923 *Science & Invention*.

* See the *Television Guided Spaceship*, by H. Gernsback, *Forecast* 1954 (Christmas, 1953)

# HIGH-GAIN TRANSISTOR AUDIO AMPLIFIER

By JOSEPH BRAUNBECK

*Using six transistors, unit solves impedance mismatch problems*

TRANSISTORIZED audio amplifiers having low and medium gain and using one to four junction transistors are common. But how many transistor stages may be added without risking instability and excessive noise? This amplifier shows that up to six stages may be combined without these troubles.

Excellent results are obtained using grounded-collector and grounded-emitter stages together. Such a high-gain transistorized amplifier has many applications. Besides all purposes for which you need an audio amplifier with high gain and low output, it may be converted to an acoustic burglar alarm, a receiver for low-frequency wireless communication, a "speech-on-light" receiver, etc.

A junction transistor may be connected three ways: you can ground either base, emitter or collector. The grounded-base circuit, which is most important for the point-contact transistor, is not very common in junction-transistor circuitry. Grounded-emitter stages have to be matched to a low-impedance input and a high-impedance output. A grounded-collector stage, however, has much different matching impedances: its input impedance is high, output impedance low.

If, as usual, several grounded-emitter stages are combined by transformerless R-C coupling, there is considerable mismatch between any two succeeding stages (Fig. 1-a), reducing gain. This may be avoided by combining grounded-emitter and grounded-collector stages (Fig. 1-b), providing better interstage matching. It is still not quite correct from the theoretical point of view, but the horrible mismatch between two grounded-emitter stages is avoided.

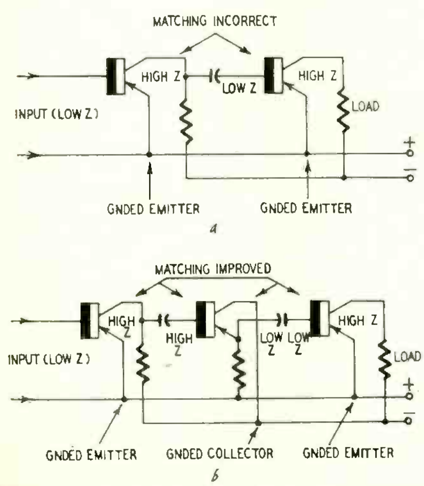



Fig. 1—Improving interstage mismatch.

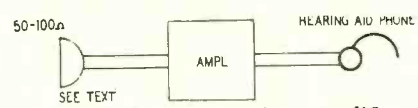



Fig. 3—A supersensitive amplifier.

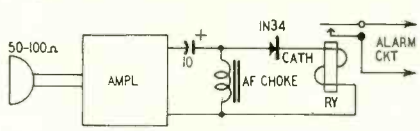



Fig. 4—An acoustic burglar alarm.

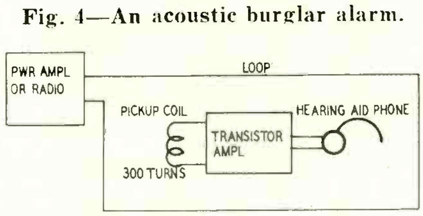



Fig. 5—Speech-on-loop diagram.

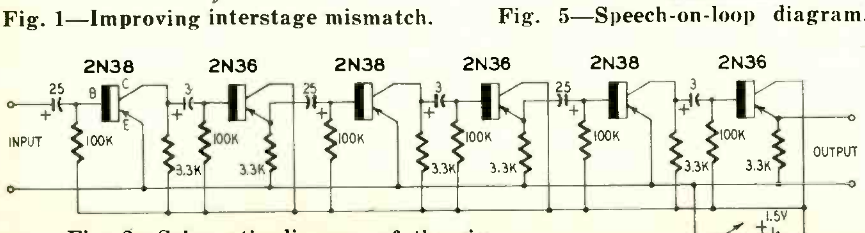



Fig. 2—Schematic diagram of the six-transistor high-gain audio amplifier.

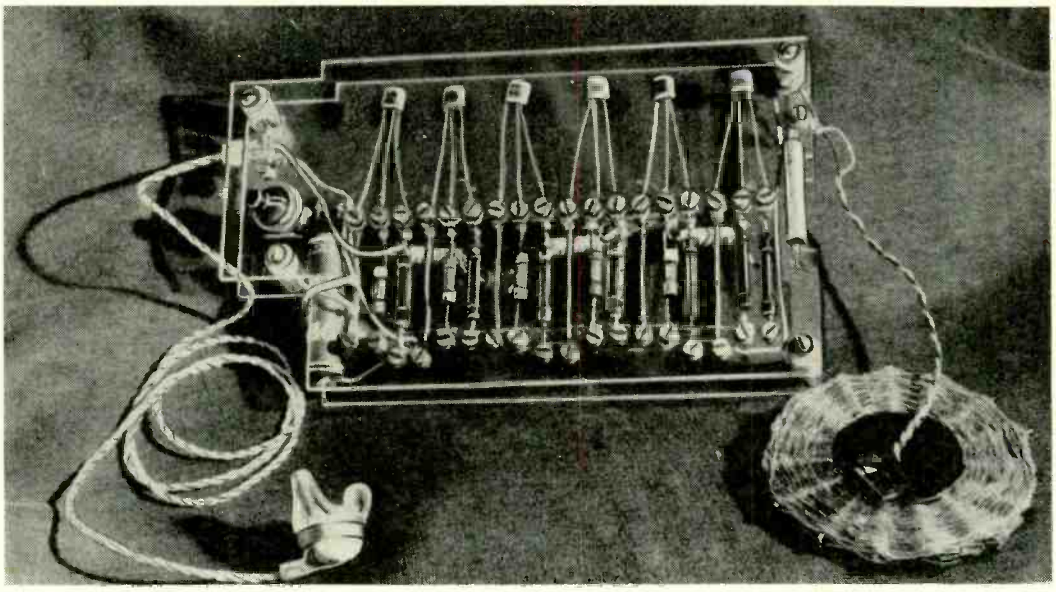
The complete amplifier circuit is shown in Fig. 2. The grounded-emitter stages use 2N38 junction transistors, the 2N36's are used with their collectors grounded. The 100,000-ohm resistors between the transistor bases and negative supply provide the necessary bias. The internal resistance of the single flashlight cell (which is the whole power supply) is low enough to prevent motorboating.

Every grounded-collector stage is thermally stabilized by itself, thanks to the load resistor in the emitter lead. All load resistors are 3,300 ohms. Coupling capacitors are 3 μf for the grounded-collector inputs and 25 μf for the grounded-emitter inputs. These values are not at all critical. The output is designed for use with a low-impedance miniature earphone. A 3,300-ohm load resistor shunts the output terminals to permit an oscilloscope or similar test gear to be connected to the amplifier.

The input is designed for low-impedance matching, too. A dynamic or magnetic microphone may be connected directly to it.

## Circuit applications

What is this elaborate amplifier good for? One possible application is shown in Fig. 3. Take a single headphone with an impedance of between 50 and 100 ohms. Connect it as a magnetic microphone to the input of the amplifier. Listen with a hearing-aid type miniature earphone—you will hear a faint hiss. This is the noise which prevents you from adding further stages. The amplifier now serves as a supersensitive listening device, but it is not a hearing aid! *For this purpose amplification is too great.* But you can use it to hear many things which you never heard before. For example, put the microphone on your chest and listen to your heartbeat. Do not speak while you do so; it would be painful for your ears.



**The high-gain amplifier connected to pickup coil for speech on loop.**

**Acoustic burglar alarm** Disconnect the listening earphone from the amplifier. Add a coupling capacitor, an af choke, a crystal diode and a sensitive relay (Fig. 4). This changes the listening amplifier into an electronic burglar alarm. Any noise picked up by the microphone generates a voltage across the output terminals of the amplifier. This is rectified by the crystal diode, and rectified current actuates a sensitive relay.

For best results use a highly sensitive relay like the Weston Sensitrol or the Siemens polarized relay. They hold the contacts closed after their coil has been energized. Thus, noise starts the alarm which remains on until it is reset. Polarized telegraph relays are much quicker acting than the moving-coil types.

This alarm is very sensitive. It responds to speech at a distance of 30 feet. Nobody can break through a door fitted with the microphone. The relay will snap on if you rub the door with your fingertip.

**Speech on loop** Wireless communication within a certain area—a garden, house or room—is often established with a "speech-on-loop" system. A loop of wire surrounds the area. The loop is connected to the low-impedance output of a power amplifier (Fig. 5). The receiver consists of a small pickup coil connected to an earphone via the amplifier. The receiver picks up messages or music transmitted by the big loop everywhere inside as well as for some distance outside of it.

If you use the six-stage transistor amplifier instead of a conventional hearing-aid circuit, real "dx" may be obtained. I installed one loop around a small room in the second floor of an apartment house and fed into it the output of a small phono amplifier (about 4 watts). Reception was perfectly clear and loud all over the street in front of the house. A coil of 300 turns on a 2-inch-diameter form served as a pickup coil.

**Phototransistor amplifier** The first transistor may be replaced by a phototransistor such as the X-25 (made by Transistor Products, Inc.). Fig. 6 shows the modified circuit. This transistor needs no bias. It has to be connected "upside down" with the emitter negative and the collector positive, as it is an n-p-n transistor. This circuit is that of a sensitive modulated light receiver.

Circuits for obtaining modulated light have been described very often. A very good one is shown in Fig. 7. A fluorescent light is connected in parallel with a power pentode. B plus is fed to both the pentode and the light through an audio-frequency choke. The control grid of the pentode is fed with the audio to be transmitted. Old hams will recognize this good old Heising modulator circuit. Though it works well indoors, you will have trouble when you want to focus the light beam over greater distances. In that case a conventional light modulator must be used.

As phototransistors are very sensitive to infra-red radiation, this device may also be used to detect infra-red radiation from devices such as hot stoves and soldering irons. In that case the radiation has to be chopped mechanically to give an ac signal. Chopping can be done with a small cardboard fan rotating in front of the transistor.

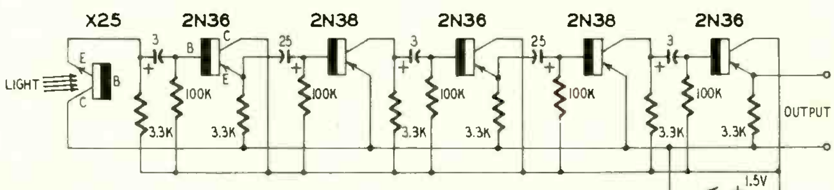




**Fig. 6—A phototransistor amplifier. The X-25 does not require any bias.**

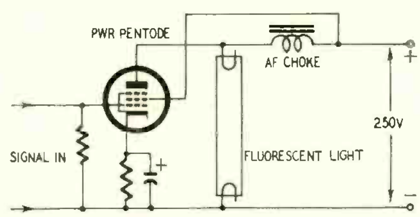




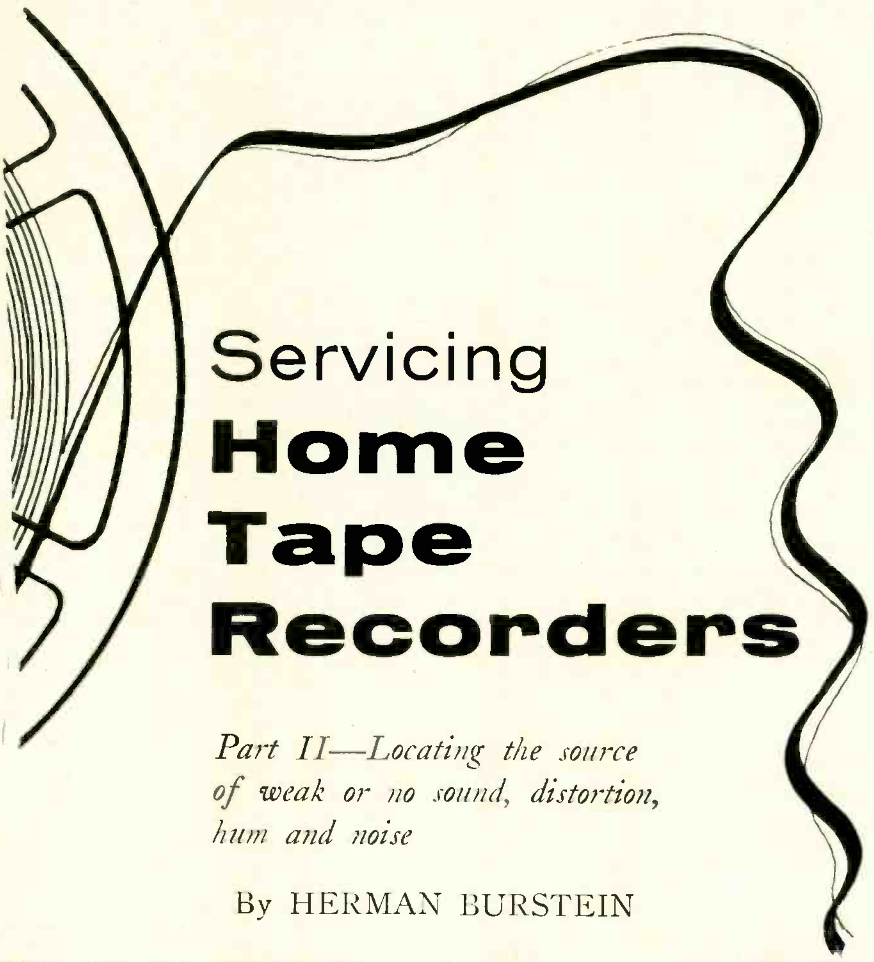
**Fig. 7—Obtaining modulated light.**

## Construction

Thanks to the low input impedances of transistor stages as compared to vacuum-tube stages, capacitive hum cannot occur in a transistor amplifier. Therefore there is no need for a metallic chassis. The experimental model of the amplifier has been built on a sheet of polystyrene. Every soldering connection is supported by a soldering tag held by a screw. To keep the transistors from vibrating they are held in place by cellulose tape. Another polystyrene sheet of the same size and form is used as a cover to protect the transistor from curious fingers when the unit is used for demonstration. This way of construction might be called a sandwich layout, as the whole circuitry is enclosed between the polystyrene sheets. However, every point in the circuit is electrically accessible, as every soldering tag is held by one of the screws visible in the photograph of the amplifier. This unit is stable and should find many applications. END

**Parts for transistor audio amplifier**

6—3,300-ohm ½-watt resistors; 6—100,000-ohm ½-watt resistors; 3—3-μf, 3—25-μf, 6-volt filter capacitors; 3—2N36, 3—2N38 transistors; 1—1.5-volt cell; 1—spst switch; 1—chassis (could be constructed on a plastic subchassis); 2—sets of terminals (input and output).



# Servicing **Home Tape Recorders**

*Part II—Locating the source of weak or no sound, distortion, hum and noise*

By HERMAN BURSTEIN

WHERE the sound is weak or nonexistent, a preliminary check would consist of playing back a test tape (or other previously recorded tape). If the recorder functions in playback, the fault is in the record section. If not, the trouble lies in playback or in both record and playback.

Before signal tracing, test tubes and check for B-plus voltage and high resistance to ground (50,000 ohms or more) at the rectifier cathode. B plus at the rectifier is generally about 250 volts; at the plates of the various tubes it may range from as low as 50 in the early stages to 180 volts or more in later stages.

If playing back the test tape indicates trouble in the playback function and if the machine contains a built-in power amplifier and speaker as most home recorders do, it is advisable first to check the speaker by applying a signal to the power amplifier.

If it appears that the difficulty is in the record or playback preamplifier, signal tracing similar to that used for radio, TV, amplifiers, etc., may be applied. Commonly, an audio signal is fed to the grid of the output stage and output is observed on an oscilloscope or vtvm. Signals of lower amplitude are then fed to earlier stages. If the output signal disappears, the stage at which the signal was applied should be checked for defective components.

Tape recorders have relatively complex arrangements for switching from record to playback. Some of the complexity is in the equalization circuits. In tape recording, the practice is to supply all or most of the treble boost in record and all or most of the bass boost in playback. Consequently, some tape recorders which use the same preamplifier for record and playback switch in different equalizing circuits for each function. When dealing with an elusive difficulty, do not overlook the possibility that it may lie in a switch or one of the circuit components controlled by it. Trouble is sometimes due to a dirty switch contact, easily remedied by applying volume-control cleaning fluid. However, more serious defects may call for a new switch, often a special item available only from the factory or a repair specialist.

Failure in record or playback may be due to a head with an open or shorted coil. To check for a shorted record head, feed an audio signal of about 1 volt into the record preamplifier and observe with an oscilloscope whether this signal is present across the record head—a shorted head shows no signal. The bias oscillator must be disabled before this test to prevent it from interfering with the pattern on the oscilloscope. This may best be done by removing the oscillator tube. To check for an open coil in the record head, connect a 100-ohm resistor between ground and the ground lead of the head. Then observe whether there is a signal across the resistor—no signal appears if the coil is open. If neither the short nor open test shows a signal at the head, then the record preamplifier should be checked.

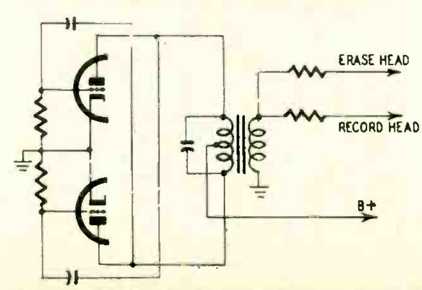



**Fig. 1—Typical bias oscillator circuit.**

To check for a defective playback head, disconnect the head and substitute an audio signal of about 10 millivolts at the grid of the first playback tube. The output of the playback preamplifier should produce a signal of about 0.5 volt or more. If not, the preamplifier rather than the head should be suspected.

Another means of checking for defective heads, if a tape recorder of the same or similar brand in good condition is available, is to bridge the transport mechanism and heads of the second machine across the recorder being checked and then make a tape recording. Leads from the heads being checked should be disconnected from the preamplifiers and leads from the other heads connected in their place. If sound, after recording and playback, appears reasonably normal, the heads of the machine under test are apparently defective.

A dead bias oscillator can account for very low, as well as distorted, output.

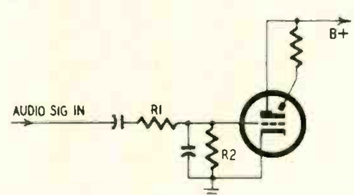



**Fig. 2.—Electron-ray indicator circuit.**

Fig. 1 shows a typical oscillator. With the recorder in record position, the presence of bias current may be determined by measuring the voltage across a 1,000-ohm resistor placed between ground and the ground lead of the record head. Since the bias current may be less than 1 ma, the voltage reading will be from a fraction of a volt to a few volts. Working farther back into the oscillator circuit, test at the grids of the oscillator tube for a high negative voltage which should be present if oscillation is taking place. If there is no oscillation, the circuit components should be checked.

## Distortion

This can result from too low a bias current that in turn may be due to a defect in the oscillator or to a resistor or capacitor which couples the bias current to the record head.

A frequent source of distortion is excessive recording level. Home tape recorders contain an electron-ray tube, neon bulb or VU meter to indicate when the recording level is such as to produce the maximum tolerable distortion. At this point the ray tube closes fully, the neon bulb lights or the VU pointer swings to a designated point. However, change in value of a circuit component may cause the indicator to read low, thus encouraging too high a recording level. Fig. 2 shows a typical electron-ray tube circuit. If R1 of the voltage divider to which the grid is connected increases considerably in value, the user is apt to be led into overrecording, with consequent distortion, because the audio signal required to close the "eye" is greater than it should be. The relationship between recording level and distortion is far from a linear one. Beyond the point where about 2% or 3% harmonic distortion occurs, a few db increase in recording level produces a vast increase in distortion. Thus the increase in distortion through slight overrecording is of far greater consequences than the reduction in signal-to-noise ratio through moderate underrecording.

To measure the point at which distortion begins to be discernible, use a scope. However, the human eye begins to detect harmonic distortion in a sine wave only when it reaches about 5%. Therefore, it is advisable to calibrate the indicator so that it registers maximum level at about one-half the recording level which produces visible distortion on the oscilloscope; in the case of a VU meter, however, about 8 db additional allowance may be made for the fact that the pointer cannot move rapidly enough to follow transients fully. If a harmonic or intermodulation distortion meter is available, more accurate calibration is possible. The intermodulation test is the better of the two and the level indicator should be calibrated to read maximum when IM distortion is about 5%, using a 4-to-1 ratio between a low frequency and a high one. If the harmonic distortion meter is used, calibration should be based on a level of about 2% distortion. More satisfactory calibration is obtained by the IM test because overrecording causes intermodulation to rise much more rapidly than harmonic distortion.

Faulty components in the preamplifier may cause distortion. Waveform checking with an oscilloscope is useful. Also, a harmonic or intermodulation distortion meter can be helpful in checking for distortion stage by stage, using the signal-tracing technique. Tracing should be done with the heads disconnected. When working back in the circuit, the signal should of course be reduced. By the time the first stage is reached, the signal input should be reduced to about 1 volt if the record preamplifier is being checked and 10 millivolts if the playback preamplifier is being checked. Otherwise overloading of one or more stages may be the result.

## Hum and noise

The listening satisfaction provided by a tape recorder depends not only upon low distortion and good frequency response, but also upon a satisfactory ratio between the desired audio signal and the undesired hum and noise generated by the recorder. Although it is not ordinarily the service technician's task to make changes in design, in the interest of cutting hum and noise there are some simple, rapid expedients he can try.

Hum may be of three kinds: principally fundamental (60-cycle) pickup from the power transformer or from power and heater leads; principally second-harmonic pickup (120 cycles) from the B supply; principally third-harmonic pickup from a motor or the power-transformer primary. Pickup may be inductive (hum fields) or capacitive (lead dress or insufficient B filtering).

Hum pickup can result from improper dress of heater and low-level grid leads. Special care must be observed in the lead dress from the playback head to the grid of the first playback tube. A filter capacitor may be at fault. Even though the existing filter capacitors check out good, adding a large capacitor—40$\mu$f or more—sometimes brings a significant improvement. Measures such as tightening the laminations of the power transformer or reversing the heater lead connections can reduce hum. In two instances that have come to my attention, an annoying hum which no other measures could alleviate was reduced to insignificance by removing the power transformer from the preamplifier chassis and mounting it elsewhere in the housing for the transport mechanism and preamplifier.

Some tape recorders have a hum balancing control which may not be properly adjusted. Usually the center arm of the control goes to ground. Occasionally, better results can be had by disconnecting the arm from ground and connecting it to between 10 and 75 volts. This voltage can sometimes be found at the cathode of the output tube of the internal power amplifier. If no such voltage is available, it can be obtained by putting two resistors of suitable value in series between B plus and ground and adding a filter capacitor of 20 $\mu$f at the junction of the resistors. Total value of the two resistors should be about 200,000 ohms.

Considerable hum reduction can sometimes be obtained by trying several tubes of the required type in the first stage of the record or playback preamplifier. Even tubes like the 5879, specially designed for high-gain audio applications, vary with respect to heater–cathode leakage, which results in hum when heaters are operated on ac. Such variations may be even greater for other tubes, such as the 12AX7 or 6AU6, used in the first stage of conventional tape recorder preamplifiers.

As with hum, noise also varies among tubes of a given type. If noise rather than hum is the predominant offender, a first-stage tube may be selected on the basis of its noise characteristic, bearing in mind that it should also have the necessary gain.

Although tube hum and noise most commonly originate in the first stage, it is possible for later stages to be at fault. This may be quickly checked by removing the first-stage tubes from the record and playback preamplifiers, then making a tape with no signal input and volume control all the way up. This tape should then be compared with a similar tape made when the first-stage tubes are in the circuit.

Thermal agitation in resistors in the first stage of a preamplifier is sometimes an important cause of noise. Replacement of plate, screen and cathode resistors in this stage with low-noise types often brings substantial benefits. The use of oversize, standard resistors, for example, a 2-watt instead of a ½-watt size, can accomplish the same results. Avoid overheating a replacement resistor during soldering for this can increase its noise characteristic.

Another important source of noise is distortion in the bias waveform. A clean sine wave produces least noise in recording. A dc component in either record or playback produces noise and an asymmetrical bias waveform in effect contains such a component. The bias frequency should be observed on an oscilloscope. If distortion is noticeable, components in the oscillator circuit should be checked.

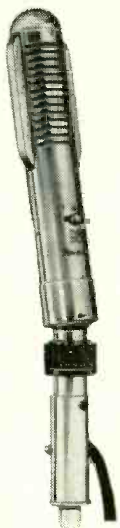
Any dc component produces noise and such a component may originate in a magnetized record or playback head. A head can be readily demagnetized by carrying a magnetic eraser slowly to and away from it. If the technician does not already have such an eraser, he can make one from a discarded power transformer. The I plates are removed, all the E plates are faced the same way, all leads except to the primary winding are cut off, a line cord and plug are attached to the primary and the service technician has a powerful electromagnet. This can also be used for quick erasure of an entire reel of tape by bringing the reel to the magnet and withdrawing it slowly, meanwhile describing a circular motion. END

**A recorder for home entertainment.**

# FOR GOLDEN EARS ONLY

*Browning L-500 broadcast and shortwave tuner; Crestwood 404 tape recorder, and amplifier-speaker; Robins tape splicer; two ribbon microphones*

By MONITOR



**The Fentone B & O ribbon microphone**

EVEN under the best circumstances and with the best tuners AM reception is inferior to FM. However, there is a great deal to interest listeners on both the broadcast and shortwave bands between 5.8 and 18 mc. Moreover, in some places FM reception is too poor or programs do not provide adequate fare and one is dependent on AM broadcasts. There has, therefore, been a need for an accessory tuner capable of delivering the best possible quality from broadcast stations and of receiving the shortwave as well. The Browning L-500 fills this bill nicely.

Though it is extremely compact and can be squeezed into just about any odd corner in the hi-fi layout, the Browning is self-powered and delivers very fine performance. The sensitivity is specified to be 2 μv or better. I could not measure it absolutely but it is comparable with my old SX-32 which is still in excellent condition. There is a built-in ferrite-rod antenna which will give adequate broadcast reception in most localities and a hank of antenna wire hidden around the room will provide excellent shortwave reception in most parts of the country. The receiver is commendably stable and free of drift, the avc action is excellent and the noise figure very fine.

With no bandspread dial or knob, tuning shortwave stations is a somewhat delicate operation and exact logging is not possible. But with very little experience it is not at all difficult to find and tune in the stations one wants. It is even possible to do a pretty good job of tuning through the 20-meter ham band. It has a hot rf stage and two if stages—which accounts for the fine sensitivity.

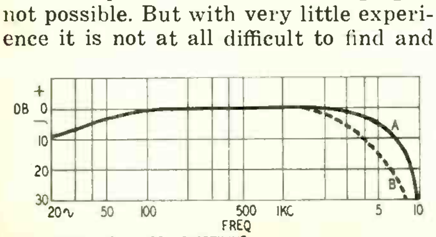



**Fig. 1—Response of Browning L-500.**

The fidelity, too, is about as good as is usable on the broadcast and shortwave bands. A broad-tuning position provides a passband of about 15 kc at 3 db down and a tuned-T whistle filter provides nearly complete attenuation of the 10-kc adjacent-channel beat note and of monkey chatter. Fig. 1 gives the *overall* response as measured at 1600 kc with an audio generator modulating an rf generator at about 40%. The listening quality is good. A cathode follower in the output permits the use of long cables and an extra jack is paralleled with the output jack for a tape recorder.

Personally I would have preferred to have the variable-bandwidth feature available also on the shortwave bands. Granting that there are few occasions when it is possible to use a wide bandwidth for shortwave reception, the opportunity does arise sometimes when stations are receivable above 16 mc and the broadcasts of the BBC especially meet high-fidelity standards. However, I suppose the arrangement leads to more foolproof operation. The Browning comes either in chassis form or in a small cabinet with a timer clock for automatic on–off operation optional.

## Crestwood 404 tape recorder

Priced at $230, this unit is meant to fill the gap between the home type recorders selling in the region of $100 and the semiprofessionals costing $400 or more. It does better than meet the minimum standards for high fidelity, and is in many respects comparable to the semipro types.

The electronic portions of the recorder are not completely flat, having a −4-db slope at 15 kc and a −2-db slope at 20 cycles. The high-frequency slope can be compensated with the tone control and the curve of Fig. 2 was taken with the tone control adjusted to provide a flat response to 10 kc. The output level amplifier and indicator circuits have an even greater slope at both ends, hence the response was measured at the output jack rather than the monitor-headphone jack.

Many other recorders, even those of professional quality, are guilty of the same sin but it is not an important one provided that one remembers not to adjust the recording level for extremely low tones. Adjusting for full closing of the eye on a 50- or 60-cycle or lower input would overload the tape in the normal peak region between 200 and 1,000 cycles, and probably also lead to saturation on the very high frequencies. This is unlikely to happen when recording music or voice. The curve was taken through the mike channel at the usual −20-db level. The response through the radio channel is very little different. Beat notes appeared above 14,000 cycles and no attempt was made to measure above that point. Response at 3¾ ips was adequate for all voice use and good enough for AM recording.

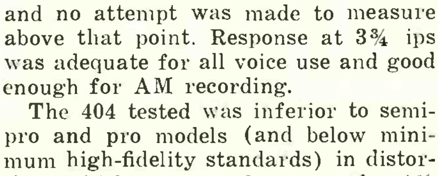



**Fig. 2—Response of Crestwood 404.**

The 404 tested was inferior to semipro and pro models (and below minimum high-fidelity standards) in distortion which amounted to nearly 4% harmonic at the peak input level (eye fully closed). Most of this was ascribable to the amplifiers which registered more than 2% when used as a PA preamp; it *is* possible the excessive reading was the result of a poor tube. The distortion is lower with the radio input. Distortion falls off fast as recording level is decreased and at a level of −10 db (eye about half closed) is quite acceptable.

Hum is more troublesome than with

most semipro recorders but not a factor unless used with mikes of very low sensitivity. The wow and flutter were acceptable for nonprofessional and even for routine broadcast use and the lightness and compactness of the 404 lends itself nicely for portable applications.

Operation is simpler and more convenient than with most semipro types and incomparably better than with home types. Editing and cuing of adequate accuracy for routine broadcast use is possible. There is no provision for adjusting bias and the adjustment of recording and monitoring levels requires a service manual, instruments and some care. (Better leave it alone.) Head alignment is not too easy either but the mounting is such that loss of alignment should not occur under ordinary use. The heads, incidentally, are Brush.

A single motor is used for all operations through a well-thought-out and constructed mechanism which should give long service without trouble. The 404 can be used as a preamplifier to feed a power amplifier. Beside the mike and radio inputs it also has an input equalized for the G-E phono cartridge. With the Crestwood amplifier described below and a record player it will comprise a complete portable hi-fi or small PA system and deliver acceptable performance, considering its small size.

## Crestwood amplifier–speaker

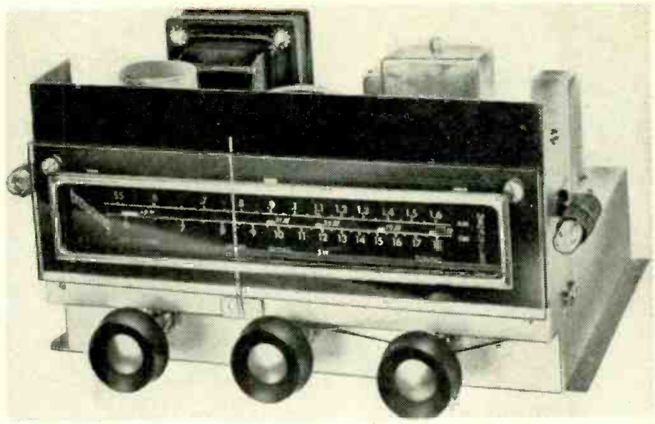
In a mere 1.5 cubic feet, this unit succeeds in delivering a response from 60–12,000 cycles highly acceptable for musical appreciation and above minimum high-fidelity standards.

The frequency response is little short of amazing, though the peak above 50 kc is excessive and, as the square waves indicate, results in a poorer transient response than one would like. However, the amplifier is completely stable under all normal operating conditions. The power output curve is excellent for small 6V6 amplifiers and the distortion (3% IM at 5 watts) is about average.

The listening quality is equal to that of average amplifiers with larger speakers. The fundamental response goes down to 60 cycles. The doubling below that impairs the definition but produces a bass which is sometimes awesome. The overall quality will permit a good evaluation of tape quality which is what it is principally intended to do. All in all, the system delivers notable quality for the space occupied.

## Robins Gibson-Girl tape splicer

More often than not the really big difference between amateur and professional or semiprofessional tapes is merely the editing. Many amateurs own recorders and mikes as fine as those used by recording studios; many also have considerable skill in mike placement, control of dynamic range, proper tone balance, etc. The professional, however, ends up with a better tape because he has more skill in taking out faults, synthesizing several versions into one, excerpting, etc. Tape editing is an art but as in all arts good tools help. The essential tool is a good tape splicer but it is amazing how few amateurs own one.



The Browning L-500 AM tuner.

I have been using the Robins Gibson-Girl splicer many months and recommend it heartily. It is both effective and easy to use and the Gibson-Girl splice it makes is corrective for the error which produces most trouble with splices: letting the adhesive tape stick out even a few thousands of an inch beyond the edge of the tape which, when the tape is wound on the reel, results in adhesion to the adjacent layer and often breaks the tape.

The Gibson-Girl splicer has a track and clamps for fastening the two ends of tape in place. When they are properly positioned, they are cut with a diagonal slash. A piece of splicing tape can now be applied across the cut and another made—the Gibson-Girl cut which scallops out two shallow arcs on each side of the tape to make sure there is no overlap whatever. If the proper tape is used, there is practically no risk of adhesions. For that matter, even cellophane tape can be used in an emergency without undue risk. Those who want even more complete simplicity can get the deluxe model with a built-in tape dispenser so there is no need for separate cutting of bits of tape.

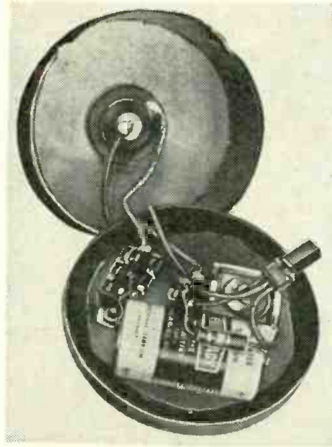
## Two ribbon microphones

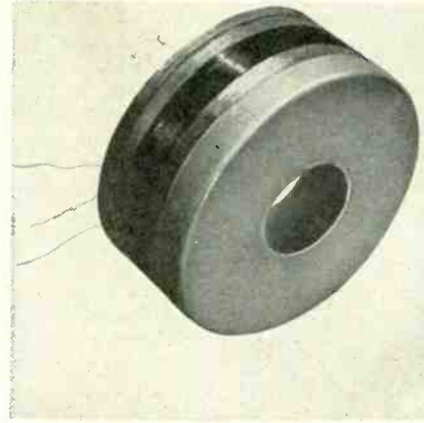
Microphones reasonably flat to 15,000 cycles or higher are scarce and expensive. Two imported ribbon mikes which claim a response within 2 db to 15,000 and indeed a relatively shallow slope to 20,000 cycles are now available. One is the B & O, made in Denmark; the other the Reslo, made in Britain. Aside from their specifications, which are apparently accurate, the remarkable thing about them is the price of under $50, less than half the cost of previously available mikes with this response.

The B & O (see photo) is available only in the low (50-ohm) impedance and therefore requires an additional transformer to match the high-impedance mike input of semipro tape recorders. It has a switch which provides two characteristics—one for remotely (6 feet or more) miked music, the other for close talking. The pickup pattern is the normal figure-8 bidirectional one of velocity mikes but the nulls are not as broad as is usual. Thus, no special placement is necessary to obtain good sound. Yet there is enough control to provide, in skilled hands, correction for some of the acoustic conditions one is likely to meet in portable or studio recording. The sensitivity is surprisingly high for a ribbon mike and no preamp should be necessary with any of the standard semipro recorders. It is very compact—about the same as the "slim type" dynamics—and it comes with a fine ball and socket mount which permits easy angle adjustment. The protection against blasting is unusually fine, though the mike is not suitable for outdoor use.

The British Reslo, also a ribbon job, comes in several combinations of impedances. The Celeste can be used to match either a 30–50-ohm or a high-impedance input and has a switch for muting. The impedance is changed by plugging in different cables (both cables come with the mike) which has the advantage of maintaining proper balance and match. The Symphony is for either 250-ohm balanced or 600-ohm unbalanced input. The frequency response is similar to that of the B & O but the high-end response is sharper and more evident to the ear, although I did not notice any particular coloration.

The Reslo provides a very high degree of versatility in changing pickup patterns and response. The normal pattern is the figure-8 bidirectional. However, the back has a sloping response at high frequencies, being down 2 db at 1 kc and 20 db at 10 kc. This is valuable for live pickups of bands which can be arranged so the bass section is picked up by the rear of the mike while the other instruments are picked up by the front. It also produces interesting results with remote miking since the room reverberation tends to be held down at high frequencies. Each Reslo comes with felt pads and cloth reflector which can be inserted in the back of the mike to change characteristics to semicardoid or to cardoid for close-talking. In this respect it is one of the most versatile of all microphones. Incidentally, it can also be used outdoors with good results. The sensitivity is a little higher than that of the B & O and should be adequate to saturate a semipro tape recorder. END





Extreme right—antenna coil wound around the case. Microphone is not as yet installed. Right—View of the completed microphone. Below—the microphone is put through its paces.

# TRANSISTORIZED WIRELESS MIKE

By ELLIOTT A. McCREADY

ABOUT the most widely available and certainly the least expensive transistor on the market today is Raytheon's CK722. Although designed primarily for audio and low radio-frequency applications, most of these units will oscillate at frequencies as high as 1 or 2 mc.

The wireless mike described here makes use of these attractive features of the CK722 and has proven a source of much enjoyment for my small daughter and her friends. Incidentally, this little gadget should make an excellent companion piece for the "Radio for Junior's Car" described in the December, 1954, issue of RADIO-ELECTRONICS.

A slightly modified Hartley oscillator (see diagram), modulated by an ordinary carbon telephone mike inserted in the collector lead of the transistor, puts out a respectable signal. The tap on L1 was experimentally placed for greatest output. Coil L1 is wound on the outside of the microphone case and serves as a loop antenna. The position of the tap on L1 has me puzzled. Theoretically, it should be closer to the base end of the coil to maintain the proper input-output impedance ratio for the CK722. But in this position the circuit won't oscillate at all.

With the L-C ratio shown, the oscillator will tune from about 500–800 kc, a fairly blank spot in my part of the country. Reducing the size of C1 will, of course, raise this frequency range. The unit should be operated at as low a frequency as possible, however, to insure strong oscillation of the CK722.

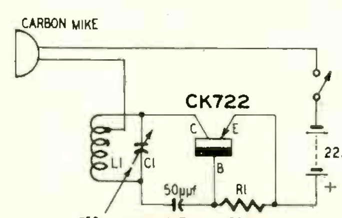



Diagram of transistorized wireless mike.

## Construction

The unit is entirely self-contained and housed in a 1½-inch slice from the bottom of a 3¼-inch cardboard Morton salt container. Coil L1 is close-wound on the outside of the salt box with 36 turns of No. 30 enameled wire, tapped at 9 turns. After winding L1, give the entire outside of the carton a coat of service cement and allow it to dry thoroughly. Cut a 1-inch hole in the bottom of the salt box and insert an ordinary carbon telephone mike. A little service cement under the edge of the mike holds it in place.

The other components of the wireless mike are mounted on the cardboard re-enforced lid from a similar salt carton. The hearing-aid battery is held in place with a spot of service cement.

When all the components are mounted, proceed with the wiring, which is strictly noncritical. The CK722 can be soldered directly into the circuit or a Cinch five-prong hearing-aid socket can be used. I prefer the socket as the transistor is easily damaged by heat from the soldering iron. If a socket is used, remove both of its alternate pins.

When the unit is completely wired, put the lid in place and glue on the base, being careful not to glue the lid to the salt box in the process. A coat of flat blackboard enamel completes the project. I used a cardboard base but a sturdier unit could be made of wood or sheet metal.

**Parts for wireless mike**

1—150,000-ohm ½-watt resistor; 1—50-μμf ceramic capacitor; 1—750-μμf mica padder capacitor; 1—spst switch; 1—22.5-volt hearing-aid battery; 1—carbon telephone microphone; 1—CK722 transistor; 1—coil, 36 turns of No. 30 enameled wire on a 3¼-inch form, tapped at 9 turns (see text); 1—chassis (see text); 1—socket for CK722 (see text).

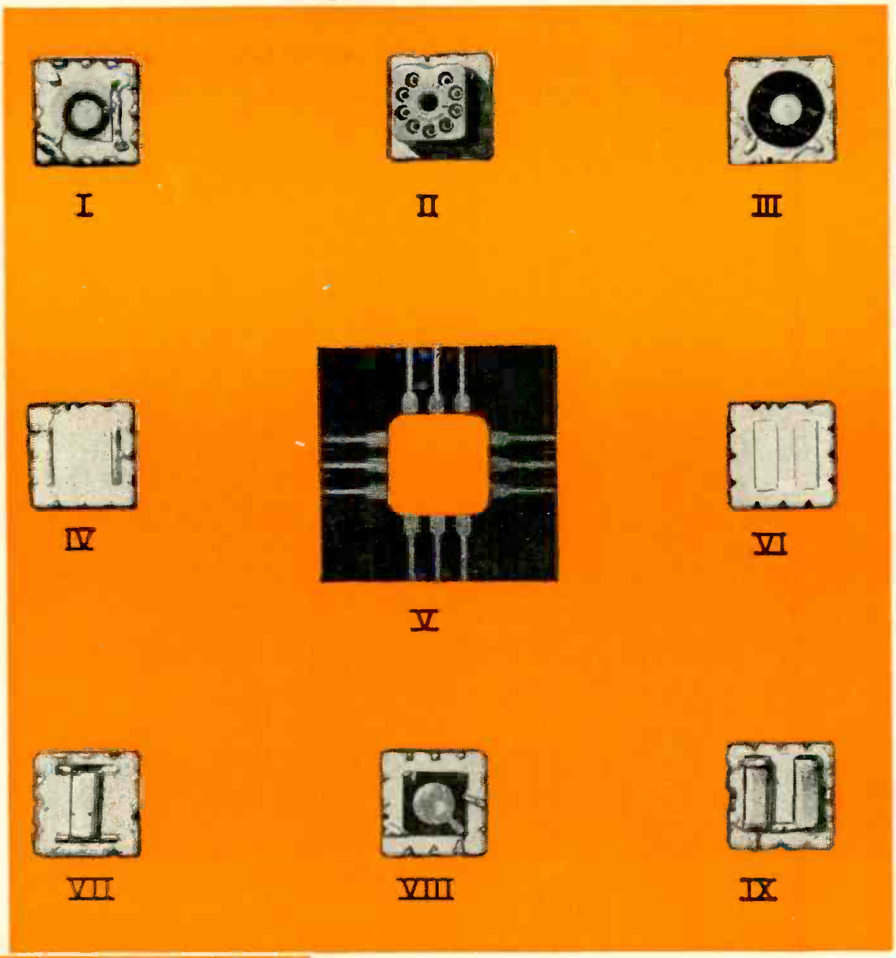
## Operation

When the paint is thoroughly dry, turn the unit on and place it near an operating receiver tuned to a blank spot within the operating range of the wireless mike. Adjust C1 until a carrier is heard and the unit is ready for the kids to use.

As this gadget was designed as a toy, its 10–15-foot operating range was considered adequate for room-to-room use. In some cases, however, it may be desirable to increase this range. This can most easily be done by increasing the size of the container and thus increasing the size of the loop antenna. If this is done, L1 will have to be redesigned to cover the desired frequency range. Output of the oscillator can also be increased slightly by reducing the value of R1, which was selected to limit collector current to about 2 ma. (Be careful not to exceed the transistor current rating.) In any event battery life will shorten considerably and hence this maneuver is not recommended.

The new G-E 2N76 transistor, designed to operate at higher frequencies, would also probably increase oscillator output. As yet I haven't been able to get my hands on one of them, but it will undoubtedly be an interesting experiment when they become a little more widely available. END

Typical module components: I—small inductor; II—tube socket; III—large inductor; IV—blank wafer with plated strip for attaching components; V—square hole in circuit board into which module is connected; VI—two adhesive resistors; VII—small plastic capacitor; VIII—ceramic capacitor; IX—two flat capacitors having one common terminal.




*A new type of electronic circuitry is on the way*

# NOW—A MODULAR TV RECEIVER

By FRED SHUNAMAN
MANAGING EDITOR

TELEVISION engineers—and radio engineers before them—have continually been on the search for more economical and simpler methods of wiring components into receivers. This search for economy and simplicity has taken two main paths: one in the direction of easier wiring methods; the other toward packaged circuitry. The first probably began when Western Electric started using harnesses and has now been pretty well solved with printed circuitry. Printed circuits (and even some earlier wiring methods) often include some components in the circuitry itself.

One of the earliest of these combination systems, in which flat conductors also acted as capacitor plates, was described in a patent issued to Flewelling in the mid-Thirties and later assigned to RCA. The Sargrove receiver, made in Britain in 1947, printed capacitors, resistors and conductors on the chassis by a fully automatic method ("Robot Makes Radios," RADIO-CRAFT, September, 1947). The Compo radio, described in this magazine in December, 1947, combined components and wiring into cylinders resembling shield cans, which were plugged into sockets on the chassis. This was not so much an attempt at wiring simplification as to make servicing easier by simply replacing units containing a defective component.

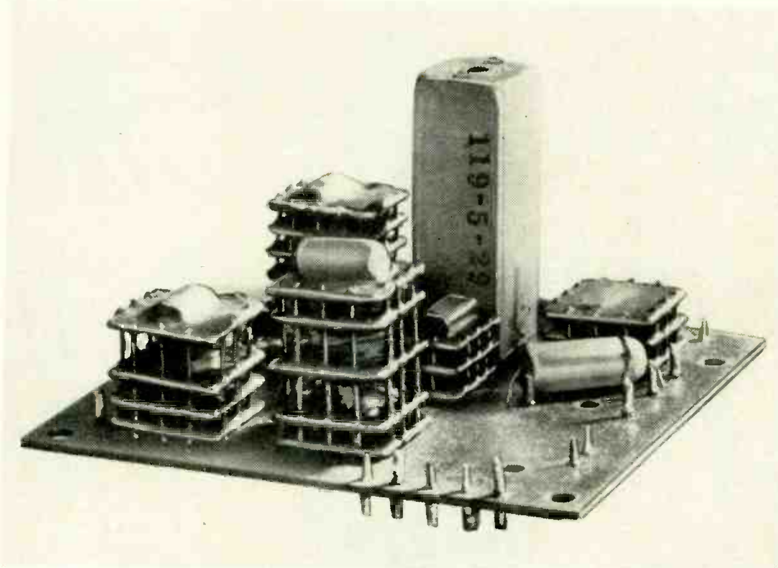
Other types of packaging and unitization have been proposed and a few actually manufactured. Of them all, only etched ("printed") circuitry has survived and prevailed. It has also been combined with printed or appliqued resistors and capacitors which form part of the circuitry.

Yet printed circuits have their drawbacks. One of these is the crossover. Old-fashioned wiring is three-dimensional, and crossovers can be made very easily. Printed wiring is two-dimensional, and all conductors are directly in contact with the chassis or circuit board. To cross over, one of the "wires" must be run through the circuit board, past the crossing conductor on the other side, and back again. This is often taken care of by running one lead on each side of the board. But in some cases actual hairpin tunnels through the board have been made to get past a crossing conductor.

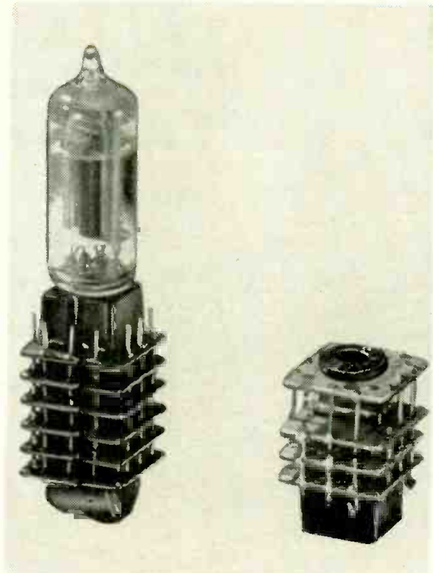
Etched or printed circuits are not any easier to service than the conventional sort. Capacitors and resistors are often special printed-circuit types, and when they have to be replaced the job of removal and resoldering takes more time and care than with wired-in components.

## A different approach

The modular concept combines some of the best features of printed wiring techniques with the idea of combining groups of components into a single package which can be replaced as a unit. The package typically contains the components associated with a single- or double-section tube, though it




A circuit board in the modular TV receiver. Note the variation in modules.



Complete modules—unit at left contains socket for miniature tube.

may contain less than one stage or more than two, and of course does not necessarily contain a tube. The tube is mounted in a socket that forms the module's top section. The rest of the unit is a series of ceramic plates or wafers, commonly about ⅞ inch square, spaced 3/16 inch apart.[1] The wafers are held together by 12 wire risers—3 on each side—which also serve as connectors. Each wafer may carry from 1 to 4 capacitors or resistors or an inductor or some other circuit component.

The module is inserted into a square hole in the circuit board, connecting to 12 printed leads which radiate from the 4 sides of the hole. Each module is therefore an independent package which may be conveniently replaced in minutes.

The module's greatest advantage is its adaptability to mass production. Components are applied and wafers assembled by automatic machinery. A second advantage is that it solves the crossover problem. If a lead is attached to a given riser, another lead that would cross it in printed circuitry can if expedient be attached to another riser. Then the wafer immediately above or below may possibly contain nothing but the crossing conductor. The module puts the third dimension back into wiring while retaining the advantages of printed circuitry. By adding depth, it makes great compactness possible. In some cases all the parts for two stages are contained in a module ⅞ inch square and not even an inch high.

## The components

Obviously, components of special form are needed for such compactness. The resistors are a type developed by the Bureau of Standards. They are processed in the form of adhesive tape and can be used singly or in parallel to dissipate from ½ to 2 watts. Capacitors are ceramic types similar to those used in ordinary printed circuitry or —for the larger sizes—special rolled plastic units. The ceramics go down to 10 $\mu\mu f$ and the plastic types up to 0.5 $\mu f$.

Inductors may be small, simple windings or larger flat universal-wound coils running up to 10 mh. Larger coils and capacitors are positioned on the chassis, external to the modules. This is seldom necessary in actual practice. The various types of components that can be wafer-mounted are shown in the photograph.

Since a tube is usually part of the unit, each module is likely to carry the circuitry of one or two stages, depending on whether it carries a single- or double-section tube. The double triode of Fig. 1, for example, acts as sync phase inverter and vertical oscillator.

The seven resistors and the four capacitors which comprise the circuitry are distributed among four wafers of a six-wafer module. The large number of wafers and risers reduce crowding to the vanishing point and the vertical construction permits greater compactness than has heretofore been achieved.

The Emerson 120306 chassis TV receiver pictured on the cover uses 13 modules. Tuner and power supply are conventional. It was also found convenient to mount tubes closely associated with transformers, such as if amplifiers, separately though parts of their circuitry may be module-mounted. Other tubes and most of the other components are mounted in modules. (Incidentally, Emerson has simultaneously engineered this model for manufacture in printed-circuit form using conventional individual component parts, thus permitting comparisons as to cost, adaptability to servicing and other features.) The complete schematic of the receiver is on pages 46–47. (Its rather unfamiliar appearance may be typical of TV receiver diagrams in the foreseeable future.)

## Servicing the modular set

The ideal and ultimate method of servicing a modular receiver is simply to locate the module in which the defect is lurking and replace it. If modular construction becomes universal, no doubt soldering guns with heads in the form of a hollow square to unsolder the 12 contacts simultaneously will form part of every technician's tool kit. Another tool will be a swage with which the 12 risers on the replacement module will be bent outward and clinched against the 12 contacts on the chassis board. The same square-headed soldering tool can then be used to solder the new module into place.

While modules are new, it may be found advisable to replace individual components. Indeed, it is by no means certain that it will not always be more practical to replace certain parts than to substitute a complete new module. Troubleshooting will not be as simple as with open wiring, because it is not always possible to see the connections of a component. But since they are connected to given risers—which are indicated on the schematic—they can be located readily. No voltage at the plate of the sync amplifier in Fig. 1, for example, would almost certainly indicate an open R47 or R46, if plate voltage was found on riser 6 (riser numbers are circled in the diagram). A voltage check from riser 6 to riser 10 would indicate which of the resistors

[1] These specifications describe the ACF modules, made by ACF Electronics, Alexandria, Va. They appear in the photographs and are used in the new Emerson TV receiver which forms the subject of our cover and this article.

was open and a new resistor could be soldered to the two risers between which the defective one was connected.

An open capacitor could be handled like an open resistor. A shorted capacitor would give more trouble but could in many cases be removed from the circuit by snipping one of the risers to which it was connected. It is likely that the plans of each module, like Fig. 2, will eventually be included in service data so the problem of locating a shorted capacitor would be simplified.

It is likely that modules will give rise to their own conventions and traditions, which may make life easier for the repairman. In traditional circuitry he is greatly aided by customs and habits. The great majority of tubes, for instance, follow one of three or four patterns as to placement of grid, ground and cathode terminals. In spite of the numerous exceptions, this uniformity helps the service technician. There is no reason to suppose that it may not become traditional to look to one riser (or one of four risers) for ground, another for B plus, etc. However, no pointers in that direction have yet been observed, and designers will be quick to point out that such straitjacketing would reduce wiring flexibility.

To the technician, the module offers promise of a receiver that can be serviced quickly and efficiently in the home and that should yield service charges large enough—due to the replacement of the fairly consequential-looking modules—to pay adequately for the work. END

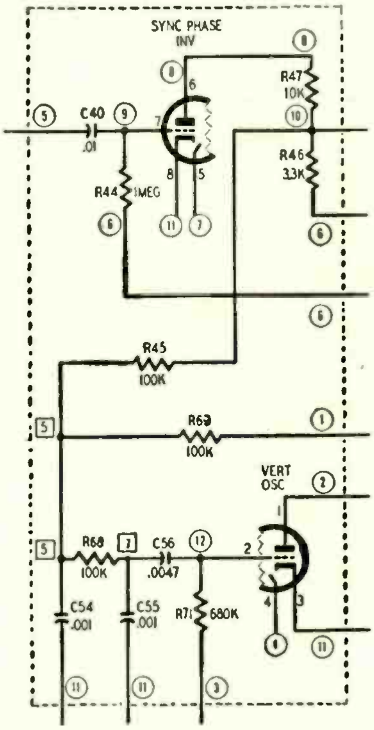



Fig. 1—Sync phase inverter and vertical oscillator as wired in a typical module.

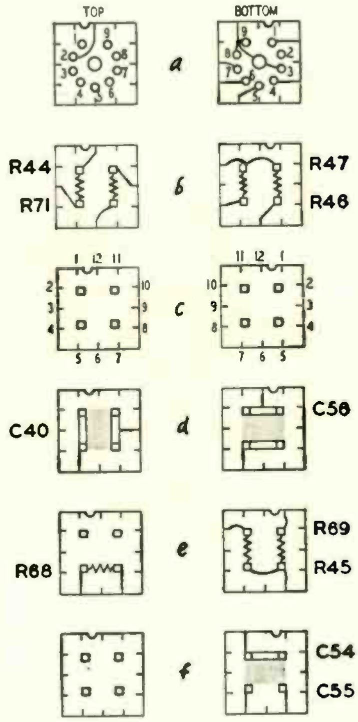



Fig. 2—How the Fig. 1 module is wired. Parts values are the same as in Fig. 1.

## Government TV-Set Certification Program

UNCLE SAM has set new and specific limits on permissible radiation from TV, FM and some communication receivers and has ordered receiver manufacturers to certify that their products meet these limits, beginning this spring. It has prescribed that "a distinctive seal or label" be affixed to each certified receiver for the protection of the customer.

While each manufacturer will design his own seal or label, they will all carry the same wording, approved by the Radio–Electronics–Television Manufacturers Association (although RETMA will not be identified with the certification program). The purpose of the label will be to indicate that the receiver doesn't generate radiations which can spoil neighbors' enjoyment of TV or interfere with communications services.

Use of the label will be required under the Federal Communications Commission's new receiver certification rule—the first Government attempt to regulate the manufacture of TV and FM receivers. The rule was prepared after 5 years of Government–industry conferences and has the approval of the vast majority of the receiver industry.

While the rule is aimed at manufacturers, the regulated party actually is the operator—the viewer or listener—since the FCC is permitted by law to regulate only users of communications equipment. The regulation stipulates limits on the amount of radiation a receiver may legally transmit at various frequencies and provides for certification of each model or type of set offered for sale so the purchaser may know he will be complying with the FCC law when he operates the receiver.

The certification label is to be affixed to all sets which comply with the new FCC standards. It can be attached only to receiver models certified by the manufacturer or a private testing laboratory to meet the radiation specifications established by Government and industry engineers as being noninterfering.

It's estimated that 90% of television sets now being made comply with the radiation limits but the certification program is being relied upon to curb those few manufacturers who have been putting out receivers which are also "transmitters."

**FCC RADIATION LIMITS**

| Frequency of Radiation (mc) | Field Strength (µv/m) |
|---|---|
| 0.45–25 | See Note |
| Over 25–70 | 32 |
| 70–130 | 50 |
| 130–174 | 50-150* |
| 174–260 | 150 |
| 260–470 | 150–500* |
| 470–1000 | 500 |

* Linear interpolation

NOTE: Pending the development of suitable techniques for measuring the actual radiation in this band, the interference capabilities of a receiver in this band will be determined by the measurement of rf voltage between each power line and ground at the power terminals of the receiver. The voltage so measured shall not exceed 100 µv at any frequency between 450 kc and 25 mc, inclusive.

The new regulations (see table) apply to all receivers which tune anywhere from 30–890 mc—and this includes not only TV and FM sets but many communications receivers.

The certification and labeling rules go into effect May 1 for vhf TV sets, FM sets and all other receivers, with these exceptions:

Uhf receivers are given later deadlines—new models put in production after Dec. 31, 1956, must comply with the rules. By July 1, 1957, all TV sets—uhf or vhf only—must meet the requirements and carry the seal. Pocket type superregenerative receivers used in one-way signaling service must be produced in conformance with the new radiation rules after the end of this year.

Some manufacturers haven't waited for the rules to go into effect, and are already telling prospective customers that their sets are noninterfering. One leading manufacturer attaches a tag to its new receivers stating that the television set ". . . has been carefully designed and heavily shielded to virtually eliminate oscillator radiation. This means that undesirable radiations from its circuits will not interfere with picture reception on your neighbors' TV sets. The elimination of excess radiation also results in a better picture for you."—*David Lachenbruch*

# Troubleshooting AGC Circuits

By CYRUS GLICKSTEIN

*Part II—Isolating agc defects; manufacturer's service notes*

A LARGE group of agc troubles originates in the agc filter, the R-C network connected to the agc bus. Faulty agc filtering can cause buzz in the sound, hum pickup in the picture and unstable sync. Faulty filtering leaves in the agc voltage a ripple which is fed back to the controlled rf and if stages and modulates the incoming signal. Defective filtering is generally caused by an open capacitor in the agc filter, a capacitor or resistor which has changed value or incorrect values in the original filter-network design.

Another large group of agc symptoms arises from a complete or almost complete loss of agc voltage. This may be caused by a defect in the agc bus (shorted capacitor, open resistor, etc.), a failure in or loss of input to the agc stage. The loss of agc results in a confusing variety of symptoms. For example, it may cause either a very strong, contrasty video signal or exactly the opposite—a very weak video signal or possibly a blank screen.

The key to understanding the reasons for these symptoms is found not in the agc system but in the video detector–video amplifier circuitry found in many current models (Fig. 1). The video detector is direct-coupled to the video amplifier which in turn connects directly to the picture tube. The rectified video signal across the detector load is negative (Fig. 2).

When agc bias is lost, the controlled stages operate at maximum amplification. An unusually large detected video signal (Fig. 2-b) is developed across the diode load and applied to the video amplifier grid. Since this video signal is pulsating dc, it not only provides the signal input to the video amplifier but also biases the stage in accordance with signal amplitude.

Thus, a stronger than normal video signal may not only cause a contrasty picture but may drive the video amplifier to cutoff on the negative signal peaks. This in turn would cause sync pulse clipping and defective horizontal and vertical sync. An even stronger video signal may produce enough bias to shift the operating point of the video amplifier sufficiently to cause extremely low amplification. This produces weak video output and poor sync.

A very strong video signal may even drive the video amplifier stage to cutoff. This may also cause picture-tube cutoff since the higher video amplifier plate voltage is applied to the cathode, thereby increasing the bias on the picture tube. In this event, the picture tube may be cut off only when the set is tuned to an active channel. Sound would come in at or above normal levels in split-sound sets. In intercarrier sets, sound would come through (though some buzz might be present) in sets with the sound takeoff point at the video detector. If the sound takeoff point is at the video amplifier plate, a signal strong enough to cut off the video amplifier results in no sound as well as a blank screen.

Varying the contrast control setting does very little to remedy an overload due to a loss of agc bias. The contrast control is generally in the video amplifier cathode circuit. Even with the control set for minimum bias, the abnormally large signal at the video amplifier grid would still overdrive it.

Most of these effects are also possible in models with two stages of video amplification. In these sets the video detector is still connected as shown in Fig. 1. There is usually R-C coupling between the two video amplifier stages and the plate of the second stage is connected to the grid of the picture tube to obtain the correct picture phase. The only effect not produced in such sets by a loss of agc would be picture-tube cutoff.

We have discussed symptoms caused by defects in the agc system proper. However, a substantial number of agc troubles can be caused by a defective component not actually a part of the agc network but merely connected to it. For example, a leaky coupling capacitor between the mixer plate and grid of the first if stage can place a small positive voltage on the agc bus, thereby producing the usual symptoms associated with the loss of agc bias.

The same effect on the agc bus can be caused by a gassy or partially shorted (high-resistance) rf or if tube, by a leaky coupling capacitor between the plate of an if stage and the grid of a following controlled if stage, by a leaky capacitor between plate and grid of the first stage in a cascode rf amplifier (C105, Fig. 3).

Excessive agc bias can be developed by a fault in the video amplifier stage in Fig. 4. The video amplifier is direct-coupled to the grid of the keyer tube. An open heater or low emission in the video amplifier causes a higher than normal plate voltage in the video amplifier stage. This higher plate voltage is also applied to the keyer tube grid which then conducts continuously. An excess agc bias, which may be sufficient to cut off the rf amplifier and other controlled stages, is developed. In sets with this kind of circuit there will be a loss of both video and sound.

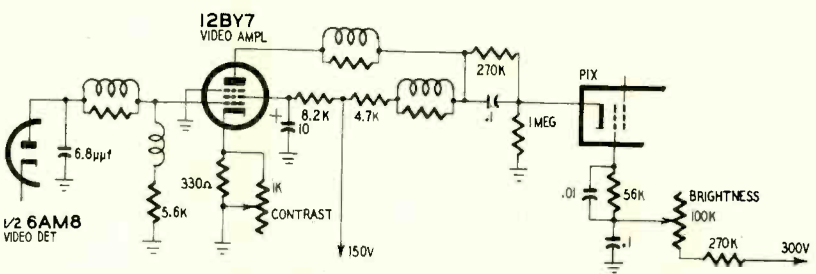



Fig. 1—Schematic diagram of direct-coupled video detector–video amplifier.

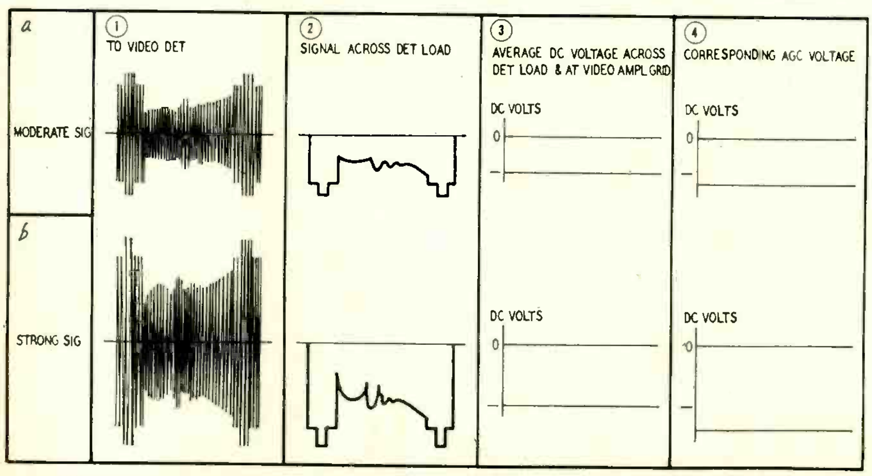



Fig. 2—Diagram shows various voltages related to agc circuitry.

As usual, the first step in troubleshooting is to check tubes. When symptoms point to video trouble, video and sound trouble or poor sync, change some or all of the following, depending on the symptoms: front end, video (common if), video detector, video amplifier, sync, horizontal afc and sweep oscillator tubes. In addition, the agc tube(s) should be changed, including any tube used as an agc clamping diode. This tube is easy to overlook since it usually is a diode section of the audio detector–first audio tube. Changes in tubes are usually made immediately after checking control settings (see step 1, below).

The following steps should be taken to determine whether the fault is in the agc system:

1. Vary the contrast and, if present, the agc and noise limiter controls. Incorrect setting of the agc threshold control can cause bend, contrasty or weak picture, buzz in the sound or a complete loss of picture and sound. Vary the contrast control to determine if there is the normal range of control. Resetting these controls may clear up the trouble. If not, rotating each control on either side of the setting usually indicates whether they are operating normally.

2. The most important quick check is to measure the negative (dc) voltage across the video detector load resistor and then from the agc bus to ground with an active channel tuned in. The voltages should be approximately equal (Fig. 2). (They may vary somewhat depending on the type of agc system).

If little or no agc voltage can be measured while several volts appear across the diode load, this indicates a loss of agc and further checks should be made in the agc system for shorts or an open agc bus, a defect in the agc diode or gated agc stage or loss of signal input to the agc system. If the agc bus has a positive voltage, checks should be made for a faulty component which may be connected to the agc line. A defective clamping diode or threshold-control voltage-divider may also be responsible.

If the negative agc voltage is considerably higher than the voltage across the detector load, this indicates a continuously conducting keyer tube so check this stage and the video amplifier connected to it.

3. If agc voltage is normal and the symptoms indicate the possibility of hum pickup in the agc bus or defective filtering, bridge the agc line with a 0.1-$\mu$f capacitor and note the effect on the output. Because of the susceptibility of the agc bus to hum pickup, the capacitor should be tacked in rather than held when making the test. If some improvement is noted, the various capacitors in the agc filter should be bridged with units of equal value to determine which one of them may be defective.

4. If the above checks have no effect, make the usual checks for trouble in other circuits which can cause similar symptoms.

Once trouble is localized to the agc system, voltage and resistance checks around the agc tube(s) and bus will usually uncover the defective part.

Signal tracing with an oscilloscope is an additional method for localizing video–sync–agc troubles. Peak-to-peak voltage and waveform checks should be made at the diode load resistor, video amplifier grid and plate, picture-tube input and the keyed agc tube grid and plate. A loss of signal or a noticeably incorrect signal as compared to the manufacturer's specifications indicates trouble at or immediately preceding the point under observation. The scope quickly reveals hum or ripple on the agc line.

## Troubleshooting notes

A good deal of helpful information has been compiled by manufacturers on the basis of field service reports. In addition, various manufacturers have recommended field modifications to improve agc operation. Some typical reports and recommended modifications are listed below for reference since they are useful in indicating possible faults in most other models.

**1. Sync instability**

a. *Horizontal instability (jitter).* May be caused by a partially filtered horizontal signal fed to the grids of the first two if stages with the agc voltage. This signal, which has shifted in phase with respect to the horizontal oscillator, modulates the video signal and causes horizontal instability when fed back to the sync circuits. Correct this by adding additional agc decoupling capacitance.

b. *Tearing at top of pix.* Insufficient agc. Check control setting.

c. *Distortion or pix tearing in strong signal areas; erratic horizontal hold.* Remove the resistor from the agc bus to ground. This provides higher agc voltage for pix if tubes. Weak or gassy if tubes will cause similar trouble.

d. *Loss of horizontal sync.* Open in agc pulse coil (connected across a section of the flyback transformer). Disconnect one side of this coil from flyback transformer before checking continuity.

e. *Horizontal pulling or jittering.* Horizontal wavering regardless of the contrast control settings can be corrected in most cases by inserting a 0.47-$\mu$f capacitor across the filter capacitor that bypasses the agc line to ground. The electrolytic capacitor does not have adequate high-frequency bypassing action, which is provided by the 0.47-$\mu$f unit. The pulling effect is more pronounced with strong signal reception and in many cases might be mistaken for overload. However, addition of the 0.47-$\mu$f capacitor corrects the condition.

f. *Picture pulling.* Caused by either hum pickup in the agc bus or from a leaky agc tube. If replacing the tube does not cure the trouble, place a 0.5-$\mu$f paper capacitor from the agc bus to chassis.

**2. Video defects**

a. *Weak pix, very snowy; weak sound.* Defective agc clamp. If this tube is nonconducting, the effect may not be immediately apparent but may cause the rf amplifier or mixer to become defective.

b. *Overloading with normal contrast —near station.* Insufficient agc voltage is overdriving receiver. Check setting of agc control.

c. *Pix overloads on strong signal.* If pix is unstable and agc control has little effect, test capacitor in the agc filter network. It may be leaky.

**3. Miscellaneous troubles**

a. *Raster, no sound, no pix.* Trouble was found to be an open heater in the first video amplifier (one section of tube). Failure of this section of the tube causes the bias on the agc line to cut off the common audio–video if amplifier stages, killing the sound as well as the picture although this is a split-sound receiver.

b. *Agc drift (change in sensitivity as set is operating).* Defective agc amplifier. When this tube is replaced, the agc control setting should be readjusted.

c. *Agc control adjustment.* In medium- and strong-signal areas the agc threshold control adjustment should be made on the strongest signal to avoid receiver overload. In weak-signal areas the adjustment which gives the best signal-to-noise ratio (minimum snow) may be preferred. The position of the fine-tuning control is important. It should be set so the pix carrier is well up the if slope when making final adjustment of the agc control. END

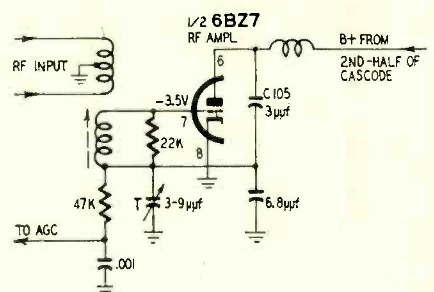



**Fig. 3—Du Mont RA-312 rf input.**

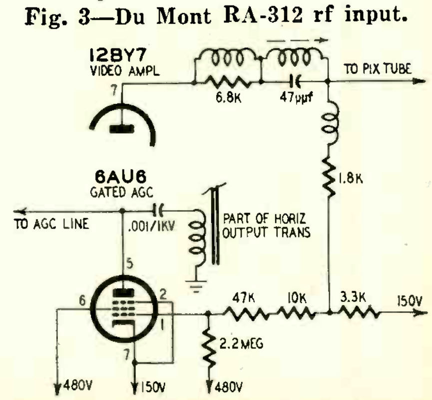



**Fig. 4—Sparton 23U214 gated agc.**

# SERVICING INTERCARRIER BU-Z-Z-Z-Z

By JAMES A. McROBERTS

*Servicing procedures for locating trouble sources*

TELEVISION sound and picture carriers are transmitted separately, independent except for a frequency interlock holding them 4.5 mc apart. The receiver's local oscillator heterodynes with the two carriers and produces two intermediate frequencies each containing its original modulation. Fig. 1 shows a block diagram of the signal paths.

The if amplifier delivers these two carriers to the video detector. The picture signal is sent through the video amplifier to the picture tube and we lose interest in it, as far as this article is concerned.

A new frequency is produced in the video detector as the result of mixing the sound and picture carriers—this is the 4.5-mc intercarrier signal, or the sound if as it is often called.

If the picture amplitude is about five times that of the sound, the picture carrier will act almost like a local oscillator. There will be some amplitude modulation in the 4.5-mc signal but very little in comparison with the frequency modulation which is retained in its entirety.

The 4.5-mc if may be taken directly off the pix detector, or at the output of the video amplifier, and amplified in one or more 4.5-mc if stages. An FM detector—almost universally a ratio detector—removes amplitude variations and demodulates the signal which is then fed to an audio amplifier. This completes the sound signal path.

Keep in mind that the picture if acts as a local oscillator at the pix if detector. It must be present or there cannot be a 4.5-mc carrier!

## Overloading

If a tube is driven to cutoff by an excessively large negative voltage—its plate current does not change so long as it remains at cutoff. Or if a tube is driven to saturation as by a high positive signal on its grid, the plate current does not vary while the tube is in saturation.

Thus, if a sync pulse drives any tube into either saturation or cutoff, it cannot transmit the variations of either the picture or the sound carrier during the time it remains in that condition. Hence the 4.5-mc carrier will vanish and so will the sound! Although the horizontal pulses may produce such overloading if their amplitude is excessive, they are relatively inaudible. The vertical pulse group *is* audible since it has a 60-cycle repetition rate. If the sound is cut off 60 times a second, intercarrier buzz is produced due to carrier interruption rather than amplitude modulation. The picture is relatively unaffected since the blanking pulse cuts off the picture tube and no video information is being transmitted.

The cure is to remove the overload. The most frequent troublemakers are the last pix if stages; they may have their B plus feed from higher voltages to permit handling larger signals. In sets—the economical ones—where the sound takeoff is from the video amplifier output, the video amplifier is generally the offender. It must pass the 4.5-mc intercarrier variations which it cannot do if cutoff or saturated. Here, too, the remedy is to remove the overload. (Some overloading may occur due to overmodulation of the station.)

In sets using the video amplifier as a 4.5-mc amplifier, varying the contrast control will indicate the trouble. Applying a higher negative voltage from a bias box on the agc bus will lower the gain and cut out the overload on the last picture if stages, localizing the trouble.

## Excessive amplitude modulation

Another cause of intercarrier buzz is excessive amplitude modulation of the 4.5-mc intercarrier signal by the picture-carrier modulation. At a ratio of about 1 to 5 (sound to picture) practically no amplitude modulation exists in the 4.5-mc carrier but this is not true for lower ratios. The amplitude-limiting device—the ratio detector circuit or a separate limiter in the few discriminator sets—cannot handle excessive amplitude modulation. The vertical pulse group becomes audible as a result (note this in varying the fine tuning control on most sets).

Intercarrier sets have an if response approximately like that shown in Fig. 2. The sound carrier is at 10% of maximum and the pix carrier at 50%, resulting in the 1-to-5 ratio. Lowering the picture carrier to 20% will definitely result in intercarrier buzz. Fig. 2 is the output of the video if amplifier. Make a sweep alignment check or test with a signal generator and a voltmeter across the pix-detector load. Preferably feed a signal into the antenna input at both carrier frequencies so that the front end may be tested also for any undesired attenuation or overly strong response of either carrier. The ratio must be about 1 to 5 at the detector!

Closely allied with the above is failure of the amplitude limiter in the sound system. This is simply an electrolytic capacitor in the typical ratio detector as shown in Fig. 3. The test is simple. Shunt the capacitor with another as in ordinary power-supply tests except that the value should be the same as that required for the set.

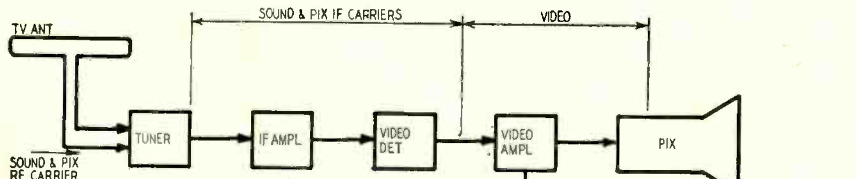
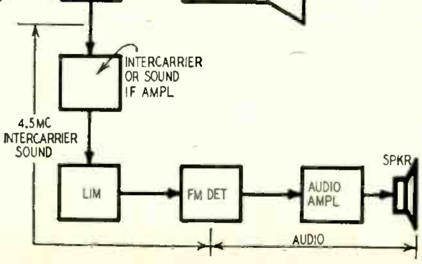




**Fig. 1—Block diagram shows signal paths in a typical intercarrier receiver.**

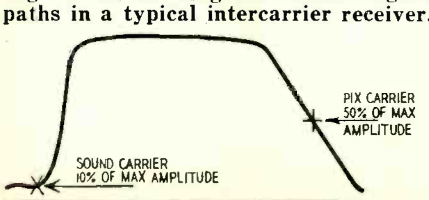



**Fig. 2—Intercarrier if response curve.**

A useful test is the sound agc voltage developed at the negative terminal of the ratio detector electrolytic capacitor whether actually used to control the sound if tubes or not. (See Fig. 3.) Use a high-resistance (20,000–100,000-ohms-per-volt) voltmeter or a vtvm between its negative terminal and ground.

Increasing the sound (4.5-mc) if amplitude by increasing the contrast control should result in an increase in this agc voltage as should a stronger station signal. Any decrease taking place under such circumstances means that something is wrong with the signal paths. The contrast control will tell if the trouble is in the video amplifier or thereafter for such takeoffs of this type. Otherwise, the trouble is in the circuits ahead of the video detector, such as improper alignment, etc.

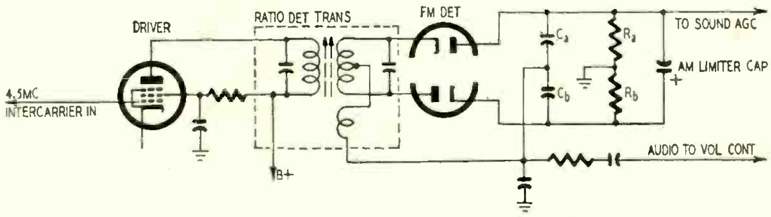



**Fig. 3—A typical ratio detector. The sound agc is an important test point.**

## Sound alignment

Sound alignment requires centering the sound if stages on 4.5 mc so that even amounts of any residual amplitude modulation will be applied equally to the ratio detector and cancel out in it. Although instrument alignment is preferred, screwdriver alignment is most practical. Make a mark on the chassis with a pencil and count any half-turns made so that the adjustment can be turned back. Particularly important is the secondary of the ratio detector transformer. Do not neglect the sound take-off trap or other 4.5-mc alignment adjustments.

The balance of the ratio detector may be upset by variation in its components, particularly the load capacitors and resistors. The dual-diode tube should be substituted early in the testing procedure.

## Test sequence

A logical sequence of testing is necessary to localize intercarrier buzz. A suggested procedure follows:

1. Substitute tubes in sound if section, particularly the FM detector tube.
2. Balance secondary of FM detector transformer for minimum buzz.
3. Touch up remainder of 4.5-mc adjustments.
4. Shunt amplitude-limiting capacitor.
5. Make the bias box test on main agc and the test on the sound agc as described previously.
6. Inspect alignment by sweep or signal generator-voltmeter method.
7. Check ratio detector load components.

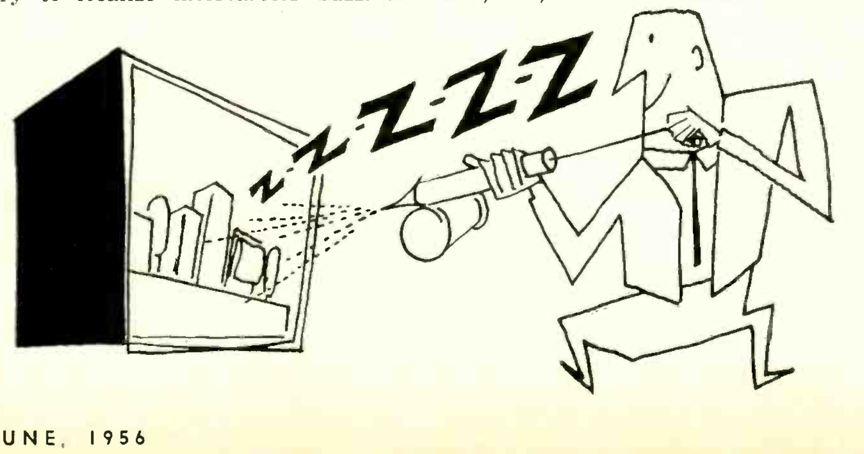
If the contrast control reduces the buzz rather sharply at some setting, look for overloading immediately.

If the fine tuning reduces the buzz, but cannot reach a good minimum on some station, the local oscillator slug needs adjustment or the strips of the turret may have to be replaced. In line type tuners, the rf and oscillator adjustments may be faulty so attention is immediately directed to them.

Worthy of mention are relatively obscure causes of intercarrier buzz.

Nonlinear action in any part of the receiver that acts as an amplifier in the signal path of the two independent carriers may result in a spurious modulation producing excessive buzz. Particularly offensive in a few localities is the cross-modulation of the FM carrier in the mixer stage. A strong local signal is the offender. The remedy is attenuation of that signal, even though it is the desired station, by wavetraps in the transmission line.

Ghosts with their vertical buzz pulse groups can cause similar trouble which will also be evident as a false picture or ghost on the picture-tube screen. The problem is getting rid of the ghost in this case. Traps, antenna orientation, etc., are the methods. END




# DRAMATIC HIGH-VOLTAGE DEMONSTRATOR

By L. H. WILSON

MOST television technicians know that their repair work would be much easier if TV owners and their well-meaning but untrained friends would leave the set alone after a defect has occurred. Of course, there is nothing greatly wrong with a set owner applying a little first-aid to a set if he goes only as far as he really knows what he is doing. But 99% of TV owners are out of their class and just asking for more trouble once they take the back panel off. Besides the hazard to themselves they can make a really tough repair job out of a simple one. And the average technician cannot make money on the tough ones.

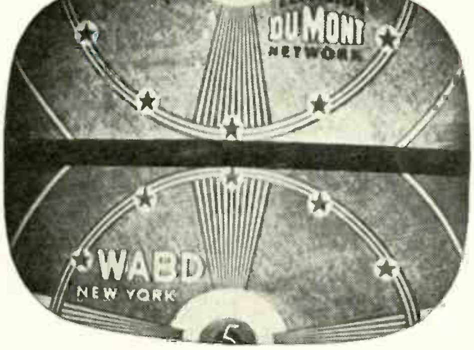
Thus, the technician should educate his customers to leave the set alone when it breaks down and to call him immediately. This is not an easy job, particularly with all the "Save Money—Fix Your Own TV" books on the newsstands these days, but it is worth a try. Many service organizations and set manufacturers have spent much time and money in an attempt to educate set owners against the advisability of tinkering. However it is no easy task stopping the home tinkerer.

I have found the best way to impress a customer with the fact that he would be foolish to tinker with his set is to demonstrate the high voltage and let him see for himself the hazard that he might be exposed to.

The most dramatic way to do this is to hold the base of an incandescent lamp bulb near the cap of the high-voltage rectifier tube. Since an incandescent lamp is not a vacuum tube, but contains an inert gas at just a little below atmospheric pressure, a brilliant display of lightning-like sparks can be obtained inside the bulb as the gas ionizes and lights up by capacitive coupling through your body to ground. A 200-watt clear glass bulb makes the most effective display, giving 2- or 3-inch purple sparks which crackle to each of your fingertips as you hold the glass bulb.

This trick has never failed to impress my customers, and once they see this demonstration we do not have much "people trouble" any more. There is no hazard to yourself in making this demonstration, and you cannot even feel it. But a little facial grimacing while the sparks are licking your fingertips might leave the impression that you are supernaturally qualified for such hazardous work. At the very least, this demonstration has an advertising value that will help the customer remember you the next time the set needs a repair.

*(But don't do it if junior is present; he might get ideas.—Editor)* END


The vertical blanking bar as it appears between frames of a TV picture.

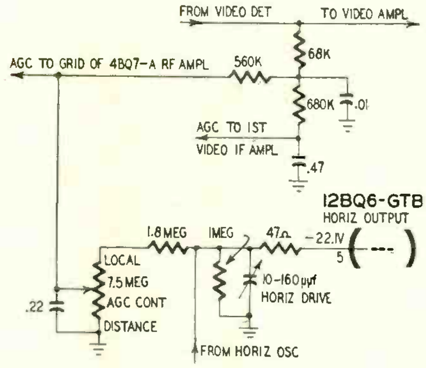



**Fig. 1.—The agc divider circuit in some versions of RCA KCS95 chassis.**

By observing the sound and picture of a television receiver as its many controls are varied, the service technician can obtain a pattern or profile of a defect that will pinpoint the trouble to a particular stage and sometimes even to a particular component. A TV set is composed of many interdependent circuits—low- and high-voltage power supplies, keyed agc, etc. Thus, some knob-twisting and straight thinking will usually dovetail the individual symptoms and produce a dependable generalization even before the back cover is removed. At the very least, much wasted servicing time will be eliminated.

Knob turning is of little value if it is practiced on defective sets only. The technician must get the "feel" of the controls on properly operating sets of different makes and models. This is especially true of the independent technician who may be called upon to repair any set from an Admiral to a Zenith.

Almost regardless of the defect, the channel selector provides the first significant clue. Observe the picture and sound as you turn to inactive and both weak and strong active channels. On each channel, vary the fine-tuning control through its entire range, generally about a 2-mc oscillator variation. The various channels will help isolate interference and intermittent effects, smearing, sync instability due to signal overload or insufficient signal strength, agc action, sound bars in the picture, raster troubles, hum, buzz and many other effects. In conjunction with these controls, the oscillator slug of an individual channel can be varied where a defect appears due to improper oscillator adjustment on that channel.

Thus, the channel selector and fine tuning offer an important clue—not necessarily as to what is wrong but as to what is not wrong. Circuits as remote from the front end as the high-voltage power supply have been affected by signal strength (through the effect of sync amplitude on the horizontal afc and oscillator circuits).

The picture or contrast control is probably the next most important one on the front panel. Here, knowledge of where it is located in the set is important. It is commonly found in the cathode circuit of the video amplifier, with some sets having it in the video amplifier plate circuit. Older receivers made great use of the contrast control in agc circuitry. The location of this control is important in terms of the takeoff points for the intercarrier sound and the sync signals. Varying the contrast control should produce a wide range in shading between the blacks and whites in the picture.

Generally fed from the video amplifier output, the sync pulses pass through the sync circuits and control the timing of the horizontal and vertical sweep circuits. Here two other front-panel controls come into play. Normally, slightly varying the vertical hold control should not cause loss of vertical sync. When the vertical hold is critical or unstable, roll the picture and hold it so you can study the vertical blanking bar (see photo). This is the blacker-than-black region and it should appear as such; observe the strength of the vertical sync and equalizing pulses. Vary the contrast control and observe the change in sync strength. Letting this bar roll also gives a quick check of vertical linearity.

The effect of varying the horizontal hold control will differ greatly with the type of horizontal afc circuit used. However, in normal operation the pull-in and hold-in effects should be strong.

Thus, for example, where the contrast is normal and vertical and horizontal sync poor, the suspected area falls between the sync takeoff and the input to the sweep circuits. Also, where horizontal hold is poor and vertical hold good, the technician may *initially* assume the sync circuits are operating properly.

The brightness control varies the dc bias on the picture tube from cutoff to maximum brightness (often producing blooming). Observe its effect on sync stability and picture contrast. Experience with the contrast and brightness controls will often permit the technician to appraise the condition of a picture tube.

One other important front-panel control is that of volume (and sometimes tone). Since this controls the amplitude of the audio output, varying it offers a clue in cases of audio coupling to the video circuit. Sound bars often develop at high volume levels. Also, in a no-picture no-sound condition, the technician can often detect a difference in the sound of hiss produced by trouble in the tuner or in the if amplifier.

On the rear apron of a TV set the number and type of controls vary considerably. Observe which portion of the picture is affected by the height and vertical linearity controls and to what extent. Certain particular components will be found to exert a great influence over picture height and linearity.

Check the width control, especially in cases of insufficient high voltage. It appears in several forms, most popular being a variable inductive load on the flyback transformer or a variable screen-grid resistor for the horizontal output tube. A defective width coil not only causes horizontal trouble but could affect any stage fed from the boost circuit. In many cases a defective width coil can load down the low-voltage power supply, producing many strange symptoms. Varying it often brings out an intermittent condition that might otherwise be overlooked.

In the same general circuit is the horizontal linearity control. Check this out where it produces no noticeable effect.

The horizontal drive control should be checked wherever ringing or drive lines appear and in cases of insufficient high voltage. It could affect width, keyed agc action and circuits fed with bootstrap voltage.

Many sets have noise controls. For example, the Capehart CX-43 has a noise-rejection control in the cathode circuit of the 3BN6 sound detector (some manufacturers call this the AM rejection or the buzz control). In many sets the sensitive sync circuits are protected by noise-rejection networks; recent Admiral sets have a noise gate control in the 6CS6 sync separator circuit. Thus, where there appears insufficient AM limiting or general sync instability, study the effect of the noise-rejection controls.

One last common control is the agc potentiometer (Fig. 1) or local–distance switch. This control determines the amount of agc applied to rf and if circuits and affects the gain of the receiver. It has an important effect in very weak and very strong signal areas.

Thus, we see, although somewhat superficially, how the various circuits "lean" on each other. The technician who varies the many controls and applies logical thought to the effect each produces will be considerably informed before even a single component is tested or measurement made.

## Picture overload

*A DuMont RA-164 came in with a complaint of insufficient brightness. It turned out that the picture appeared dark as a result of picture overload caused by improper agc action. Varying the agc potentiometer had little or no effect on the picture. I checked the alignment of the receiver and, except for certain settings of the agc control, the response was fine. At these settings the response seemed to peak. A check at the agc test point showed less than 1 volt, indicating that the trouble is picture overload.*

*The only other symptoms are poor horizontal lock-in and critical horizontal sync. A thorough check of the set indicates everything is in order except for the agc.—I. S., Chicago, Ill.*

Your symptoms leave little doubt that insufficient agc action is the cause of the trouble. The peaking you observed during alignment was most likely the result of regeneration in the if's caused by the large-amplitude signal. The poor sync stability is most likely the result of sync compression.

Fig. 2 shows the agc amplifier circuit and the normal dc pin voltages. You state that you measured less than 1 volt at the agc test point. For a moderately strong signal, you should measure about –6 volts or so. If replacing the 6AU6 does not help, replace C212, a 1-μf capacitor with a notorious reputation for becoming defective. Closely allied with this unit is C215, a .001-μf 2-kv capacitor that also opens far more than might be expected. One other good possibility is C296, a 4-μf 200-volt cathode bypass capacitor. However, this capacitor opening produces cathode degeneration which brings on sync instability rather than picture overload. But as so often, happens, two or more of these components might be defective. Thus, check the above components and dc voltages.

## Installing uhf strip

*I recently was called on to install uhf strips in an Emerson model 1106D. This is ordinarily a simple job, but I have been unable to get anything but the faintest of pictures and a great deal of snow. I used R type uhf strips recommended by a local distributor and now wonder if perhaps some other type might perform better.*

*I have other technicians in on this but no one has improved the picture. My uhf antenna installation is known to be good. Some attempts have been made to measure voltages and check signals in the uhf strips but my test equipment could not cope with it.—M. P., Lexington, Ky.*

There is nothing wrong with using R-type uhf strips. They operate by double conversion in which the incoming signal beats with a chosen harmonic of the vhf oscillator and converts it to a vhf signal.

Make sure the oscillator slug and spring are properly positioned. Check to see that the male contact pin is not bent. Look for a corroded ground strap or drum detent disc and make a mechanical check for shorted leads, open connections and cold solder joints. If possible, try using one or more additional crystals, keeping the exact dress.

The trouble is often due to misalignment. Alignment can be done with the aid of a station signal. Remove about three sets of strips directly opposite the uhf strips. After the set is warmed up, adjust the oscillator slug for best picture and sound. Then, using a nonmetallic tool, adjust the uhf preselectors, through the opening made by removing the strips. Adjust the antenna input and uhf preselector for maximum contrast. During these adjustments use very loose antenna coupling. Then adjust the harmonic selector and if coil for minimum snow.

Adjusting the harmonic selector is very critical, so tune slowly. The if transformer tunes rather broad. When adjusting the above slugs, work carefully. Turning them out too far will permit the slug tension spring to snap out and it is difficult to reposition it.

## High-voltage failure

*I have a peculiar trouble in a Philco model 50-T1600. There is no high voltage but every component in the high-voltage circuit checks good. With –18 volts on the grids of the horizontal output tubes, the drive is sufficient.*

*When the set came in, R104, a 4,700-ohm 1-watt resistor in the cathode circuit of the damper (Fig. 3), was burned out. I replaced this resistor but it immediately began to smoke. I don't want to replace it with a higher-wattage unit because I have seen it operate in other sets. The 5V4-G damper is running very hot. I have checked the damper circuit components but all check out good. I am passing this along for any suggestions you might have.—W. S., Portland, Ore.*

The key to this problem is the overheating of the 4,700-ohm resistor. In almost every case where there is no high voltage and this resistor overheats, replace C86, a 40-μf capacitor connected to one side of the filter choke in the low-votage power supply. This capacitor provides a bypass to ground for signals in the damper circuit. When

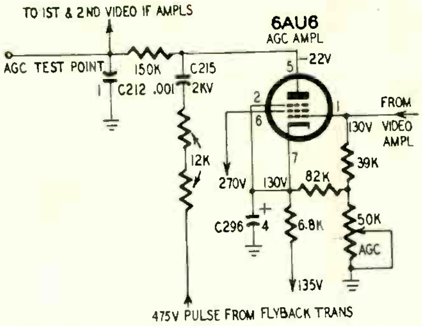



**Fig. 2—Du Mont RA-164 agc amplifier.**

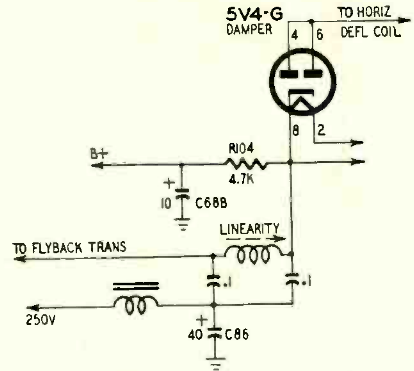



**Fig. 3—Horizontal linearity and low-voltage filter circuit in Philco set.**

it decreases in capacitance or—more likely—opens the current flow is through R104, causing it to overheat. If you check, you will notice that the boost voltage is considerably higher than normal. When replacing C86, also replace R104 and C68B.

## 5AXP4 ion burns

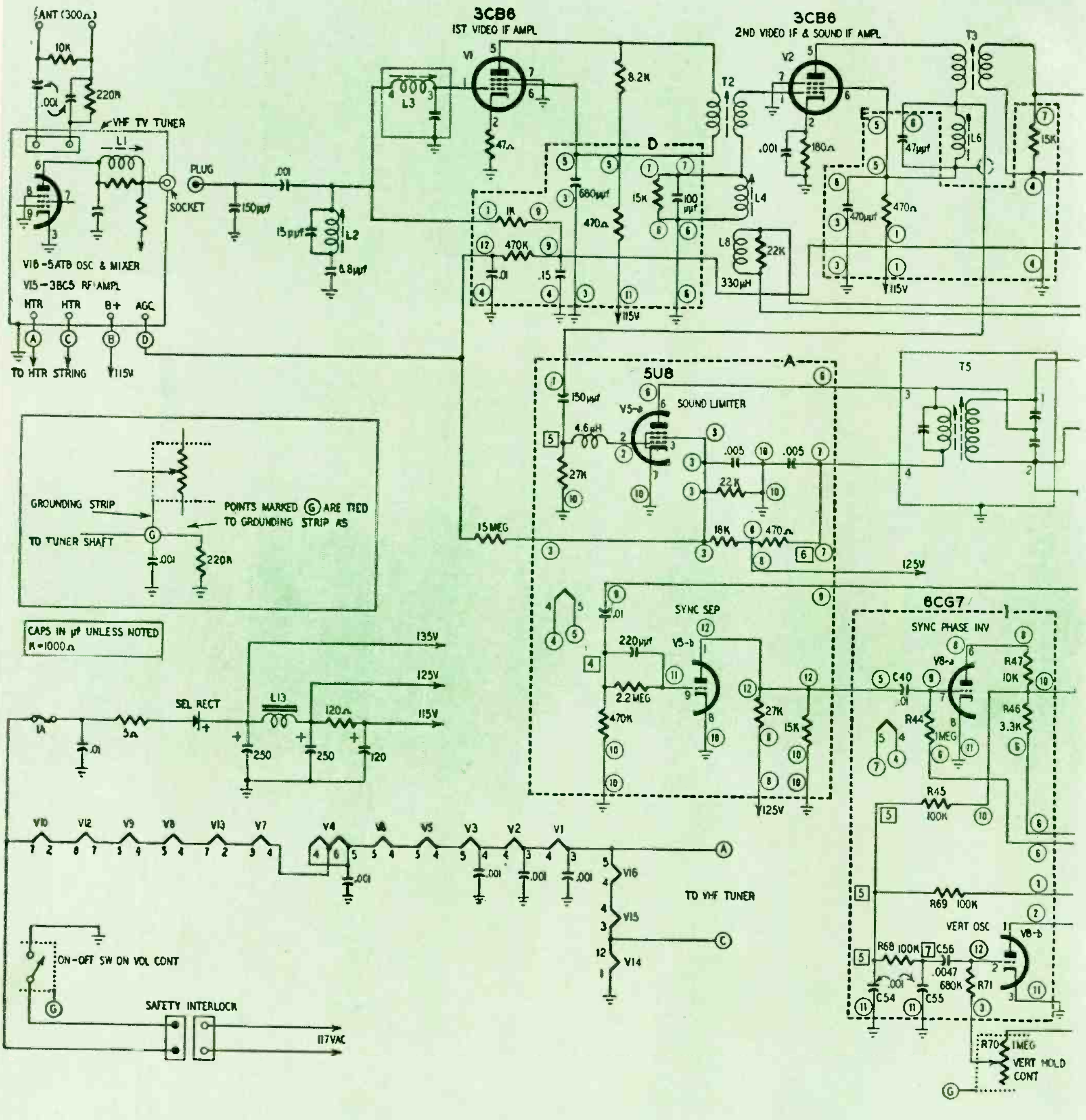
*I have recently purchased a 5AXP4 universal replacement picture tube. After only a few weeks' operation a small brown spot appeared on its face. It looks like an ion burn. Recently it has been getting larger and I have stopped using it. While in operation it worked very well and came in handy.*

*I have checked with service technicians and many of them have had a similar experience. My guess is that I am using the tube in circuits where it was not intended. However,* Radio-Electronics *stated that it could replace any tube. What is causing the ion burns?—P. L., Baltimore, Md.*

This letter is one of several on the same subject. The spot may be a true ion burn, caused by negative undeflected ions in the beam striking the screen. In making a universal type picture tube the ion-trap magnet was intentionally omitted to make setup easier. Thus, the trouble is not so much in the tube design as it is in operation.

At all times, keep brightness as low as possible. This reduces the beam current. In some cases the spot is not actually a burn, but a darkened area caused by vaporized metal from around the anode aperture. In any case, this does not indicate a defective tube or one nearly so. It is merely a warning to keep the beam current (brightness) to as low a level as is suitable. END

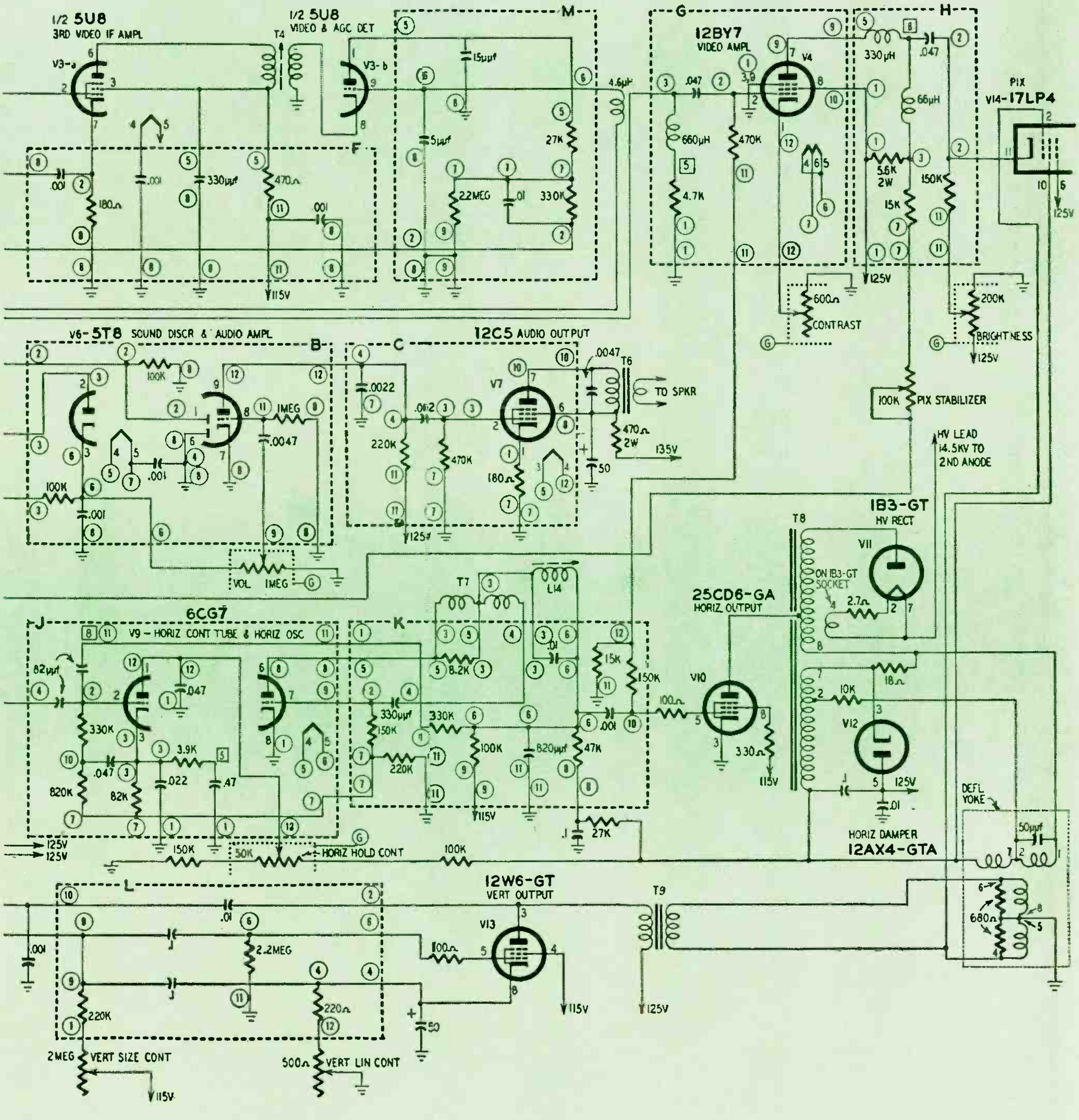
# Emerson 120306 TV chassis



This Emerson chassis is similar circuitwise to the 120245, 120256, 120259, 120269 and equivalent chassis. Its most striking feature is the combination of modular and printed-circuit construction. (See cover photo and the aricle "Now—A Modular TV Receiver" on page 37 of this issue.)

The modules are enclosed within heavy dashed lines in the diagram and each is coded with a letter which identifies it. For example, module A contains the tube and resistive and capacitive components for the sound limiter and the sync separator. Each module consists of several wafers of circuitry and components connected by 12 vertical risers which make it resemble a modern steel-and-concrete building under construction. The risers connected to external circuits are identified by circled numbers. Numbers within squares are not connected externally.

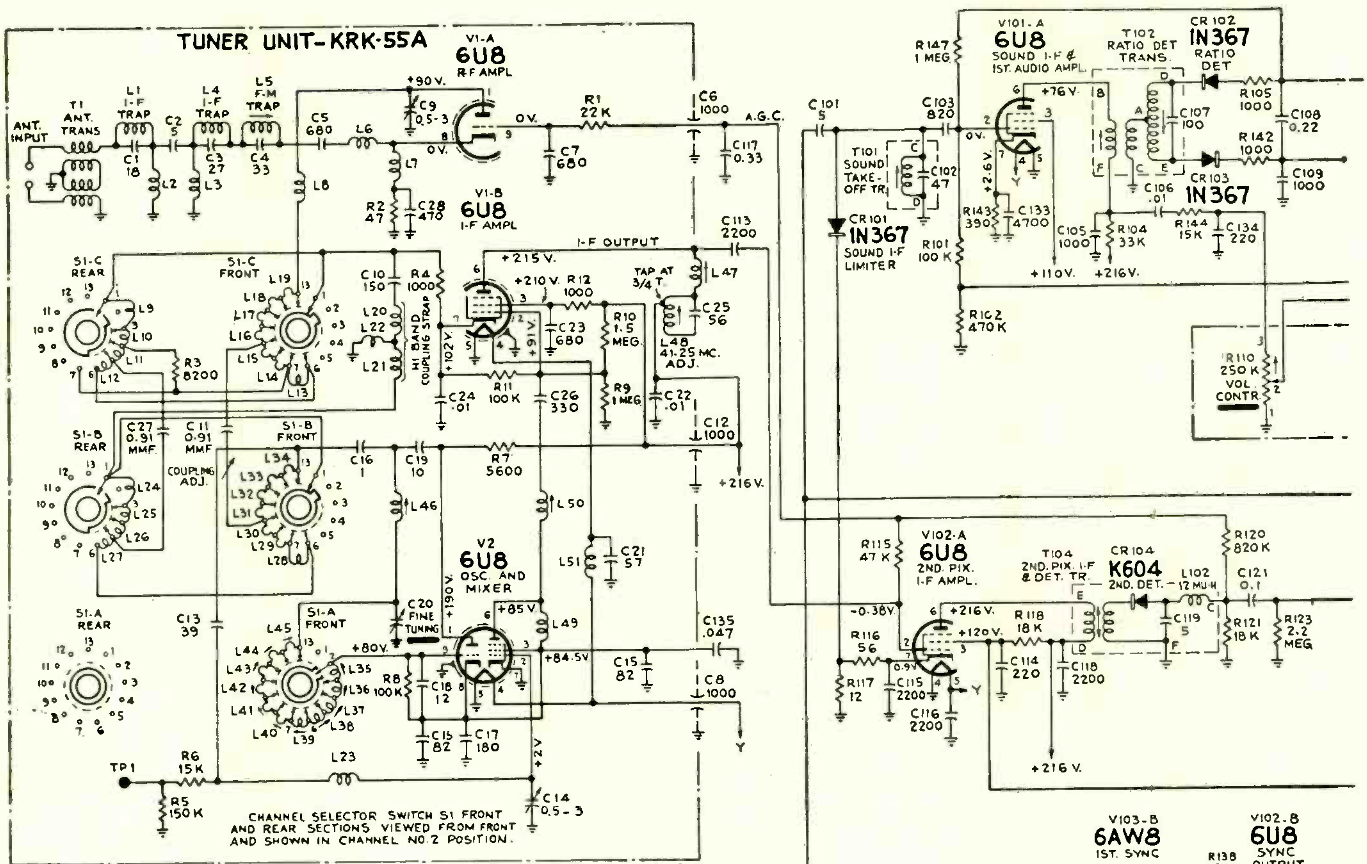
# New Set Features Modular Construction

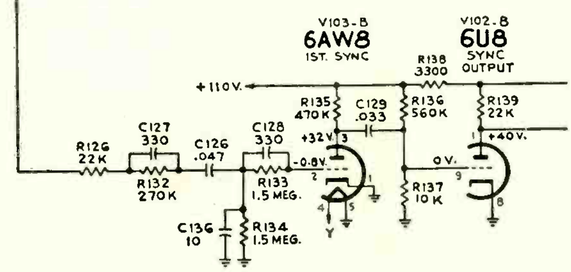


A reflex circuit combines the second video and first sound if amplifiers in one single-purpose tube. The video output containing the sound if (risers 6, module M) goes to the video amplifier through the 4.6-μh rf choke and L8. L8 is coupled to L4 in the grid return of V2. This combination acts as a 4.5-mc sound trap in series with the input to the video amplifier and as a sound take-off transformer for V2. T2 and T3 are tuned to around 45 mc and L4 and L6 are tuned to 4.5 mc, the intercarrier sound intermediate frequency. The signals developed across T2 and T3 and across L4 and L6 do not interact with each other. All controls sensitive to hum pickup or whose shafts would be hot if connected directly to chassis have their shields and shafts connected to a common grounding strip (G) connected to the chassis and B-minus bus through 220,000 ohms bypassed by a .001-μf capacitor.

# RCA PERSONAL TV RECEIVERS

All models are vhf receivers identical except for cabinet color. A removable stand can be used to support the set and hold it at an angle convenient for viewing. An adjustable rod type antenna attached to the cabinet is adequate for use in many locations. Connections for an external antenna are provided for use in areas where one is required. These sets are easy to remove from the cabinet for servicing. The front and rear chassis can be separated so all components are readily available while the set is still in operation.



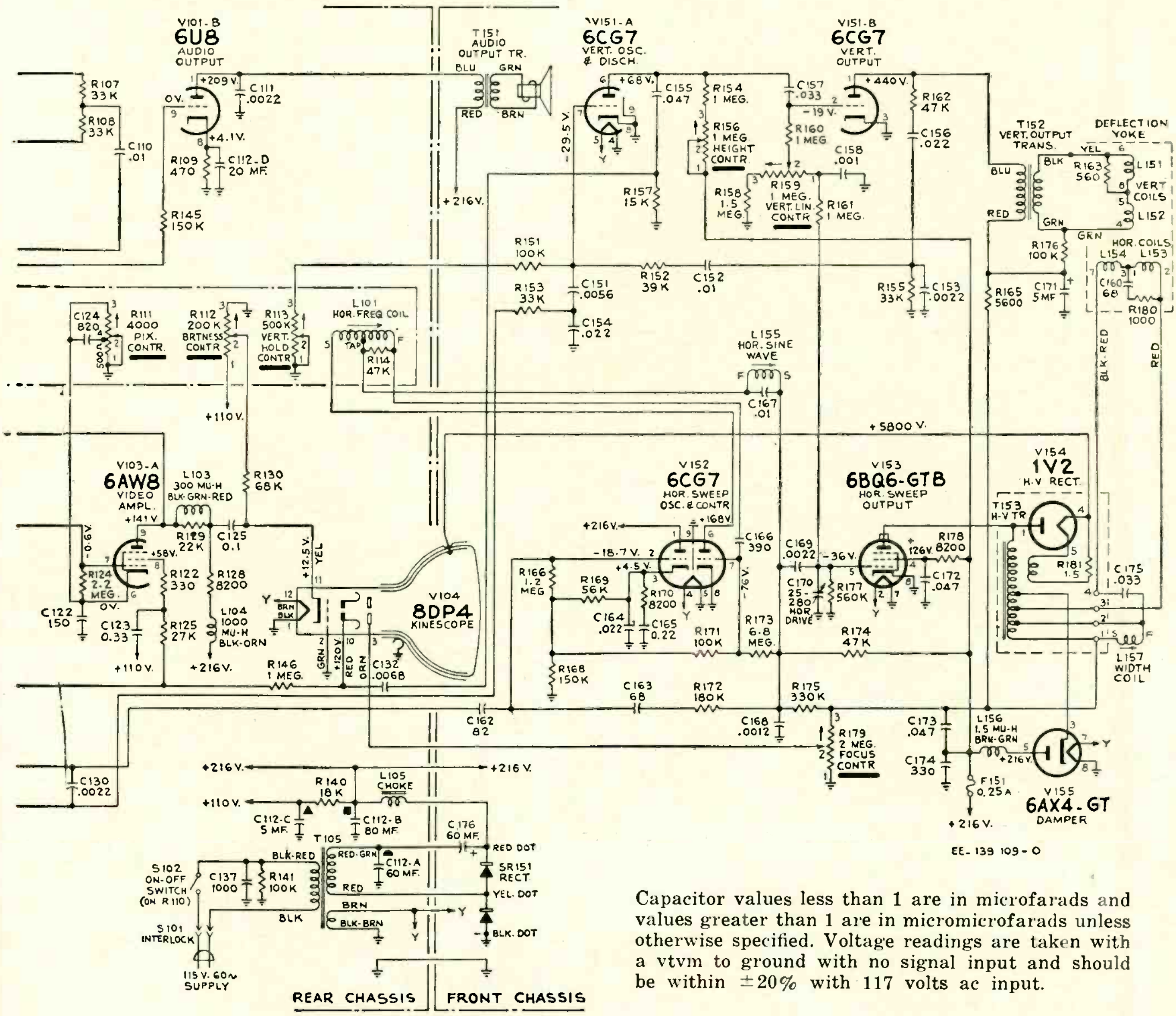




Like many of the newer portable and table-model TV sets, the controls are mounted under a panel on the top of the cabinet. Contrast, brightness, volume and horizontal and vertical hold controls are provided along with the fine-tuning and channel selector.

The 45-mc if circuit is combined with a well-trapped front end to minimize interference from FM and adjacent-channel TV stations. The FM trap is slug-tuned and is adjusted to the frequency of the interfering station. The if trap coils (L1 and L4) are tuned for minimum response to 41.25- and 47.0-mc signals, respectively. L1 and L4 are adjusted by spreading or crowding the turns.

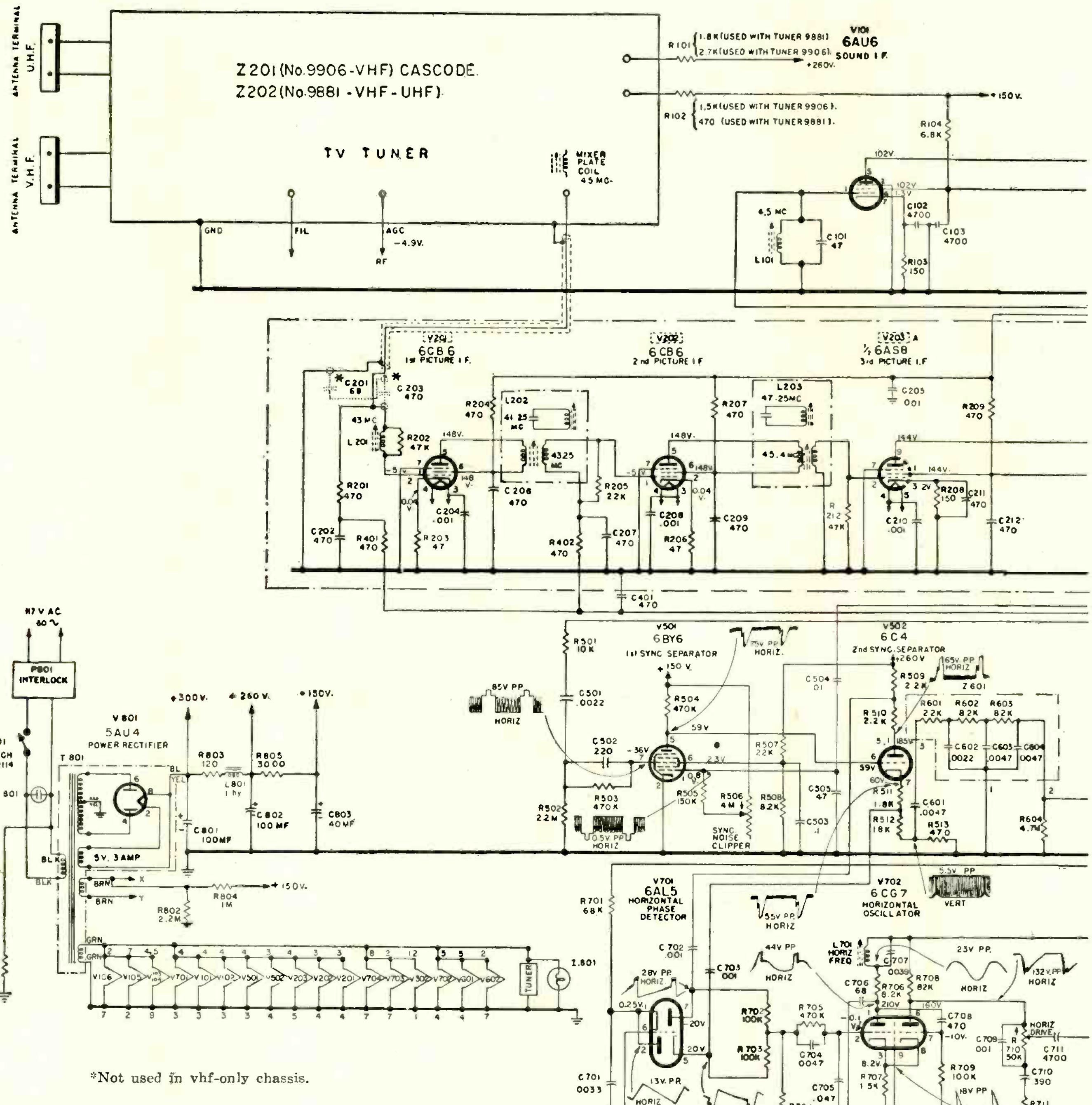
# Models 8-PT-7030, 8-PT-7031, 8-PT-7034

These models are only slightly larger than the average table-model radio. They are only 10½ inches wide, 9½ inches high and slightly less than 13 inches deep. The 8DP4 picture tube has a diagonal of 8½ inches and a viewing area of approximately 36 square inches. The 8DP4 has magnetic deflection with a 90° deflection angle and electrostatic focusing. The chassis has 11 tubes (including the 8DP4), 4 crystal diodes and a voltage-doubler type selenium rectifier to provide performance comparable to a standard 24-tube circuit.




Capacitor values less than 1 are in microfarads and values greater than 1 are in micromicrofarads unless otherwise specified. Voltage readings are taken with a vtvm to ground with no signal input and should be within ±20% with 117 volts ac input.

# HOFFMAN MARK 5

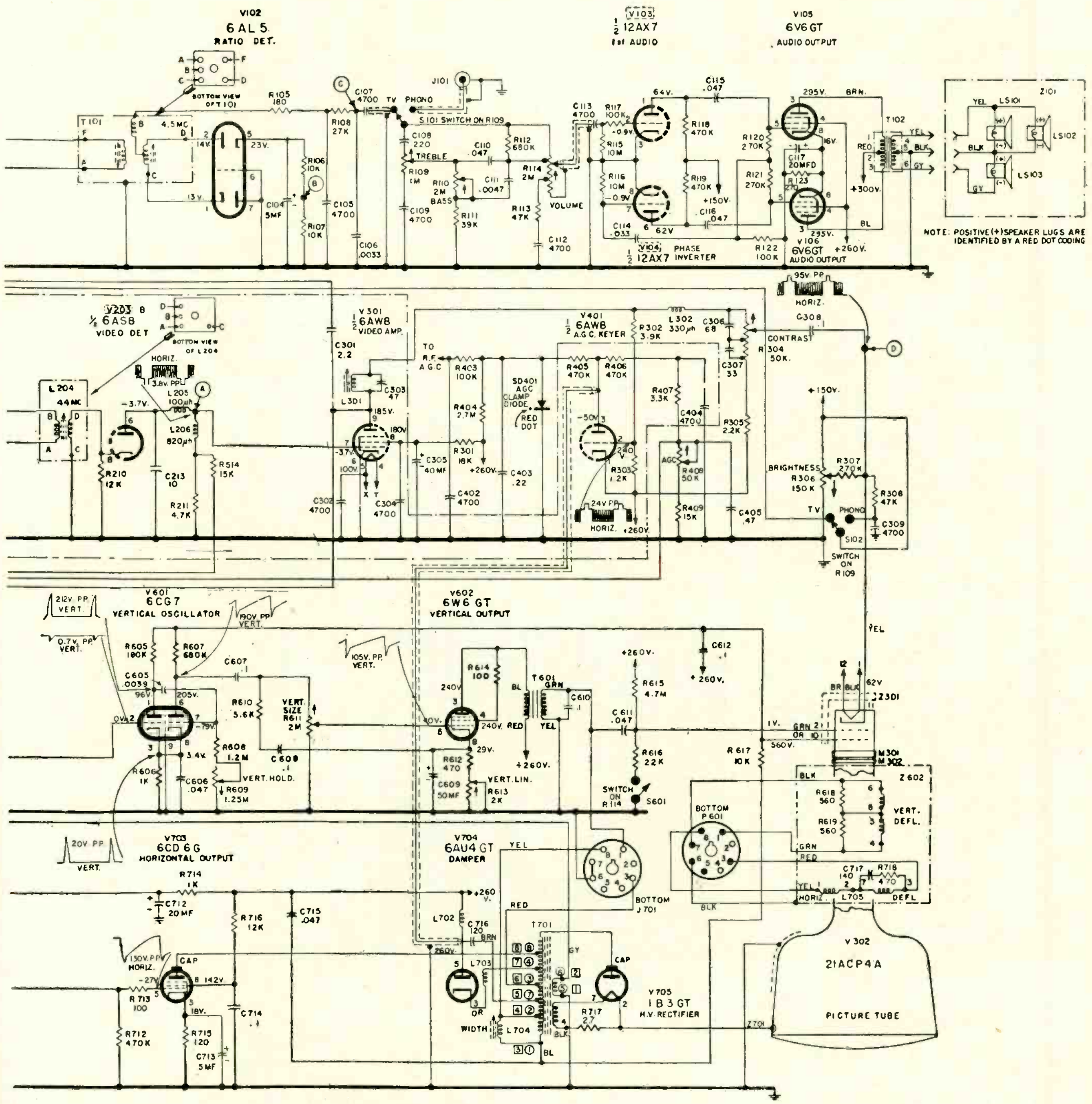


*Not used in vhf-only chassis.

The Mark 5 models are available with the 419 chassis with a vhf tuner or the 419U chassis with a vhf-uhf tuner. It features a 10-watt push-pull af amplifier with three speakers. Cascode tuners are used in both chassis. The vhf tuner has a 6BQ7-A rf amplifier and 6AT8 mixer–oscillator. The tuner in the all-channel chassis has a 6BZ7 rf amplifier, 6U8 mixer–oscillator, 6AF4 uhf oscillator and a crystal uhf mixer.

A three-stage if amplifier with delayed agc provides optimum performance under varying signal levels. Sync stability is insured by cascaded sync separators and a noise-clipper circuit. A control sets the operating point of the noise clipper. In some models, this control is a potentiometer on the secondary control panel. In others, it is a push-pull switch combined with the contrast control. It should be pushed in for normal reception and pulled out in fringe areas.

# Chassis 419, 419U




A switch between the CRT grid and ground eliminates the spot of light that often remains on the screen when the set is first turned off. This switch is ganged to the on–off control. Opening it reduces the grid bias, accelerates the residual electron beam and quickly discharges the high-voltage filter capacitor, thus killing the spot.

**Service notes:** Waveforms and socket voltages are taken with the set receiving an average signal and controls at normal settings. Socket voltages are measured with vtvm to ground and are positive unless otherwise specified. They many vary within a ±20% tolerance. Capacitor values shown as decimals are in $\mu$f and whole numbers are $\mu\mu$f unless specified. Boxed terminal numbers on flyback transformer are for part 5177A-2 used in later production. Circled terminal numbers are for part 5177A used in early production.

# UNDERSTAND

## YOUR COLOR BAR GENERATOR

*Analyzing the NTSC color signal*

By ROBERT G. MIDDLETON*

THE NTSC color bar generator is so named because it provides an NTSC color bar signal. This means that a properly adjusted color TV receiver will produce bars of saturated color on the screen of the color picture tube when energized by the output from the generator. Color bar generators other than the NTSC type are also available, usually at lower cost, but do not provide the standard NTSC signal and most of the color bars will not be pure or saturated.

To understand the NTSC color bar generator, let us refer first to the bar display in Fig. 1. Eight bars are shown, comprising the three primaries: red, green and blue; the three complementaries: cyan, magenta and yellow; the two principal luminance signals: black and white. In addition to these bars, an NTSC color bar generator usually provides the color-difference signals: I, Q, R − Y, B − Y and G − Y. An instrument of this type may also provide a (G−Y)/90° signal, another useful test signal, discussed at a later point.

Let us review the appearance of the color bar signal on the screen of a wide-band scope. Sync and burst are provided, as shown in Fig. 2, to lock the horizontal and color sync sections of the color TV receiver properly. The sync and burst supplied by the color bar generator are in all respects similar to the sync and burst seen at the second detector (Fig. 3) of a color receiver tuned to a color TV program. The burst is somewhat contaminated by noise and crosstalk with the picture and sound signals. However, the technician will soon become familiar with these imperfections.

Note carefully in Fig. 2 that the *red* bar appears as a 3.58-mc sine-wave signal superimposed upon a square wave. However, the *white*, *gray* and *black* signals have no 3.58-mc voltage component and consist solely of a square-wave voltage. This square-wave voltage is termed the Y or luminance voltage. The various colors reproduced on the screen of the color picture tube are not pure and saturated unless the color bar signal contains the proper Y voltage. This is the chief distinction between an NTSC type of color bar generator and a rainbow type of generator. The rainbow generator provides a 3.58-mc signal only, with the

*Chief field engineer, Simpson Electric Co.

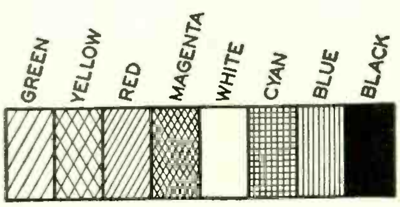



**Fig. 1—Display from NTSC color bar generator. White signal is a reference white, as used in color TV transmitters.**

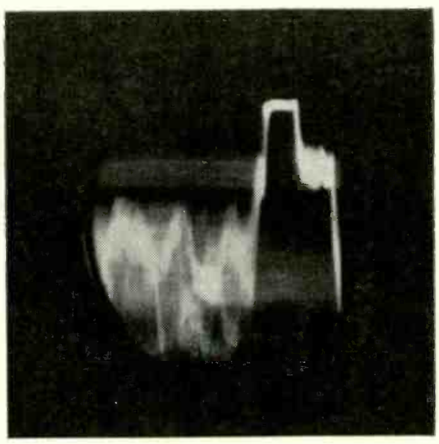


**Fig. 3—Horizontal sync and burst at output of video detector of color set.**

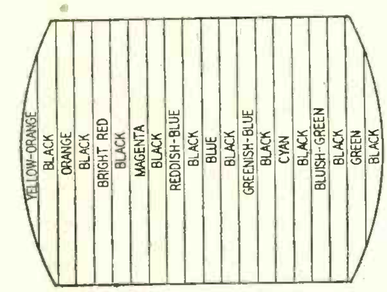



**Fig. 5—Succession of hues from typical rainbow type color bar generator.**

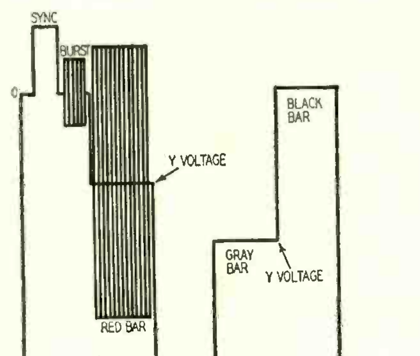



**Fig. 2—Red bar appears on wide-band scope as a Y component upon which is superimposed a 3.58-mc chrominance signal.**

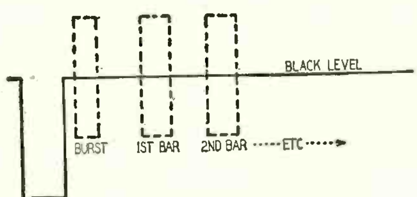



**Fig. 4—Output from rainbow color bar generator—a succession of 3.58-mc signals centered on the black level.**

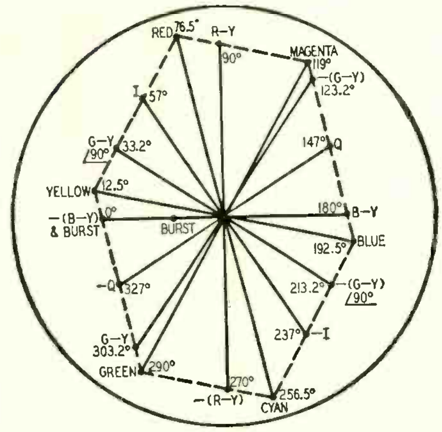



**Fig. 6—Vectorscope type display shows the various colors and color-difference signals as seen on a scope screen.**

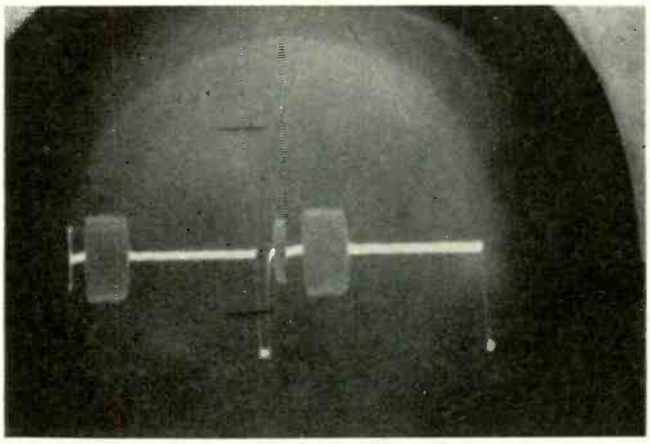


Fig. 7—Output from an NTSC color bar generator with sync, burst and a single color-difference bar.

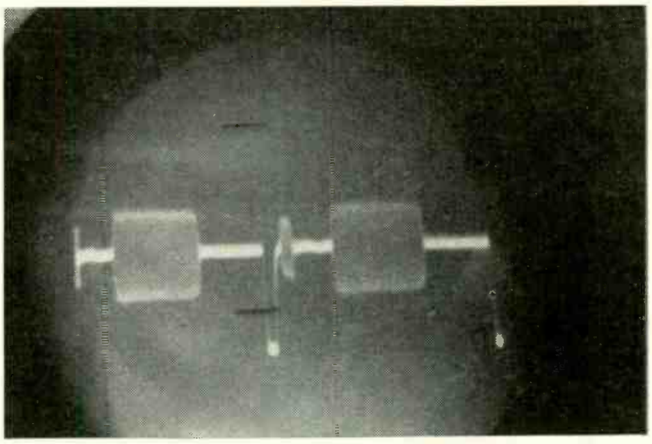


Fig. 8—Output from Fig. 7 generator with different-hue color-difference bar.

Y component. This distinction is shown in Fig. 4, which should be compared with Fig. 2.

The successive bars differ in hue because the 3.58-mc voltage varies in *phase* from one bar to the next. Fig. 5 shows the variation in hues obtained from a typical keyed-rainbow type of generator. The phases of the principal colors and color-difference signals are shown in Fig. 6. This is obtained by applying the output of the R − Y detector to the vertical amplifier and the output of the B − Y detector to the horizontal amplifier of the scope.

Fig. 7 shows the output from an NTSC color bar generator when a single color-difference bar is present in the output. Fig. 8 shows the output when a different color-difference bar is present. Fig. 9 illustrates the output form when the two color-difference bars are present simultaneously. The only difference between the two color-difference signals is a difference in phase, as indicated in Fig. 6.

When we proceed from the color-difference bars, such as R − Y, B − Y, etc., to the saturated color bars such as red, green and blue, it is required that the 3.58-mc signal not only vary in phase, but also in relative voltage for each color, as seen in Fig. 10. The spaces for white and black have zero 3.58-mc voltage. When the proper Y voltage is added to these 3.58-mc signals, the full color signal is obtained. Fig. 11 shows the Y component which corresponds to each of these color bars.

## Readjusted values

To deliver an NTSC signal, the color bar generator is adjusted to provide the *readjusted chrominance values* shown in Fig. 6. These require a bit of careful explanation. When the readjusted chrominance values are used to produce a bar pattern, the output from the generator appears as shown in Fig. 12 (as seen on the screen of a wide-band scope). The complete NTSC color signal is based on transmission of 75% saturated colors. A 100% saturated color is rarely transmitted, since it rarely occurs. Thus, the output from a color bar generator is adjusted to provide a 75% saturated signal.

Note that the black level is 10% below the porch level of the sync pulse. Green extends up to the black level; red, magenta, blue and cyan extend into the blacker-than-black region. The lower excursions of the yellow and cyan signals are on the same level as the white signal. This is termed the *reference white level* and is used in this manner to adjust the level of the chrominance signal properly with respect to the level of the Y signal. There is a 20% whiter-than-white region between the reference-white and the zero carrier levels. This residual is provided in the NTSC transmission to avoid sync buzz in intercarrier receivers.

The setup interval is the region from 0% to 100% as shown along the ordinate. In terms of setup units, the sync pulse occupies an excursion of 40% and extends 50% above the black level. The black level is 10 setup units below the level of the back porch of the sync pulse. The burst has the same excursion as the sync pulse (40%); the when a different color-difference bar

The color bar signals in Fig. 12 are NTSC signals and are a modified signal in which R − Y is reduced to 0.877 of its original value and B − Y to 0.493 of its original value. The reason for this reduction of chrominance voltages with respect to Y voltage is to avoid overmodulation on

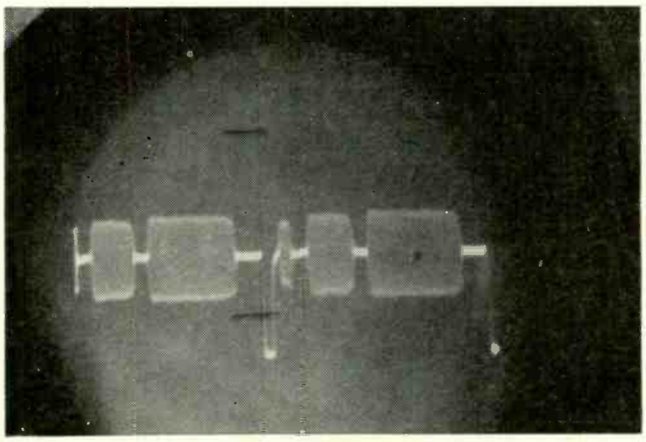


Fig. 9—Outputs of Figs. 7 and 8 produced simultaneously by generator.

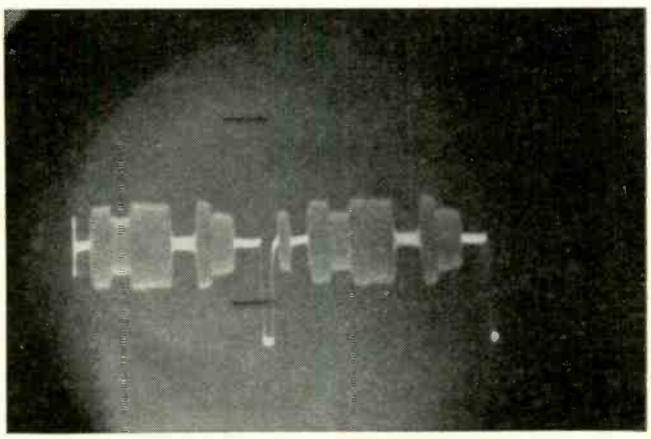


Fig. 10—The 3.58-mc color components. Black and white are at zero voltage.

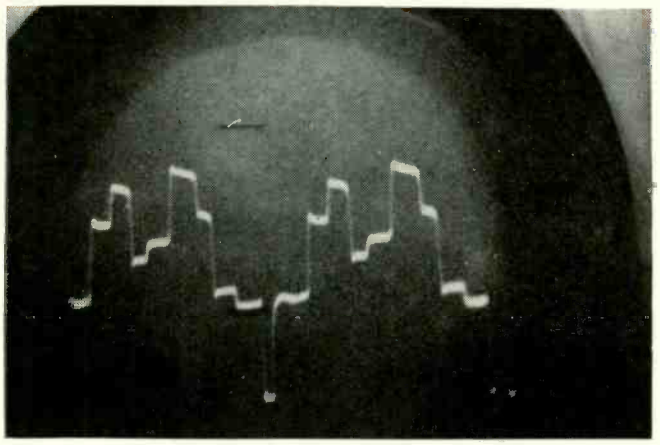


Fig. 11—This Y signal is added to 3.58-mc signal for complete color signal.

highly saturated colors (such as color bars), as illustrated in Fig. 13. The excursions of the Y signal and wave envelopes are shown with respect to the black level. When 100% saturated colors are transmitted without modifying the signal in accordance with NTSC specifications, overmodulation of as much as 79% can occur. But when the NTSC signal is used, overmodulation on 100% saturated colors is reduced to 33%. In practice, overmodulation does not actually occur since program material rarely reaches saturations greater than 75%, and 75% of 1.33 = 100%. A 75% saturated color transmitted by the NTSC signal reaches but does not exceed the white level.

In the NTSC system the Y signal is unmodified to permit normal operation of monochrome receivers. The R − Y and B − Y detectors (Fig. 14) receive the same drive from the bandpass amplifier. Since R − Y is reduced to 87.7% of its original value and B − Y to 49.3% to avoid overmodulation at the transmitter, the B − Y detector is adjusted to develop 1.78 times the output of the R − Y detector. The R − Y and B − Y outputs then represent correct chrominance balance and G − Y is obtained in correct proportions by mixing −0.51(R−Y) with −0.19 (B−Y). The B − Y level must first be set correctly with respect to the R − Y level before the G − Y matrix is checked. The relative settings of the chrominance and luminance controls are made so that approximately 12% more gain is applied to the color signal than to the Y signal. In this manner, complete signal balance is restored, as shown in Fig. 15.

The chrominance and luminance signals are processed in separate signal channels, hence the operator has control of each signal level. The contrast control is set to provide a normal black-and-white picture of satisfactory contrast. The color-intensity control is then set to obtain the most satisfactory flesh tones, since the viewer is most critical of this aspect of color reproduction. If any color distortion is present, it is preferable to relegate the distortion to hues and saturations other than flesh tones. Since an NTSC signal is processed by the signal circuits, the output from the B − Y detector is made proportionally greater than the output from the R − Y detector, to restore color balance. Under these circumstances, the G − Y matrix then develops a green-signal output with proper color balance. The saturation of the NTSC signal is less than the theoretical value, which requires that the color-intensity control be advanced proportionally to restore color saturation.

We now proceed to a closer inspection of the mechanics of color bar generation. Bear in mind that a color bar generator produces the same end result as the transmission of a test pattern from the color TV station. In an R − Y B − Y transmitter Y is obtained by adding 0.3 red voltage to 0.59 green voltage and 0.11 blue voltage in the Y matrix. The −Y signal is obtained by passing Y through a phase inverter. R − Y is obtained by adding the red voltage and the −Y voltage in the R − Y adder. B − Y is obtained by adding the blue voltage to the −Y voltage in the B − Y adder. The output voltages from the R − Y and B − Y adders are used to modulate the output from the 3.58-mc color-subcarrier oscillator. The modulated 3.58-mc voltage is then added to the

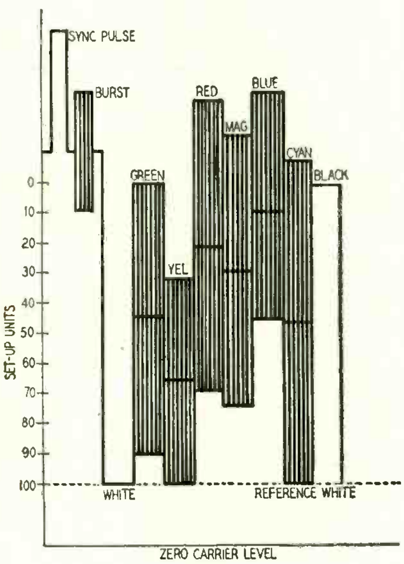



Fig. 12—NTSC complete color signal.

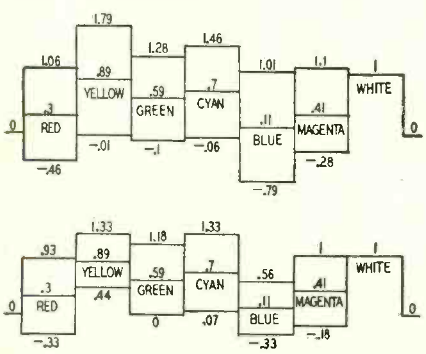



Fig. 13—Top, waveforms for bar generator providing 100% saturated color signals. Bottom, generator waveforms provide standard NTSC color signals.

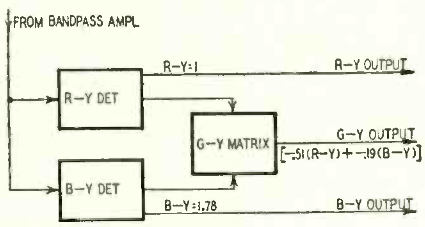



Fig. 14—The detector and matrix layout for obtaining correct color balance.

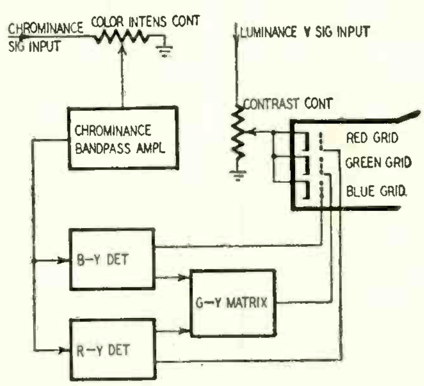



Fig. 15—Chrominance and luminance signals processed in separate channels.

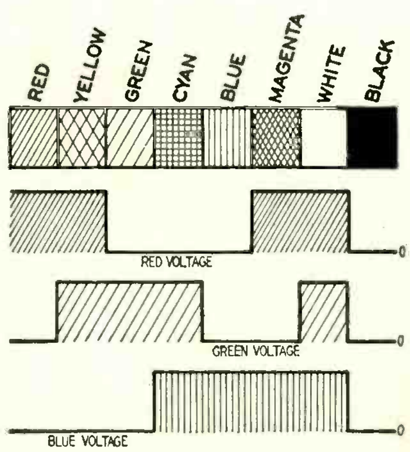



Fig. 16—Producing color range by keying red, green and blue multivibrators.

Y voltage in the complete-color-signal adder. The output from this adder is the complete color signal.

This same general arrangement can be used (and often is) in the design of color bar generators of the quadrature encoder type. However, in the color bar generator, the red camera is replaced by a multivibrator which provides a square-wave signal; likewise, the blue and green cameras are in their turn replaced by similar multivibrators.

We know that suitable mixtures of red, green and blue can produce any visible color. Fig. 16 shows how the red, green and blue multivibrators are timed to produce the hues of yellow, cyan and magenta, in addition to black and white. The square-wave outputs from the red, green and blue multivibrators shown in Fig. 16 are applied to the Y matrix and to the $R - Y$ and $B - Y$ adders. From the Y matrix is obtained the luminance signal $+Y$. This signal is passed through a phase inverter to obtain $-Y$ for the formation of the $R - Y$ and $B - Y$ signals. The $G - Y$ signal is recovered at the receiver from $R - Y$ and $B - Y$, hence $G - Y$ is not formed as such at the transmitter (bar generator). Instead, the green bar is transmitted as $-0.59(R-Y) -0.59(B-Y)$. The result is that the $G - Y$ signal phase appears as seen in Fig. 6. It might be supposed offhand that $G - Y$ would appear at an angle of 45° with respect to $-(R-Y)$ and $-(B-Y)$, but remember these are NTSC signals in which $R - Y$ is 1.78 times $B - Y$.

The end result of applying this NTSC signal to a properly adjusted color receiver is as if the red camera (red multivibrator) were connected to the red gun in the color picture tube, the blue camera to the blue gun, the green camera to the green gun. The only reason for the seeming complication of the signal system is to achieve compatibility and to compress the color signal within the existing black-and-white TV channel space.

The reader will perceive that the various chrominance signals depicted in Fig. 6 are the *resultant* of $R - Y$ and $B - Y$ voltages and could be generated by direct switching of chrominance phases instead of using a quadrature encoding process. This direct-switching approach leads to important simplifications and makes possible a more stable instrument for service use. END

In the *July*
**RADIO-ELECTRONICS**
**QUESTIONS ABOUT CROSSOVERS**
by *Norman Crowhurst*

# EISENHOWER HAILS INVENTOR

THE magnitude of American contribution to world-wide better living was illustrated March 16, in a letter from President Eisenhower to Dr. Lee de Forest heralding the 50th anniversary of the radio tube.

Dr. de Forest, through his invention of the grid vacuum tube in 1906, endowed the world with electronics—the industry which provides the most breathtaking constellation of human conveniences ever to stem from a single discovery.

The fruits of the De Forest basic invention include such long-accepted wonders as radio and television, long-distance telephony, talking movies, hearing aids, radio therapy and radio aids to air navigation.

The President's letter stated: "You must also feel great satisfaction in remembering your past decades of service and in anticipating future achievements that your handiwork has made possible." The great scientist, with over 300 patents granted to him, is approaching his 83d birthday, his way lighted by the endless panorama of miracles born of his genius.

Among the more recent "spin-offs" from the 1906 De Forest invention are electronic computers, radar, guided missiles and a veritable chain effect in new industrial electronic controls and automation.

A man of great personal warmth and vigor, Dr. de Forest, in his Los Angeles laboratory, holds indomitably to his research with a keen, youthful interest in the future.

THE WHITE HOUSE
WASHINGTON

March 16, 1956

Dear Dr. de Forest:

In this fiftieth anniversary year of a great invention, I congratulate you on your many contributions to scientific progress. Through your long and distinguished career you must have experienced many moments of pride that your imagination and talent furthered the development of modern radio, television and radar. You must also feel great satisfaction in remembering your past decades of service and in anticipating future achievements that your handiwork has made possible.

May you enjoy many more years in which to witness the fruit of your labors.

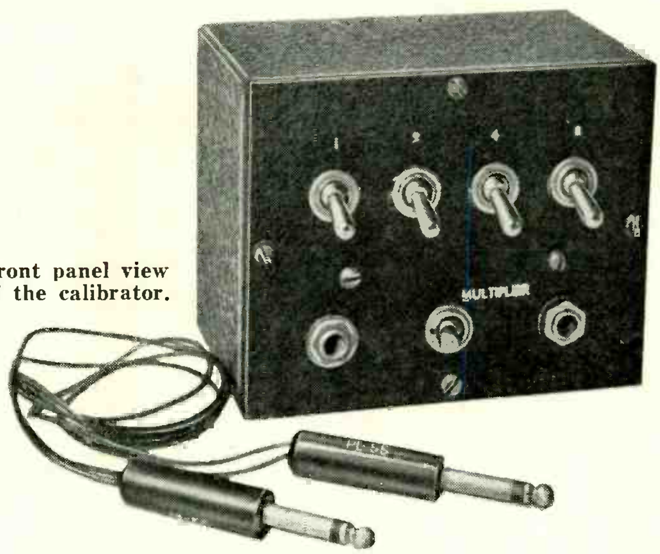
Sincerely,

Dr. Lee de Forest
c/o Rear Admiral Ellery W. Stone, USNR
American Cable & Radio Corporation
67 Broad Street
New York 4, N. Y.

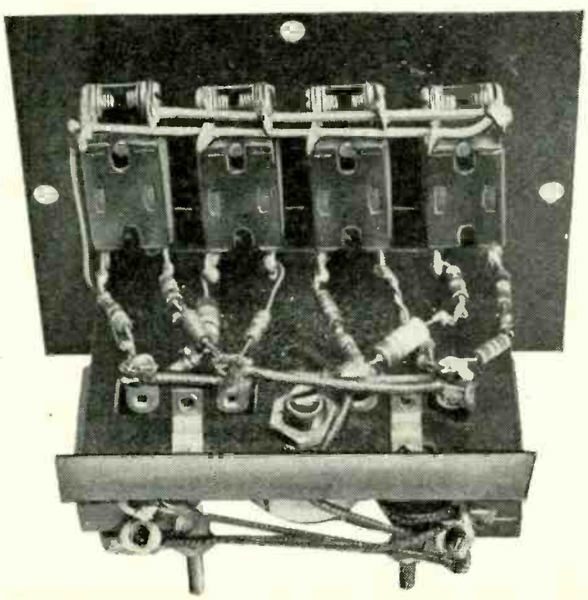
# PRESET AF CALIBRATOR

*Unit provides check frequencies from 100 to 15,000 cycles*

By I. QUEEN
EDITORIAL ASSOCIATE




**Front panel view of the calibrator.**



**Top view of shelf shows switch layout.**

MANY constructors have built some form of variable af oscillator. Completion of the instrument still leaves a big problem, *frequency calibration*. Many technicians do not have an oscilloscope or standard frequency source for checking with Lissajous figures. Line frequency is not satisfactory because its multiples are inconvenient; the submultiples cannot be used because they are so low.

This preset calibrator provides check frequencies from 100–15,000 cycles. Instruments can be calibrated far more quickly and accurately than with any dial-set method. Calibrator frequency is determined from values of resistance and capacitance.

The calibrator is a Wien bridge with fixed elements as shown in the basic circuit in Fig. 1. There are four arms.

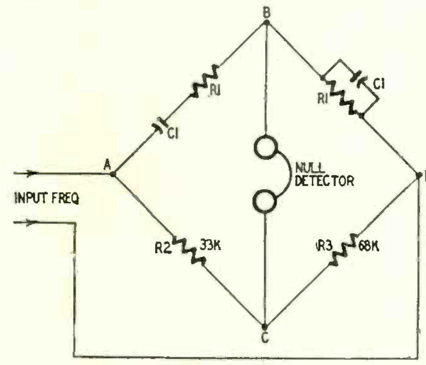



**Fig. 1—A basic Wien-bridge circuit.**

A–C and C–D are resistive with C–D twice the value of A–C. A–B and B–D are resistance–capacitance combinations. The bridge is balanced and produces a null at a frequency in *cycles* given by the formula

$$\frac{1}{2\pi RC}$$

where R is the resistance of R1 in megohms and C the capacitance of C1 in $\mu$f.

The complete circuit of the calibrator is shown in Fig. 2. A potentiometer has been added to compensate for minor deviations in the resistances from those required for balance. Resistors and capacitors corresponding to R1 and C1 (in Fig. 1) are fixed and are switched in pairs to vary the frequency. Changing the resistance varies the frequency

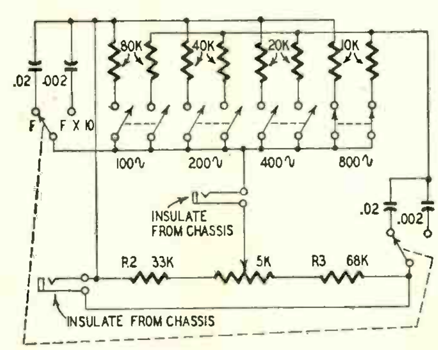



**Fig. 2—A null type frequency calibrator using the Wien-bridge circuit.**

in steps and changing the capacitance provides a multiplication factor to extend the range.

Four toggle switches select basic frequencies. These are 100, 200, 400 and 800 cycles in the low (F) range; the F × 10 range multiplies by 10. Ranges are marked 1, 2, 4 and 8 above the row of switches. In this case the switch between the jacks is thrown in one direction for *hundreds* and in the other for *thousands*. The instrument is not limited to these eight frequencies however. Actually, 29 frequencies are available by flipping one or more switches.

In a Wien bridge frequency is inversely proportional to resistance. When two resistors are connected in parallel, the new frequency is the sum of the first two. The same law applies when three or more resistors are paralleled. In each case the new frequency is the *sum of the frequencies* corresponding to individual resistors. The same theory holds when capacitors instead of resistors are switched.

With the basic frequencies listed above this calibrator (see diagram) can be tuned from 100–1,500 cycles in 100's and from 1,000–15,000 cycles in 1,000's. For example, if the switches corresponding to 100, 200 and 800 cycles are closed, the bridge is tuned to 1,100 cycles.

Resistors R2 and R3 are not critical because the potentiometer can be adjusted for balance. These may be 1-watt units. All other resistors should be carefully selected for close tolerance, about 1 or 2%. The values listed in the schematic are about 0.6% higher than the theoretically correct values. Therefore it is better to select resistors slightly lower than those called for. If a precision bridge is not available, use the values listed in the diagram. Time can be saved by pairing resistors; two may be connected in series or parallel to give needed values. For example, 40,000 ohms can be obtained by checking the resistance of several 39,000-ohm units or trying 18,000- and 22,000-ohm resistors in series. 80,000 ohms may be obtained from an 82,000-ohm unit or by connecting 33,000 and 47,000 ohms in series.

The instrument has two phone jacks, either of which may be used for input and the other for output. Headphones are plugged into the output jacks; the output from an af oscillator is plugged into the other jack. As the oscillator is tuned to the bridge frequency, minimum sound will be heard. Then the potentiometer is adjusted for a better minimum.

I found that the same null point held for all frequencies in either range. However, there was a slight difference between ranges. This indicated a slight error in one of the capacitors. It was corrected by adding a 250-μμf trimmer across one of the .002-μf capacitors. The procedure was:

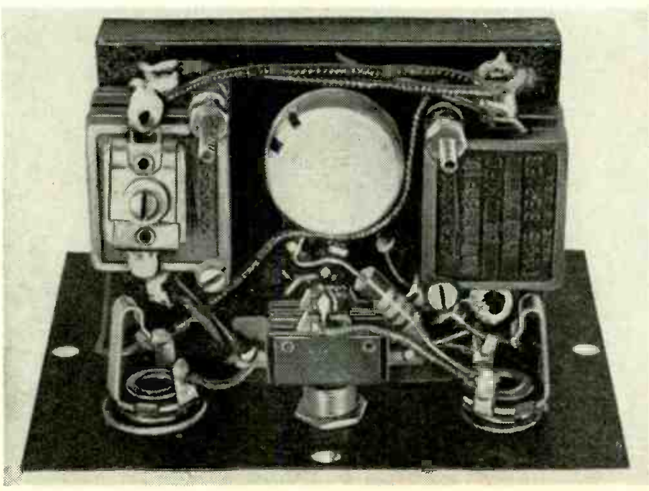
1. Set potentiometer for null on the low range.
2. Switch to some frequency on the high range. Do not touch the potentiometer again but add the trimmer across the .002-μf capacitor which minimizes the sound further.
3. Adjust the trimmer for best null.

This bridge tunes out a narrow range on either side of the tuned frequency. Therefore only a pure sine wave can be entirely eliminated. A distorted signal can be only partially tuned out, because the harmonics will pass through the bridge into the phones. In this case minimum sound will be heard. The bridge can be used to measure distortion, reduce high-frequency noise or filter out an undesirable signal.

**Parts list for preset af calibrator**

2—10,000, 2—20,000, 2—40,000, 2—80,000 ohms, ½ watt, 1 or 2% (see text), resistors; 1—33,000, 1—68,000 ohms, 1 watt, resistors; 1—5,000-ohm potentiometer; 2—.002, 2—.02 μf, capacitors; 1—250-μμf trimmer capacitor (see text); 2—phone jacks; 1—metal box, approximately 3 x 4 x 5 inches with metal shelf for supporting resistors; 4—dpst, 1—dpdt switch.

Although this bridge has been described as a rejection filter, it can be used in Wien-bridge type oscillators. The preset circuit has important advantages over conventional bridges with variable elements. It eliminates the bulky variable capacitor. Also it makes quickly available a large number of convenient frequencies. Switch tuning is always more accurate than dial tuning. If desired, the fixed resistors may be replaced with potentiometers. END



**Bottom view of shelf — large capacitors may be replaced with smaller units.**

## HAZARD on the BENCH

By B. W. WELZ

IF you haven't yet seen the kind of guy Sam was, you will some day if you stick around television long enough. The trade is full of them. Sam pooh-poohed all danger. He laughed at high voltage and turned his back on picture-tube implosions.

He used to work at the same bench with me and got a big kick out of the gingerly way I probed for high voltage. He would laugh if I put one hand in a pocket. "High voltage gets only those who are afraid of it," he would say.

(It got me once. Not bad, just across a finger. I heard it sort of hiss and pulled away, but not before it arced to the finger. From then on I've been very careful around high voltage in TV, no matter what Sam said.)

Sam got big laughs when I put on shatterproof goggles to work around big picture tubes. At first I wore an apron and gloves when I did any kind of work on those babies, but Sam laughed so hard that I gave up the apron and gloves. But I wouldn't give up the goggles.

The boss took a dim view of Sam's easy attitude toward the dangers in TV servicing. He never laughed when Sam laughed at me. He warned Sam what could happen if he wasn't careful but Sam shrugged and went ahead doing things his way.

Sometimes Sam would shove the chassis haphazardly around on the bench with the picture tube in place, often banging it against instruments. I've seen him put a big tube against his chest and tap a tight yoke on the neck with a screwdriver to loosen it. I shake a little inside even now when I think about it. When anyone warned him of implosion, he'd laugh. "They make these bottles hardier than people think," he would say.

And then one day his luck ran out! He had a 17-inch job on the bench and was pushing it around with his customary nonchalance when the tube let go.

Luckily, Sam had the tube away from him when it burst. If he had been over it or had it against his chest like he sometimes did, he would be worse off now—maybe even dead.

As it was, they spent half that first day taking glass out of him in the hospital. They say they will be probing him for about a week and then they might not have it all out. One of his eyes is pretty bad and they are not sure they can save it.

It's pretty tough for Sam and it's tough on his wife and two kids now that he won't be working for a while. You'd think a guy like Sam would think about his wife and kids even if he didn't think about himself when he worked around things as dangerous as television sets.—*Aesop*

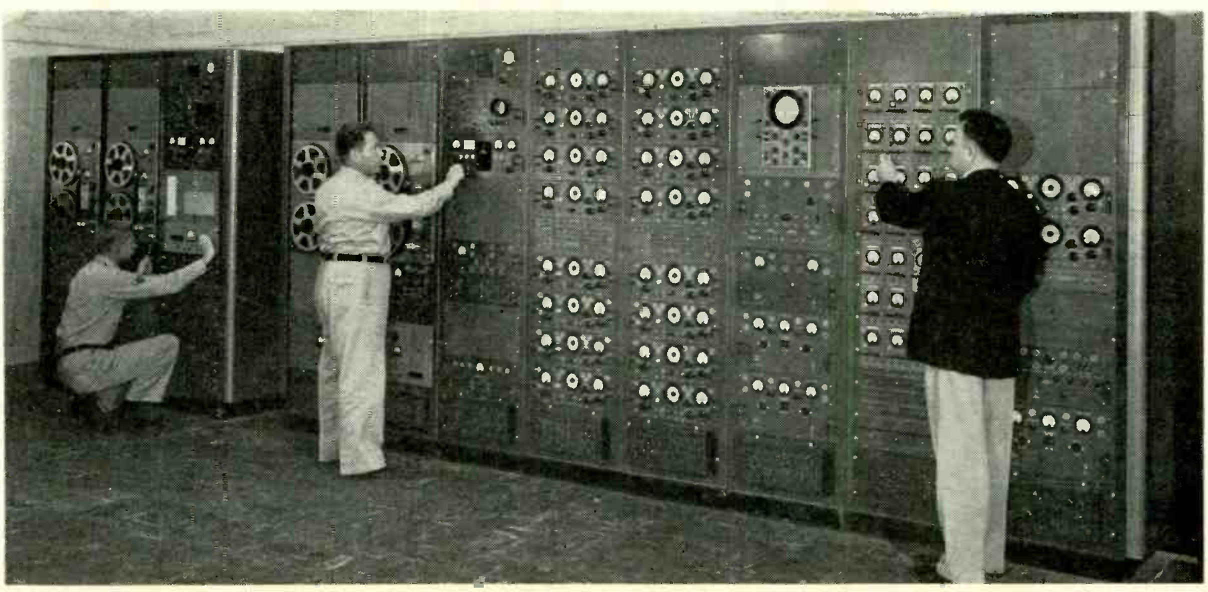
# *ELECTRONICS in the* AIR FORCE*

*A survey of some of the opportunities for personnel and some of the equipment in use*

By RONALD A. LANE

Long-range Morse code communications.

Uniformed and civilian personnel cooperate in operating Air Force equipment.



TWO results of the enormous dependence of the Air Force on electronics are an extensive training program and a remarkable series of opportunities for trained technicians, both uniformed and civilian.

In general, three classifications of personnel handle Air Force electronics operation and maintenance: uniformed personnel, employees of the U. S. Civil Service and employes of private contractors (such as RCA, G-E, Westinghouse, etc.).

A typical case is that of an Air Force sergeant who entered the service totally ignorant of electronics, was trained while in uniform at Government expense and eventually specialized in the operation and maintenance of a highly intricate digital computer. In the whole United States there are not many persons who understand that computer. So when the sergeant was discharged he went on a little vacation with his accumulated service pay and then capitalized on his training by returning to operate the identical computer at a very attractive civilian salary. Some airmen prefer to serve out their 20 years and then retire in early middle age with a pension plus the training that can earn them an excellent civilian income in addition to it.

Another type of change in individual status takes place when the Air Force contracts with a private company to perform some functions previously handled by Civil Service personnel. In that case the Civil Service jobs disappear but the same work remains to be done and the private company needs experienced hands to do it. Numbers of people resign from Civil Service but remain in the same jobs as employes of a private company and sometimes (if the individual is badly needed) at a higher salary.

Stability and flexibility are provided

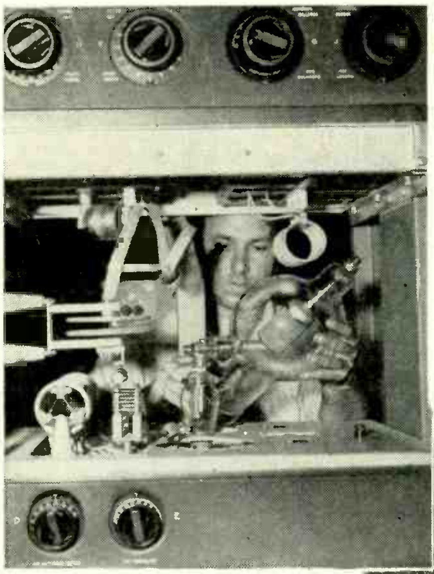
*This article has been cleared with the Air Force for security and accuracy. Such clearance does not mean that the Air Force in any way sponsors its presentation.

by these arrangements. An electronics staff composed of uniformed airmen alone would be unstable because individuals reach the end of their term of service and are discharged. The Air Force cannot reap the full benefit of their training except by rehiring them as civilians. This is usually done indirectly, as explained, through the Civil Service or through private contractors.

A Civil Service staff provides stability since a substantial percentage of the personnel prefers to remain with the work for a long period of years for the sake of the pension at the end. But Civil Service regulations are legally rigid. Employes of a private contractor can be used more flexibly. The triplex organization, therefore, combines military discipline, relative permanence and adaptability—*and it offers a triple opportunity to anyone interested in doing electronics work for the Air Force.*

## Training and advancement

Those who choose to enlist in the Air Force can obtain very sound preliminary instruction in the Air Technical Training Command Schools at Scott Field, Ill., or Keesler Field, Miss. The course takes 6 months. Graduates emerge with the rating Airman Third Class (equivalent to Pfc in the Army). Then they specialize in definite types of electronic equipment. They obtain further instruction either on the job or through additional courses at the Air Technical Training Command Schools. They can also obtain correspondence courses in electronics from the Air University.



**Technician changing "bottle" in a 5-kw high-frequency transmitter.**

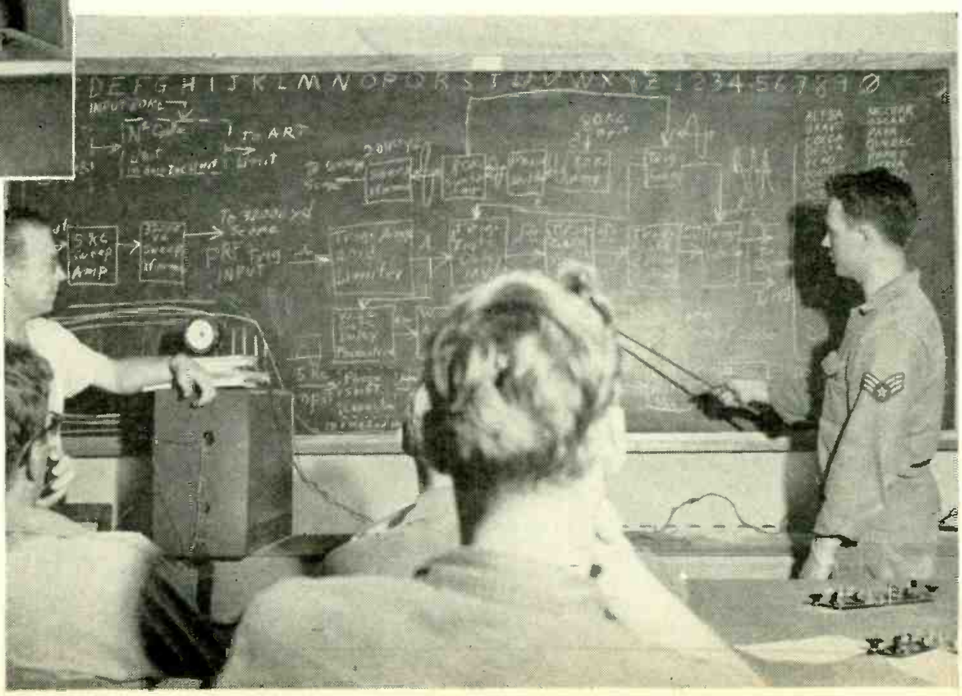
Advancement in pay and status up to and including the rating of master sergeant depends on the individual's ability and interest. During his first 4 months in service the airman is paid $83.20 per month plus maintenance, quarters, uniform allowances, allowances for dependents if any, the privilege of buying standard merchandise at reduced prices through the Post Exchange and other GI benefits. The pay of a master sergeant is $206.39 per month plus the same allowances, privileges and benefits. If, after his discharge, he wants to work for the Air Force as a member of the U. S. Civil Service or as employe of a private contractor, he may find himself assigned to do the work of a commissioned officer but with civilian pay and status.

Civil Service personnel used by the Air Force may have been uniformed airmen. As a rule such personnel are in the GS (general service) category and classified from GS-5 to GS-11 or higher. The GS-5 classification corresponds more or less to a general electronics technician or "engineering aid" with a salary beginning at $3,410 a year and advancing automatically to $4,160 after 7 years—but much more rapidly if the incumbent takes and passes promotion examinations. An electronics technician who rates GS-7 is exceptionally qualified and more or less a "junior engineer." The 1953–54 GS-7 salary range was $4,200 to $4,955 per year. Ratings from GS-9 and up require engineering training and qualifications.

Civil Service employes stationed at Air Force bases may enjoy subsidiary advantages such as Post Exchange shopping privileges, Officers Club facilities, low-rent Government housing on the base, low-cost lunches in a GI mess hall, etc., the details varying greatly according to the individual, the location of the base, local conditions there and the current policy of its commanding officer or of the Air Force. They also enjoy relative employment security, vacation and sick leave privileges, automatic promotions within each grade and pensions.

Employes of a private company that works for the Air Force under contract are simply hired hands. Their pay, privileges and job conditions are those customary in the electronics industry for the type of work and competence involved, with two exceptions: the loyalty clearance required if the work brings the individual into contact with any hush-hush military matters, the location of the work. Sometimes this may be on a remote base, on an island or in a desert, where the civilian employe lives substantially under military conditions because there are no other facilities. In such cases the company employe may be able to collect, in addition to his salary, a bonus or expense account or travel allowance, depending on how badly he is needed and how easy or difficult it may be to hire someone else for so remote an assignment.

All three types of personnel—military, Civil Service and civilian—work on an enormous range of electronics equipment: communications, navigation devices, radar to track both friendly and hostile targets, etc. Communications alone includes five kinds of operation: plane to plane, plane to ground, point to point on the ground, intercommunication in the plane, intercommunication on the ground. Many frequencies are used for such communi-



**Instructor explains electronic equipment.**

*All photos by U. S. Air Force*

cations, ranging from audio on the intercom to vhf and uhf. Voice, Morse code and teletypewriter all have their place in this communications empire.

But the meat that lovers of electronics will find really juicy (and about which least can be said) belongs to the Air Research and Development Command of the Air Force. The mission of this command is to seek new basic knowledge; investigate the fundamental laws of nature; develop new and improved devices, processes and techniques and maintain the qualitative superiority of Air Force equipment. The ARDC has eight centers located in every part of the United States from Massachusetts to California. It defines its functions as follows:

"Basic research—fundamental, theoretical or experimental investigation to increase man's knowledge and understanding of the natural world. Immediate application is not a direct objective . . .

"Applied research—and application of the results of basic research to accomplish specific objectives . . .
"Development—. . . practical application, including the construction and testing of prototype models or devices . . ."

This is some of the work to which persons who serve the Air Force in or out of uniform may be assigned, and this is where the science of electronics finds a job as big as itself and is able to show what electronics can really do!

## One type of work

One highly complex ARDC program involving massive and elaborate application of the electronic sciences may be described briefly, with many omissions necessary for reasons of national security, as follows:

One of ARDC's eight centers, Patrick Air Force Base in Florida, is the headquarters of the Missile Test Center. The German V-1 and V-2 of World War II opened a new dimension of warfare —and perhaps ultimately of transportation. Laboratory models of improved guided missiles are now being developed. They need to be tested and evaluated. Some of these missiles are launched over a long-range proving ground. The present length of the range is 1,000 miles. Observation posts in the Bahamas and West Indies are strategically located to observe and record the flight and behavior of the passing missile.

(It is a curious aside, not exactly pertinent to the general subject of this article, yet most interesting and curious, that in the preparation of the Air Force Missile Test Center the Atomic Age and the Stone Age met face to face. The population of some of the remoter islands is extremely primitive in culture, substantially neolithic. To enlist their cooperation and goodwill—and to avoid scaring them half to death with passing missiles—teams of American technicians toured the island and gave the troglodyte inhabitants elementary lectures on jet propulsion, radar and aerodynamics!)

The science of electronics launches these missiles, reports and records their behavior in flight, destroys them in flight if necessary and times everything that happens to a millisecond. From the records thus created the science of electronics computes the data the engineers need in order to built better missiles.

Electronics also provides the communications that knit together all the bases, posts and stations of a thousand-mile long range, linking the whole into a single integrated unit as taut and controlled as a regiment on dress parade.

Timing begins with an electronic clock. Millisecond pulses are communicated by uhf radio to every post and operative position along the range. The range is radar-scanned for safety and ships in dangerous locations are warned by low-flying planes equipped with loudspeakers. All posts are alerted to each step in the sequence of operations by voice and report by voice to the central control.

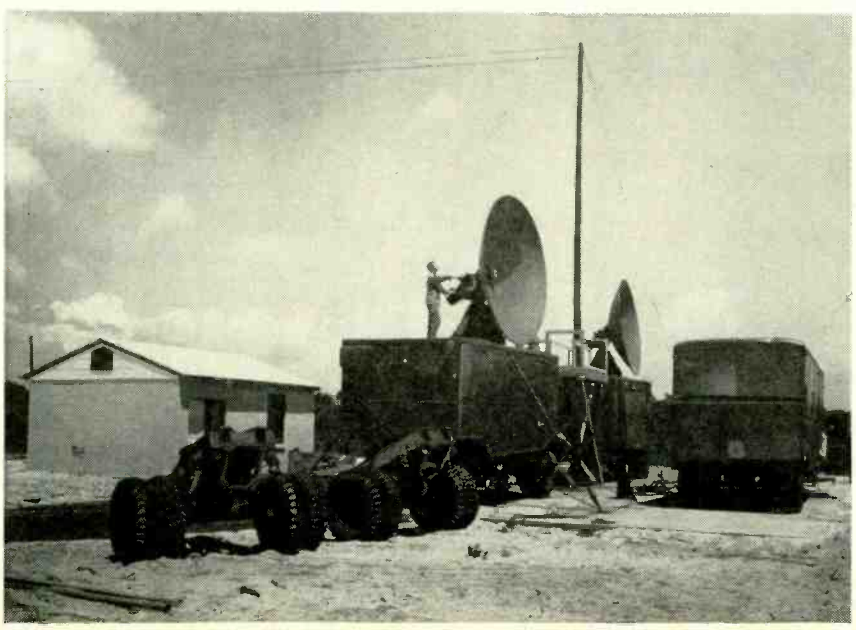
When all is ready, the missile is electronically launched from a control center located a mile distant from the launching pad. High-speed motion-picture cameras, some of them automatically controlled by electronic devices, photograph missile behavior in flight. Simultaneously these cameras record the millisecond timing signals along one edge of the film so that every aspect and phenomenon of the missile's behavior can be timed to 1/1,000 second from zero time.

As the missile proceeds down range its subsequent behavior is recorded in three ways—motion-picture cameras, radar and telemetering. A telemetering transmitter in the nose of the missile sends coded flight data. This information is in the form of a frequency-modulated subcarrier which is frequency-modulated upon a uhf carrier. This double modulation is called commutation; stripping the information from the double carriers is called decommutation. Electronic equipment currently used for telemetering at the Air Force Missile Test Center permits simultaneous transmission of 12–15 channels, some of which may be commutated with as many as 27 data channels each.

The data received by telemetered transmission are recorded on both oscillographs and magnetic tape. The data recorded by the motion-picture cameras (some of them operating as rapidly as 600 frames per second as against the ordinary rate of 24) exist on the developed film in the form of photographic images and lines of timing dots. Telemetered data, film data and data derived from radar tracking, all need to be mathematically evaluated.

Human beings could not handle the job; an army of mathematicians would be needed. The work is done by electronic mathematicians — digital computers, telereaders, automatic printing calculators—thousand-tube electronic circuits that remember and think.

The appearance of some of this incredible mathematical equipment resembles fantastic illustrations out of science-fiction magazines. Yet the personnel, uniformed and civilian, who operate and maintain it, are not necessarily mathematically trained. Most of them are trained only in electronics in general and the specific machine they operate in particular. They use standard electronics procedures and facilities. Their multimeters, oscilloscopes, signal generators, tube testers and the like are much the same—sometimes the same make and model—as in any crossroads radio repair shop. Their basic techniques of maintenance and testing are much the same. Buck Rogers obeys Ohm's law. The electronic skills that are taught in the Air Force may later be applied to repair a television portable. END



**Air Force mobile radar installation.**

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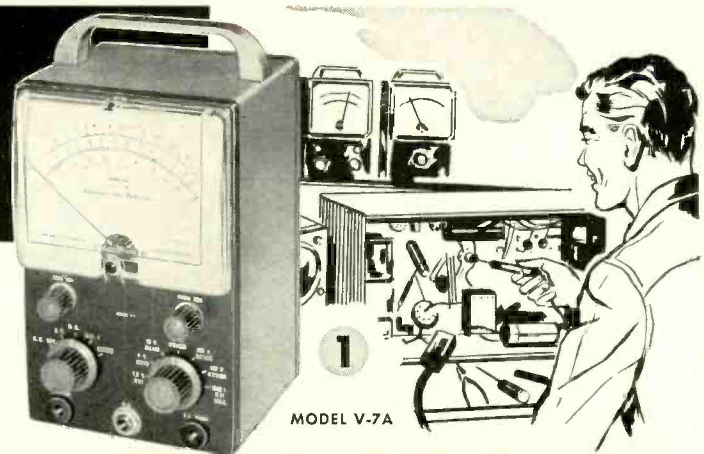


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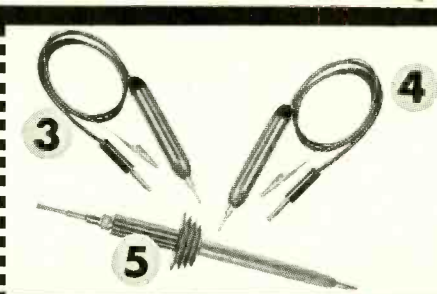


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Besides measuring AC (rms), DC and resistance, the modern-design V-7A incorporates peak-to-peak measurement for FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, and 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Also a db scale is provided. A polarity reversing switch provided for DC measurements, and zero center operation within range of front panel controls. Employs a 200 μa meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit board for fast, easy assembly and reliable operation is 50% thicker for more rugged physical construction. 1% precision resistors for utmost accuracy.

MODEL V-7A
**$24.50**
Shpg. Wt. 7 Lbs.

## ❷ *Heathkit* 20,000 OHMS/VOLT MULTIMETER KIT

The MM-1 is a portable instrument for outside servicing, for field testing, or for quick portability in the service shop. Combines attractive physical appearance with functional design. 20,000 ohms/v. DC, and 5000 ohms/v. AC. AC and DC voltage ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts. Direct current ranges are 0-150 μa., 15 ma., 150 ma., 500 ma., and 15 amperes. Resistance ranges are X1, X100, X10,000 providing center scale readings of 15, 1500 and 150,000 ohms. DB ranges cover −10 db to +65 db.

Features a 4½" 50 μa. meter. Provides polarity reversal on DC measurements. 1% precision resistors used in multiplier circuits. Not affected by RF fields.

MODEL MM-1
**$29.50**
Shpg. Wt. 6 Lbs.

## ❸ *Heathkit* ETCHED CIRCUIT RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 Mc with ± 10% accuracy. Uses etched circuits for increased circuit stability and ease of assembly.

NO. 309-C
**$3.50**
Shpg. Wt. 1 Lb.

## ❹ *Heathkit* ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scale of any 11 megohm VTVM with this new probe, employing etched circuit for stability and low loss. Readings made directly from VTVM scales, from 5 Kc to 5 Mc. Not required for Heathkit Model V-7A VTVM.

NO. 338-C
**$5.50**
Shpg. Wt. 2 Lbs.

## ❺ *Heathkit* 30,000 VOLT D.C. HIGH VOLTAGE PROBE KIT

For TV service work or similar application for measurement of high DC voltage. Precision multiplier resistor mounted inside plastic probe. Multiplication factor of 100 on the ranges of Heathkit 11 megohm VTVM.

NO. 336
**$4.50**
Shpg. Wt. 2 Lbs.

## ❻ *Heathkit* HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Measures direct current at 0-10 ma. and 0-100 ma. Provides ohmmeter ranges of 0-3000 (30 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Features a 400 μa. meter for sensitivity of 1000 ohms/volt. Because of its size, the M-1 is a very handy portable instrument that will fit in your coat pocket, tool box, glove compartment, or desk drawer. Makes a fine standby unit in the service shop when the main instruments are in use, or is ideal for the hobbyist or beginner. An unusual dollar value.

MODEL M-1
**$14.50**
Shpg. Wt. 3 Lbs.

**HEATH COMPANY** *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICHIGAN**

# *Heathkit* TV ALIGNMENT GENERATOR KIT

The Model TS-4 features a controllable inductor for all-electronic sweep, improved oscillator and automatic gain circuitry, high RF output, center sweep operation, and improved linearity. It sets a new high standard for sweep generator operation, and is absolutely essential for the up-to-date service shop doing FM, black-and-white TV, and color TV work.

Voltage regulation and effective AGC action insure flat output over a wide frequency range. Electronic sweep insures complete absence of mechanical vibration. Sweep deviation controllable from 0 up to 40 Mc, depending upon base frequency. Effective two-way blanking.

Fundamental output from 3.6 Mc to 220 Mc in 4 bands. Crystal marker provides markers at 4.5 Mc and multiples thereof. Crystal included with kit. Variable marker covers from 19 Mc to 60 Mc on fundamentals, and up to 180 Mc on harmonics. Provision for external marker.

MODEL TS-4
**$49.50**
Shpg. Wt. 16 Lbs.

1

## ❶ *Heathkit* LINEARITY PATTERN GENERATOR KIT

The new-design Model LP-1 produces vertical or horizontal bar patterns, a cross-hatch pattern, or white dots on the screen of the TV set under test. No internal connections required. Special clip is attached to the TV antenna terminals. Instant selection of the pattern desired for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Dot pattern presentation is a *must* for color convergence adjustments on color TV sets.

Extended operating range covers all television channels from 2 to 13. Produces 6 to 12 vertical bars or 4 to 7 horizontal bars.

MODEL LP-1
**$22.50**
Shpg. Wt. 7 Lbs.

2

## ❷ *Heathkit* LABORATORY GENERATOR KIT

The Heathkit Model LG-1 Laboratory Generator is a high-accuracy signal source for applications where metered performance is essential It covers from 100 Kc to 30 Mc on fundamentals in 5 bands. Modulation is at 400 cycles, and modulation is variable from 0-50%. RF output from 100,000 $\mu$v. to 1 $\mu$v. 200 $\mu$a. meter reads the RF output in microvolts, or percentage of modulation. Fixed step and variable output attenuation provided.

Features voltage regulation, and double copper plated shielding for stability. Provision for external modulation. Coaxial output cable (50 ohms).

MODEL LG-1
**$39.50**
Shpg. Wt. 16 Lbs.


3

## ❸ *Heathkit* CATHODE RAY TUBE CHECKER KIT

This new-design instrument holds the key to rapid and complete picture tube testing, either in the set, on the work-bench, or in the carton. Tests for shorts, leakage, and emission. Features Shadowgraph test (a spot of light on the screen) to indicate whether the tube is capable of functioning.

The Model CC-1 tests all electromagnetic deflection picture tubes normally encountered in television servicing. Supplies all operating voltages to the tube under test, and indicates the condition of the tube on a large "GOOD-BAD" scale. Features spring loaded test switches for operator protection.

The CC-1 is housed in an attractive portable case and is light in weight – ideal for outside service calls.

MODEL CC-1
**$22.50**
Shpg. Wt. 10 Lbs.

4

## ❹ *Heathkit* DIRECT READING CAPACITY METER KIT

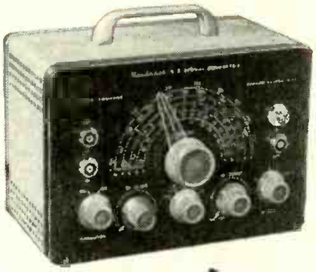
Not only is this instrument popular in the service shop, but it has found extensive application in industrial situations. Ideal for quality control work, production line checking, or for matching pairs.

Features direct reading linear scales from 100 mmf to .1 mfd full scale. Necessary only to connect a capacitor of unknown value to the insulated binding posts, select the correct range, and read the meter. The CM-1 is not susceptible to hand capacity, and has a residual capacity of less than 1 mmf.

MODEL CM-1
**$29.50**
Shpg. Wt. 7 Lbs.

**HEATH COMPANY**
A SUBSIDIARY OF DAYSTROM INC.

**BENTON HARBOR 20, MICHIGAN**



MODEL SG-8 **$19.50**
*Shpg. Wt. 8 Lbs.*

This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument. High quality components and outstanding performance.

The SG-8 covers 160 Kc to 110 Mc on fundamentals in 5 bands, and calibrated harmonics extend its usefulness up to 220 Mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 uv. Output controlled by both a continuously variable and a fixed step attenuator. Also, audio output may be obtained for amplifier testing. Don't let the low price deceive you. This is a professional type service instrument to fulfill the signal source requirements in the service lab.

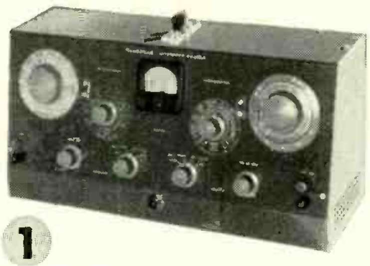
# *Heathkit* SIGNAL GENERATOR KIT

## 1 *Heathkit* . . . IMPEDANCE BRIDGE KIT

The IB-2 features built-in adjustable phase shift oscillator and amplifier, and has panel provisions for external generator. Measures resistance, capacitance, inductance, dissipation factors of condensers, and storage factor of inductance.

D, Q, and DQ functions combined in one control. ½% resistors and ½% silver-mica capacitors especially selected for this instrument. A 100-0-100 microammeter provides null indications. Two-section CRL dial provides 10 separate "units" with an accuracy of .5%. Fractions of units read on variable control.

MODEL IB-2 **$59.50**
*Shpg. Wt. 12 Lbs.*



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## 2 *Heathkit* "Q" METER KIT

The Heathkit Model QM-1 will measure the Q of inductances and the RF resistance and distributed capacity of coils. Employs a 4½" 50 microampere meter for direct indication. Will test at frequencies of 150 Kc to 18 Mc in 4 ranges. Measures capacity from 40 mmf to 450 mmf within ± 3 mmf. Indispensible for coil winding and determining unknown condenser values. A worthwhile addition to your laboratory at an outstandingly low price. Useful for checking wave traps, chokes, peaking coils, etc. Laboratory facilities are now available to the service shop and home lab.

MODEL QM-1 **$44.50**
*Shpg. Wt. 14 Lbs.*

2

## 3 *Heathkit* 6–12 VOLT BATTERY ELIMINATOR KIT

This modern battery eliminator will supply 6 or 12 volt output for ordinary automobile radios as well as 12 volts for the new models in the latest model cars. Output voltage is variable from 0-8 volts DC, or 0-16 volts DC. Will deliver up to 15 amperes at 6 volts, or up to 7 amperes at 12 volts. Two 10,000 microfarad filter capacitors insure smooth DC output. Two panel meters monitor output voltage and current. Will double as a battery charger. Definitely required for automobile radio service work.

MODEL BE-4 **$31.50**
*Shpg. Wt. 17 Lbs.*

3

## 4 *Heathkit* DECADE RESISTANCE KIT

Twenty 1% precision resistors provide resistance from 1 to 99,999 ohms in 1 ohm steps. Indispensible around service shop laboratory, ham shack, or home workshop. Well worth the extremely low Heathkit price.

MODEL DR-1 **$19.50**
*Shpg. Wt. 4 Lbs.*

## 5 *Heathkit* VIBRATOR TESTER KIT

Tests vibrators for proper starting and indicates the quality of the output on a large "GOOD-BAD" scale. Checks both interrupter and self-rectifier types in 5 different sockets. Operates from any battery eliminator delivering variable voltage from 4 to 6 volts DC at 4 amps. Ideal companion to the Model BE-4.

MODEL VT-1 **$14.50**
*Shpg. Wt. 6 Lbs.*

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4 6

## 6 *Heathkit* DECADE CONDENSER KIT

Provides capacity values from 100 mmf to 0.111 mfd in steps of 100 mmf. ± 1% precision silver-mica condensers used. High quality ceramic switches for reduced leakage. Polished birch cabinet. Extremely valuable in all electronic activity.

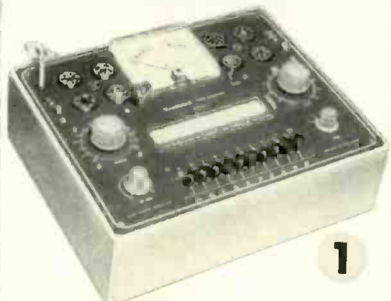
MODEL DC-1 **$16.50**
*Shpg. Wt. 3 Lbs.*

**HEATH COMPANY**
A SUBSIDIARY OF DAYSTROM INC.

**BENTON HARBOR 20, MICHIGAN**

*Heathkit*

# TUBE CHECKER KIT




**1** The Heathkit Model TC-2 is an emission type tube tester that represents a tremendous saving over the price of a comparable unit from any other source. At only $29.50, you can have a tube tester of your own, even if you are an experimenter, or only do part time service work. Extremely popular with radio servicemen, it uses a 4½" meter with 3-color meter face for simple "GOOD-BAD" indications that the customer can understand. Will test all tubes commonly encountered in radio and TV service work.

Ten 3-position lever switches for "open" or "short" tests on each tube element. Neon bulb indicates filament continuity or short between tube elements. Line adjust control provided. The roll chart is illuminated.

Sockets provided for 4, 5, 6, and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, and the 5 pin Hytron tubes. Blank space provided for future socket addition. Tests tubes for opens, and shorts, and for quality on the basis of total emission. 14 different filament voltage values provided.

MODEL TC-2
**$29.50**
Shpg. Wt. 12 lbs.

## 2 *Heathkit* PORTABLE TUBE CHECKER KIT

The Model TC-2P is identical to the Model TC-2 except that it is housed in a rugged carrying case. This strikingly attractive and practical two-tone case is finished in proxylin impregnated fabric. The cover is detachable, and the hardware is brass plated. This case imparts a real professional appearance to the instrument. Ideal for home service calls, or any portable application.

MODEL TC-2P
**$34.50**
Shpg. Wt. 15 lbs.


## 3 *Heathkit* TV PICTURE TUBE TEST ADAPTER

The Heathkit TV picture tube test adapter is designed for use with the Model TC-2 Tube Checker. Test picture tubes for emission, shorts, and thereby determine tube quality. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. (Not a kit.)

MODEL 355
**$4.50**
Shpg. Wt. 1 lb.

## 4 *Heathkit* . . . CONDENSER CHECKER KIT


Use this Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings taken directly from the calibrated panel scales without any involved calculation. Capacity measurements in four ranges from .00001 to 1000 mfds. Checks paper, mica, ceramic and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser efficiency. Leakage test switch—selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Spring-return test switch automatically discharges 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 scales. Increased sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation, the circuit is entirely transformer operated. An outstanding low kit price for this surprisingly accurate instrument.

MODEL C-3
**$19.50**
Shpg. Wt. 7 lbs.

## 5 *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT


This signal tracer is extremely valuable in servicing AM, FM, and TV receivers, especially when it comes to isolating trouble to a particular stage of the circuit under test.

This visual-aural tracer features a high gain RF input channel to permit signal tracing from the receiver antenna input clear through all RF, IF, detector, and audio stages to the speaker. Separate low-gain channel provided for audio circuit exploration. Both visual and aural indication by means of a speaker or headphone, and electron beam "eye" tube as a level indicator. Also incorporates a noise locater circuit for DC noise checks, and a built-in calibrated wattmeter (30-500 watts). Panel terminals provided for "patching" output transformer or speaker into external circuit for test purposes. Designed especially for the radio and TV serviceman. Cabinet size: 9½" wide x 6½" high x 5" deep. A real test equipment bargain.

MODEL T-3
**$23.50**
Shpg. Wt. 9 lbs.

**HEATH COMPANY**
A SUBSIDIARY OF DAYSTROM INC.

**BENTON HARBOR 20, MICHIGAN**

MODEL HD-1

Shpg. Wt. 13 Lbs. **$49.50**

Used with a sine wave generator, the Model HD-1 will check the harmonic distortion output of audio amplifiers under a variety of conditions. Reads distortion directly on the meter as a percentage of the input signal. Operates between 20 and 20,000 cps. High impedance VTVM circuit for initial reference settings and final distortion readings. Ranges are 0-1, 3, 10, and 30 volts full scale. 1% precision resistors. Distortion scales are 0-1, 3, 10, 30 and 100% full scale. Requires only .3 volt input for distortion test.

# *Heathkit* HARMONIC DISTORTION METER KIT

## ❶ *Heathkit* AUDIO ANALYZER KIT

This instrument consists of an audio wattmeter, an AC VTVM, and a complete IM analyzer, all in one compact unit.

Use the VTVM to measure noise, frequency response, output gain, power supply ripple, etc. Use the wattmeter for measurement of power output. Internal loads provided for 4, 8, 16, or 600 ohms. VTVM also calibrated for DBM units. High or low impedance IM measurements made with built-in 6KC and 60 cps generators. VTVM ranges are .01, to 300 volts in 10 steps. Wattmeter ranges are .15 mw. to 150 w. in 7 steps. IM scales are 1% to 100% in 5 steps.

MODEL AA-1 **$59.50** Shpg. Wt. 13 Lbs.

## ❷ *Heathkit* AUDIO GENERATOR KIT

This new Heathkit Model features step-tuning from 10 cps to 100 Kc with three rotary switches that provide two significant figures and multiplier. Less than .1% distortion. Frequency accurate to within ± 5%.

Output monitored on a large 4½" meter that reads voltage or db. Both variable and step-type attenuation provided. Meter reads zero-to-maximum at each attenuator position. Output ranges (and therefore meter ranges) are 0-.003, .01, .03, .1, .3, 1, 3, 10 volts. Step-tuning provides rapid positive selection of the desired frequency, and allows accurate return to any given frequency.

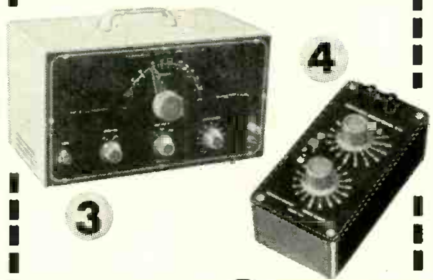
MODEL AG-9 **$34.50** Shpg. Wt. 8 Lbs.

## ❸ *Heathkit* AUDIO OSCILLATOR KIT

(SINE WAVE — SQUARE WAVE)

The Model AO-1 features sine wave or square wave coverage from 20-20,000 cps in 3 ranges. It is an instrument specifically designed to completely fulfill the needs of the serviceman and high fidelity enthusiast. Offers high level output across the entire frequency range, low distortion and low impedance output. Features a thermistor in the second amplifier stage to maintain essentially flat output through the entire frequency range. Produces an excellent sine wave for audio testing, or will produce good, clean, square waves with a rise time of only 2 microseconds.

MODEL AO-1 **$24.50** Shpg. Wt. 10 Lbs.



## ❹ *Heathkit* RESISTANCE SUBSTITUTION BOX KIT...

Provides switch selection of 36 RTMA 1 watt standard 1% resistors ranging from 15 ohms to 10 megohms. Numerous applications in radio and TV work, and essential in the developmental laboratory.

MODEL RS-1 **$5.50** Shpg. Wt. 2 Lbs.

## ❺ *Heathkit* AC VACUUM TUBE VOLTMETER KIT...

The Heathkit AC VTVM features high impedance, wide frequency range, very high sensitivity, and extremely wide voltage range. Will accurately measure a voltage as small as 1 mv. at high impedance. Excellent for sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Frequency response is substantially flat from 10 cps to 50 Kc. Ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 v. RMS. Total db range −52 to + 52 db. Input impedance 1 megohm at 1 Kc.

MODEL AV-2 **$29.50** Shpg. Wt. 5 Lbs.

## ❻ *Heathkit* CONDENSER SUBSTITUTION BOX KIT...

Very popular companion to Heathkit RS-1. Individual selection of 18 RTMA standard condenser values from .0001 mfd to .22 mfd. Includes 18" flexible leads with alligator clips.

MODEL CS-1 **$5.50** Shpg. Wt. 2 Lbs.

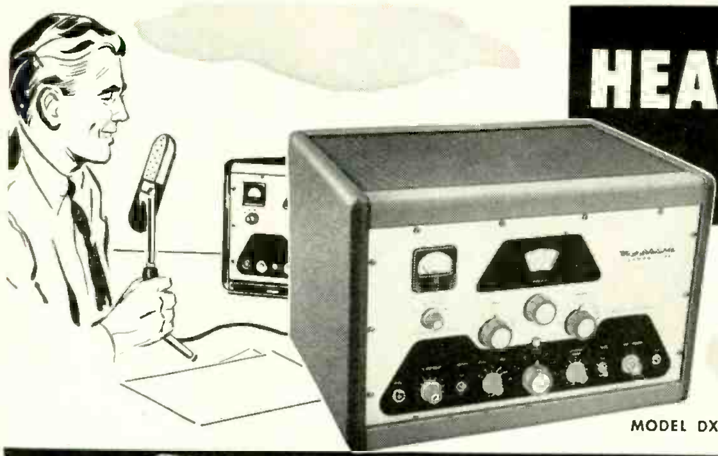
**HEATH COMPANY**

A SUBSIDIARY OF DAYSTROM INC.

**BENTON HARBOR 20, MICHIGAN**

# HEATHKIT HAM GEAR

*for high quality at moderate cost*



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MODEL DX-100

DOLLAR VALUE: *You get more for your Heathkit dollar because your labor is used to build the kit instead of paying for someone else's. Also, the middleman's margin of profit is eliminated when you deal directly with the manufacturer.*

2

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## ❶ *Heathkit* DX-100 PHONE & CW TRANSMITTER KIT

The reception given this amateur transmitter has been tremendous. Reports from radio amateurs using the DX-100 are enthusiastic in praising its performance and the high quality of the components used in its assembly. Actual "on the air" results reflect the careful design that went into its development.

The DX-100 features a built-in VFO, modulator, and power supplies, and is completely bandswitching for phone or CW operation on 160, 80, 40, 20, 15, 11, and 10 meters. All parts necessary for construction are supplied in the kit, including tubes, cabinet, and detailed step-by-step instructions. Easy to build, and a genuine pleasure to operate.

Employs push-pull 1625's modulating parallel 6146's for RF output in excess of 100 watts on phone and 120 watts on CW. May be excited from the built-in VFO or from crystals (crystals not included with kit). Features five-point TVI suppression: (1) pi network interstage coupling to reduce harmonic transfer to the final stage; (2) pi network output coupling; (3) extensive shielding; (4) all incoming and outgoing circuits filtered; (5) inter-locking cabinet seams to eliminate radiation except through the coaxial output connector. Pi network output coupling will match 50 to 600 ohm non-reactive load. Illuminated VFO dial and meter face. Remote control socket provided.

The chassis is made of extra-strong #16 gauge copper-plated steel. It employs potted transformers, ceramic switch and variable capacitor insulation, solid silver loading switch terminals, and high-grade well-rated components throughout. Features a pre-formed wiring harness, and all coils are pre-wound.

High-gain speech amplifier for dynamic or crystal microphones, and restricted speech range for increased intelligence. Plenty of audio power reserve. Measures 20⅞" W. x 13¾" H. x 16" D. Schematic diagram and complete technical specifications on request.

MODEL DX-100
**$189.50**
Shpg. Wt. 120 lbs.

Shipped Motor Freight Unless Otherwise Specified
$50.00 Deposit Required on C.O.D. Orders

## ❷ *Heathkit* VFO KIT

The Model VF-1 covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10-volt average RF output on fundamentals. Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from plug on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters. Measures: 7" H. x 6½" W. x 7" D.

MODEL VF-1
**$19.50**
Shpg. Wt. 7 lbs.

## ❸ *Heathkit* CW AMATEUR TRANSMITTER KIT

The Model AT-1 is an ideal novice transmitter, and may be used to excite a higher power rig later on.

This CW transmitter is complete with its own power supply, and covers 80, 40, 20, 15, 11, and 10 meters. Features single-knob bandswitching, and panel meter indicates grid or plate current for the final amplifier. Designed for crystal operation or external VFO. Crystal not included in kit. Incorporates such features as key click filter, line filter, copper-plated chassis, pre-wound coils, 52 ohm coaxial output, and high quality components throughout. Instruction book simplifies assembly. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 35 watts plate power input.

MODEL AT-1
**$29.50**
Shpg. Wt. 15 lbs.

## ❹ *Heathkit* . . . ANTENNA COUPLER KIT

The Model AC-1 will properly match your low power transmitter to an end-fed long wire antenna. Also attenuates signals above 36 Mc, reducing TVI. 52 ohm coax. input—power up to 75 watts—10 through 80 meters—tapped inductor and variable condenser—neon RF indicator—copper plated chassis and high quality components. Ideal for use with Heathkit AT-1 Transmitter.

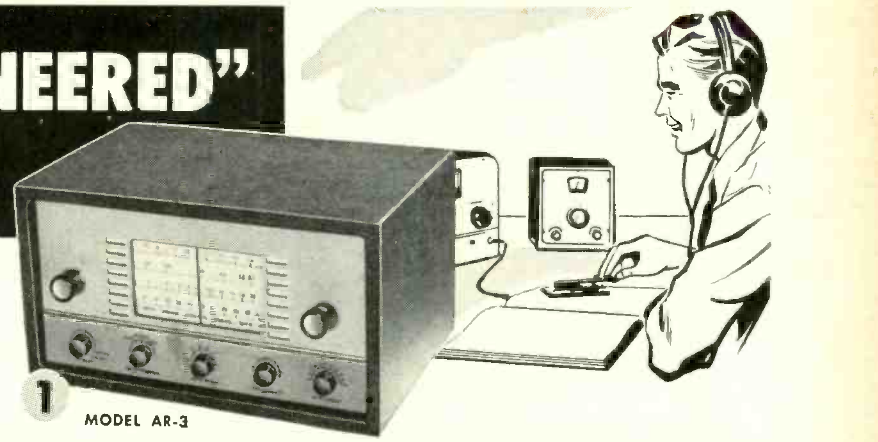
MODEL AC-1
**$14.50**
Shpg. Wt. 4 lbs.

**HEATH COMPANY** *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICHIGAN**

# "AMATEUR-ENGINEERED"

## *Equipment For The Ham*

MODERN DESIGN: *You can be sure of getting all the latest and most desirable design features when you buy Heathkits. Advanced-design is a minimum standard for new Heathkit models.*



1 MODEL AR-3

## ❶ *Heathkit* COMMUNICATIONS-TYPE ALL BAND RECEIVER KIT

The new Model AR-3 features improved IF and RF performance, along with better image rejection on all bands. Completely new chassis layout for easier assembly, even for the beginner

Covers 550 Kc to 30 Mc in four bands. Provides sharp tuning and good sensitivity over the entire range. Features a transformer-type power supply—electrical bandspread—separate RF and AF gain controls—antenna trimmer—noise limiter—AGC—BFO—headphone jacks—5½" PM speaker and illuminated tuning dial.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part No. 91-15, shipping weight 5 lbs. $4.50.

MODEL AR-3 **$27.95** Shpg. Wt. 12 Lbs. (Less Cabinet)

## ❷ *Heathkit* "Q" MULTIPLIER KIT

Here is the Heathkit Q Multiplier you hams have been asking for. A tremendous help on the phone and CW bands when the QRM is heavy. Provides an effective Q of approximately 4,000 for extremely sharp "peak" or "null." Use it to "peak" the desired signal or to "null" an undesired signal, or heterodyne. Tunes to any signal within the IF band-pass of your receiver. Also provides "broad peak" for conditions where extreme selectivity is not required.

Operates with any receiver having an IF frequency between 450 and 460 Kc. Will not function with AC-DC type receivers. Requires 6.3 volts AC at 300 ma. and 150 to 250 VDC at 2 ma. Derives operating power from your receiver. Uses a 12AX7 tube, and special High-Q shielded coils. Simple to connect with the cable and plugs supplied. Measures only 4-11/16"H.x7⅜"W.x4⅛"D. A really valuable addition to the receiving equipment in your ham shack.

MODEL QF-1 **$9.95** Shpg. Wt. 3 Lbs.

## ❸ *Heathkit* VARIABLE VOLTAGE REGULATED POWER SUPPY KIT

Provides well filtered DC output, variable from zero to 500 volts at no load and *regulated* for stability. Will supply up to 10 ma. at 450 VDC, and up to 130 ma. at 200 VDC. Voltage or current monitored on front panel meter. Also provides 6.3 VAC at 4A. for filament. Filament voltage isolated from B+, and both isolated from ground. Invaluable around the ham shack for supplying operating potentials to experimental circuits. Use in all types of research and development laboratories as a temporary power supply, and to determine design requirements for ultimate power supply.

MODEL PS-3 **$35.50** Shpg. Wt. 17 lbs.

## ❹ *Heathkit* ANTENNA IMPEDANCE METER KIT

Use in conjunction with a signal source for measuring antenna impedance, line matching, adjustment of beam and mobile antennas, etc. Will double as a phone monitor or relative field strength indicator. 100 μa. meter employed. Covers the range from 0-600 ohms. An instrument of many uses for the amateur.

MODEL AM-1 **$14.50** Shpg. Wt. 2 lb.

## ❺ *Heathkit* GRID DIP METER KIT

This is an extremely valuable tool for accomplishing literally hundreds of jobs on all types of equipment. Covering from 2 Mc to 250 Mc, the GD-1B is compact and can be operated with one hand. Uses a 500 μa. meter for indication, with a sensitivity control and headphone jack. Includes prewound coils and rack. Indispensable instrument for hams, engineers, or servicemen.

MODEL GD-1B **$19.50** Shpg. Wt. 4 lbs.

**HEATH COMPANY** *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICHIGAN**

# *Heathkits* PROVIDE THE "CONSTRUCTIVE" APPROACH TO HIGH-FIDELITY

EASY TO BUILD: *The assembly instructions supplied with Heathkits are so complete and detailed that anyone can assemble the kits without difficulty. Plenty of pictorial diagrams and step-by-step instructions. Information on resistor color codes, soldering, use of tools, etc. Build-it-yourself with confidence!*

1

## ❶ *Heathkit* ADVANCED-DESIGN HIGH FIDELITY AMPLIFIER KIT

The 25 Watt Model W-5 is one of the most outstanding high fidelity amplifiers available today—at any price. Incorporates the very latest design features to achieve true "presence" for the super-critical listener.

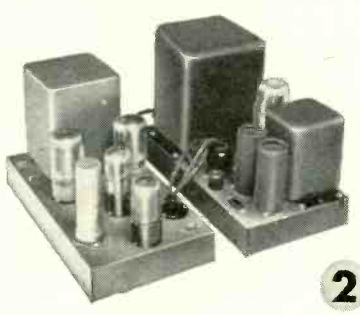
Features a new-design Peerless output transformer, and KT66 output tubes handle power peaks up to 42 watts. The unique "tweeter-saver" suppresses high frequency oscillation. A new type balancing circuit results in closer "dynamic" balance between output tubes. Features improved phase shift characteristics and frequency response, with reduced IM and harmonic distortion. Color styling harmonizes with the Heathkit WA-P2 Preamplifier and the FM-3 Tuner.

Frequency response—within ± 1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts, using 60 and 3,000 cps. Output impedance 4, 8, or 16 ohms. Hum and noise—99 db below rated output. Uses two 12AU7's, two KT66's and a 5R4GY.

**KIT COMBINATIONS:**

W-5M Amplifier Kit: Consists of main amplifier and power supply, all on one chassis. Complete with all necessary parts, tubes, and comprehensive manual. Shpg. Wt. 31 lbs. Express only. **$59.75**

W-5 Combination Amplifier Kit: Consists of W-5M Amplifier Kit listed above *plus* Heathkit Model WA-P2 Preamplifier Kit. Complete with all necessary parts, tubes, and construction manuals. Shpg. Wt. 38 lbs. Express only. **$79.50**



2

## ❷ *Heathkit* DUAL-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is a very popular high fidelity amplifier kit that features dual-chassis type construction. The resulting physical dimensions offer an additional margin of flexibility in installation. It features the famous Acrosound TO-300 "ultra-linear" output transformer, and has a frequency response within ± 1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20 watts only 1.3% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—88 db below 20 watts. Uses two 6SN7's, two 5881's, and a 5V4G.

**KIT COMBINATIONS:**

W-3M: Consists of main amplifier and power supply for separate chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 29 lbs., Express only. **$49.75**

W-3: Consists of W-3M Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 37 lbs., Express only. **$69.50**

3

## ❸ *Heathkit* SINGLE-CHASSIS WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This is the lowest priced Williamson type amplifier ever offered in kit form, and yet it retains all the usual features of the Williamson type circuit. Main amplifier and power supply combined on one chassis, and uses a new-design Chicago output transformer. Frequency response—within ± 1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output, 2.7% at 60 and 3,000 cps. Rated power output is 20 watts. Output impedance 4, 8, or 16 ohms. Hum and noise—95 db below 20 watts. Uses two 6SN7's, two 5881's, and one 5V4G.

Instructions are so complete that the kit may be assembled successfully even by a beginner in electronics.

**KIT COMBINATIONS:**

W-4AM: Consists of main amplifier and power supply for single chassis construction. Includes all tubes and components necessary for assembly. Shpg. Wt. 28 lbs. Express only. **$39.75**

W-4A: Consists of W-4AM Kit listed above *plus* Heathkit Model WA-P2 Preamplifier described on opposite page. Shpg. Wt. 35 lbs. Express only. **$59.50**

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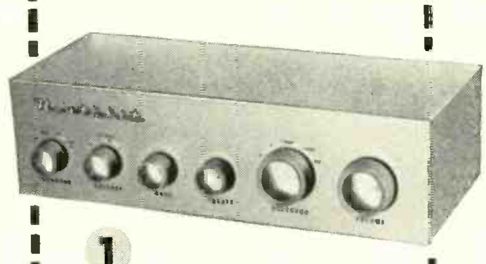
## ❶ *Heathkit* HIGH FIDELITY PREAMPLIFIER KIT



1

This outstanding preamplifier is designed specifically for use with the Heathkit Williamson type amplifiers. It completely fulfills the requirements for remote control, compensation and preamplification, and exceeds even the most rigorous specifications for high fidelity performance.

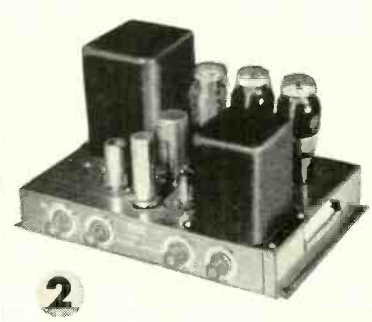
Features five separate switch-selected input channels (2 low level and 3 high level), each with its own input control. Full record equalization with four-position turnover control and four-position rolloff control.

Output jack for tape recorder – separate bass control with 18 db boost and 12 db cut at 50 cps. – treble control offering 15 db boost and 20 db cut at 15,000 cps – special hum control to insure minimum hum level – and many other desirable features. Overall frequency response (with controls set to "flat" position) is within 1 db from 25 cps to 30,000 cps. Will do justice to the finest available program sources. Beautiful satin-gold finish.

Power requirements from the Heathkit Williamson type high fidelity amplifier – 6.3 VAC at 1 amp., and 300 VDC at 10 Ma. Uses two 12AX7's and one 12AU7.

MODEL WA-P2
**$19.75**
Shpg. Wt. 7 Lbs.

## ❷ *Heathkit* 20-WATT HIGH FIDELITY AMPLIFIER KIT



2

This Heathkit Model offers you the least expensive route to high fidelity performance. Frequency response is ± 1 db from 20-20,000 cps. Features full 20 watt output using push-pull 6L6's, and incorporates separate bass and treble tone controls. Preamplifier and main amplifier are built on the same chassis. Four switch-selected compensated inputs and separate bass and treble tone controls provide all necessary functions at minimum investment. Features miniature tube types for low hum and noise.

Uses 12AX7, two 12AU7's, two 6L6G's and a 5V4G. A most interesting "build-it-yourself" project, and an excellent hi-fi amplifier for home use. Well suited, also, for public address applications because of its high power output and high quality audio reproduction. Another Heathkit "best-buy" for you!

MODEL A-9B
**$35.50**
Shpg. Wt. 23 Lbs.

## ❸ *Heathkit* 7-WATT AMPLIFIER KIT

3

The redesigned Model A-7D features a new type output transformer for tapped screen operation, and provides improved sensitivity, reduced distortion, and increased power output.

The full 7-watt output of the Model A-7D is more than adequate for normal home installations. Frequency characteristics are ± 1½ db from 20 to 20,000 cps. Potted output and power transformers employed. Push-pull output – detailed construction manual – top quality parts – high quality audio without great expense. Output transformer tapped at 4, 8, and 16 ohms. Bass and treble tone controls provided on the front chassis apron.

MODEL A-7D
**$16.95**
Shpg. Wt. 10 Lbs.

Model A-7E: Provides a preamplifier stage with two switch-selected inputs and RIAA compensation for variable reluctance or low level cartridges. Preamplifier built on same chassis as main amplifier. Model A-7E. Shipping weight 10 lbs. $18.50.

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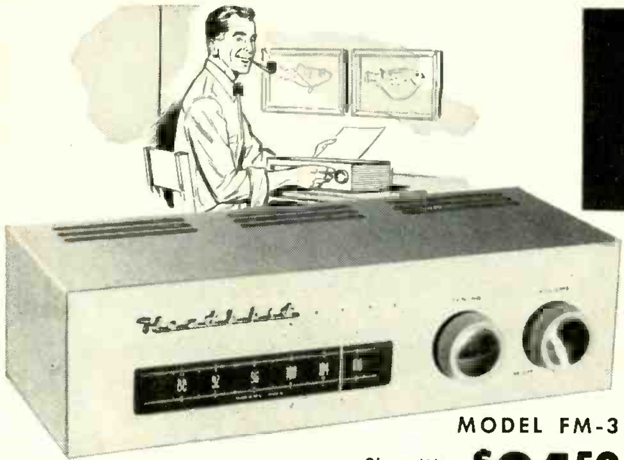

*Brand New*

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- *Low-Noise Cascode RF Stage—Two IF's—Ratio Detector—Stage of Audio.*
- *Extremely Good Sensitivity and Band-Pass for Outstanding Performance.*
- *Strikingly Attractive Satin-Gold Finish to Match Heathkit Model WA-P2 Preamplifier.*
- *Compact Physical Dimensions for Most Pleasing Appearance and Increased Circuit Efficiency.*

**MODEL FM-3**

Shpg. Wt. 7 lbs. **$24.50** (with cabinet)

The new Heathkit Model FM-3 features tremendous circuit improvements and brand new physical design. Sensitivity is better than 10 uv. for 20 db of quieting, and it employs a completely modern tube line-up for high gain and stable operation. Incorporates its own power supply, and has provision for low-level or high-level output at low impedance.

The attractive Model FM-3 matches the WA-P2 Preamplifier in color, styling, and physical size.

Incorporates automatic gain control, a highly stabilized oscillator, and illuminated tuning dial. Educational treatment of construction manual simplifies assembly for the newcomer to electronics. *IF* and *ratio* transformers are *prealigned*, and the front-end tuning unit is pre-assembled and aligned. Uses 6BQ7A as a cascode type RF stage, 6U8 oscillator-mixer, two 6CB6's as IF amplifiers, a 6AL5 ratio detector, a 6C4 audio amplifier, and 6X4 rectifier.

### HEATHKIT BROADCAST-BAND RECEIVER KIT

Build your own radio receiver with confidence, even if you are a beginner. Complete instructions supplied.

Features transformer-type power supply, high-gain miniature tubes, built-in antenna, 5½" speaker, and planetary tuning from 550 Kc to 1500 Kc. Adaptable for use as AM Tuner and phono amplifier. Educational treatment of the construction manual helps the beginner learn about radio circuits and parts as he builds.

*CABINET:* Fabric covered plywood cabinet with aluminum panel as shown. Part 91-9, Shpg. Wt. 5 lbs., $4.50.

**MODEL BR-2**

**$17.50** *Less Cabinet*

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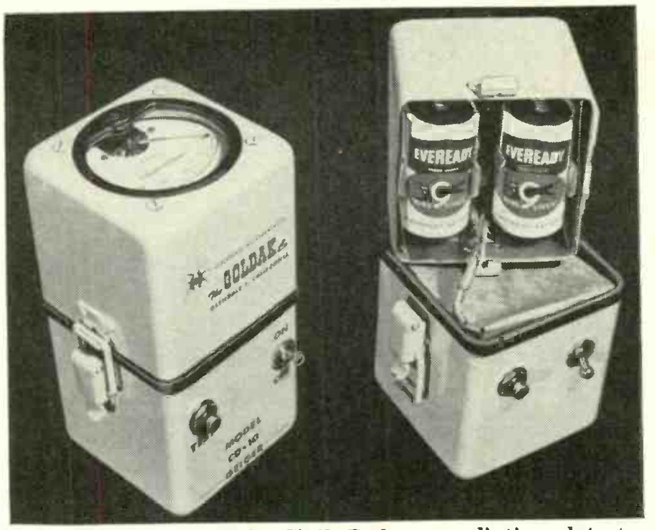
# CIVIL DEFENSE RADIATION METER

*Compact instrument measures heavy radioactivity*

By EDWIN N. KAUFMAN




**This Civil Defense rediation detector can be fastened to the wearer's belt.**

IN the event an atomic bomb bursts over your city it would be a good idea for you to know the extent of radiation remaining after the blast to protect your family and self. We will assume that your location is far enough from "ground zero" to prevent serious injury but that insufficient personnel and radiation instruments will be available to advise you of rescue, staying put or evacuation hazards.

Emergency wartime exposure to nuclear radiation is permitted at a whole body dose of 25 roentgens per day *(one day a week)* for eight total exposures. In an extreme emergency a 100-roentgen dose either in 1 day or over a period of 1 week can be tolerated but the individual should not expose himself further and should seek medical supervision. These emergency exposure rates are high compared to normal government-regulated exposure of not more than 0.3 roentgen per week for nuclear workers. A 100% lethal dosage is estimated to be 600 roentgens while 400 roentgens will kill approximately 50% of those exposed; 200 roentgens will produce grave effects and in a few cases death.

The radiation from an air burst at fairly high levels will cause many deaths from radiation emitted at the time of the bomb detonation, but little residual radioactivity will remain. Still, great care should be used to test all bomb-damaged areas for radioactivity. The low air or underwater burst will cause very dangerous surface radioactivity. A typical example is the blast at Alamogordo where the bomb was set off 100 feet above the ground. *One hour after the bomb had exploded* the radiation had decayed to 600 roentgens 650 feet from ground zero. At 1,000 feet the radiation was 150 roentgens per hour. Large areas will be affected in the event hydrogen bombs are used, up to *10,000 square miles for one bomb.* Fallout may occur in areas far removed from the bombed area, causing just as serious radioactive levels. *Now* is the time to join Civil Defense.

Alpha and beta radiation can be guarded against by wearing gloves when picking up objects in a dangerous area, but the gamma radiation must be detected to avoid body damage. In any event use great care.

If a conventional Geiger type instrument (such as used for prospecting) is carried into a radioactive area and the radiation level is over 20 milliroentgens per hour the instrument will be overloaded and the indicating meter will show a low radiation rate. Because of this great danger with conventional Geiger counters and their low range, I do not recommend them for general Civil Defense use. The ionization chamber type of instrument will always go off scale on high radiation rates above its range. These instruments also cover an immense range, typical being 5 to 50,000 milliroentgens (50 roentgens). These instruments, however, are too expensive for general use and difficult to construct.

There are, however, special Geiger tubes made by Raytheon which cover ranges of 0 to 5 and 0 to 500 roentgens. These ranges are approximately logarithmic, which permits low radiation rates to be read easily down to about 20 milliroentgens on the lower-range tube. These special tubes make up a very simple, relatively inexpensive and foolproof unit for Civil Defense radiation safety.

The simplest circuit (Fig. 1) consists of a Geiger tube, several resistors, a 50-microampere meter and batteries. The battery life is shelf life of 1–2 years. Two standard 300-volt and two Burgess K-45 67.5-volt batteries can be used or any other arrangement which will supply about 700 volts dc such as 10 or 11 of the small 67.5-volt Burgess K-45's.

The second circuit (Fig. 2) is used in the illustrated instrument which contains two size-D flashlight cells that can operate the instrument for about three 8-hour days. High voltage is generated by a vibrator and stepup transformer (a standard 4,000-ohm-primary output transformer should work) and rectified by a high-voltage selenium rectifier and filtered. The voltage is stabilized at 700 by a Victoreen 5950 or Raytheon CK1037 voltage regulator tube. As an alternate for the voltage regulator, you can use 13 NE-2 neon lamps in series. If the microammeter deflects with no radioactive material present the voltage is too high. Reduce the number of NE-2's one by one until the meter does not deflect in the absence of radioactivity.

The test switch in both instruments indicates full-scale current is available and when the batteries or high-voltage generator will no longer supply full-scale meter current this is shown on the meter. Even when the high voltage is down (a low test meter reading), as

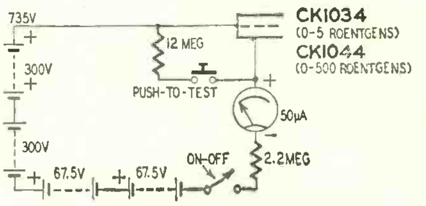



**Fig. 1—Simple radiation meter.**

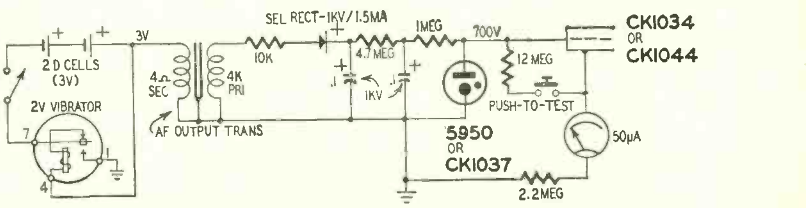



**Fig. 2—With minor modifications, the Goldak CD-10 Civil Defense instrument.**

## ELECTRONICS

long as the indicated radiation is less than the test meter reading, the correct radiation rate is shown. This extends the usable life of the batteries.

A calibration table for the CK1034 and CK1044 is shown. Although some variation in Geiger tubes exists, this should not prove serious if the emergency radiation dosages indicated in the article are not exceeded. Exact calibration can be obtained by varying the value of the 2.2-megohm resistor in series with the Geiger tube. The tubes are rated for operation at −55° to +70° Centigrade. The life is rated as "unlimited by counting rate."

**CALIBRATION TABLE**

| Meter Reading (µamps) | Radiation (mr/hr) |
|---|---|
| **CK1034 Rated 0 – 5 r/hr** | |
| 1 | 15 |
| 5 | 70 |
| 10 | 210 |
| 15 | 330 |
| 25 | 670 |
| 40 | 2300 |
| **CK1044 Rated 0–500 r/hr** | |
| 2.5 | 1.3 r/hr |
| 10 | 5.2 r/hr |

The builder should select the range he feels most appropriate. Using both tubes with a switch is an excellent idea and would cost only the price of the extra Geiger tube and switch (use a rotary wafer type). The CK1044 can be obtained easier than the CK1034 and for my personal instrument I am using the CK1044. As the radiation from fallout dies off rapidly, the first indicated (highest) rate can be divided by half and multiplied by 36 hours to arrive at the *approximate* total dosage in roentgens that can be expected. This is a very rough approximation and should err on the safe side.

**Parts for Fig. 2 radiation meter**

1—10,000 ohms, 1—1, 1—2.2, 1—4.7, 1—12 megohms, ½-watt resistors; 2—0.1-µf 1,000-volt capacitors; 1—output transformer, primary 4,000 ohms, secondary 4 ohms; 2—1.5-volt size-D flashlight cells; 1—spst switch; 1—spst pushbutton switch; 1—2-volt vibrator (Radiart 5469-2 or equivalent); 1—50-µa meter; 1—selenium rectifier, 1,000 volts (International Rectifier Corp. U50HP or equivalent); 1—CK1034 or CK1044 Geiger tube; 1—Victoreen 5950 or Raytheon CK1037 voltage regulator (see text); 1—chassis.

I must add an important note. If an instrument is being carried waist high and reading *spot* contamination, such as from a pool of radioactive oil, the indication is low by a square-root factor. Radiation from point sources decreases as the square of the distance. For example, if the midpoint of the instrument is 26 inches above the ground and indicating 10 milliroentgens per hour—which is very safe—the contaminated spot on the ground by your feet would be 43.5 roentgens per hour. Great care must be used to avoid "hot spots."

Much Civil Defense literature is available, such as "Emergency Exposure to Nuclear Radiation." Pub. TB 11-1-1952, 5 cents, Superintendent of Documents, Washington 25, D. C. END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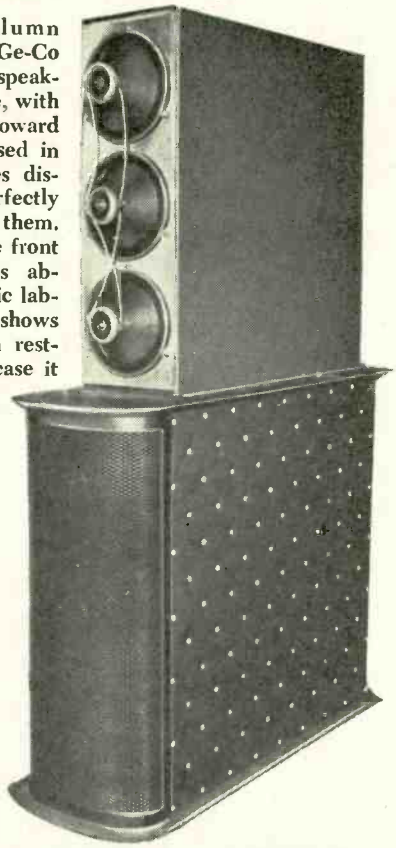
# what's new?

## FRENCH SPEAKER SPREADS HIGHS

This acoustic column speaker, made by Ge-Co (France), has three speakers in a vertical line, with their rear faces toward the auditorium. Used in this way, the cones disperse high notes perfectly instead of beaming them. The sound from the front of the speakers is absorbed in an acoustic labyrinth. The photo shows the speaker system resting on top of the case it occupies normally.



## TWO-ANTENNA TOWER

The antennas of WFAA-TV and KRLD-TV, Dallas, Tex., are on a single tower—the world's second highest structure. Unlike most installations, the two antennas are on the same level, on two of the corners of a triangular platform 80 feet on a side and 1,435 feet from the ground. This gives it the appearance that has earned it the name of "candelabra" antenna. The tower proper is three-sided—12 feet to a side—and is guyed in 5 places, at the 290-, 650-, 1,010-, 1,310- and 1,419-foot levels.

## ALL-TRANSISTOR PLANE RECEIVER

Designed for use on military aircraft, commerical and private planes, this little RCA marker-beacon receiver is the first of its type to be entirely transistorized. The smallest and lightest instrument of its type ever developed, it operates on less power than an ordinary flashlight and weighs only 15 ounces. Space occupied is 2 x 4 x 5 inches.

**NEXT MONTH**

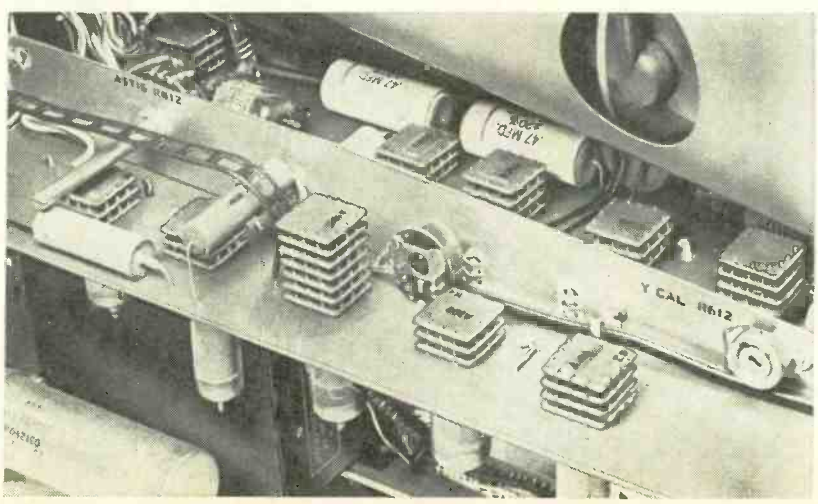
**SHIRT POCKET TRANSISTOR RADIO**

**By I. Queen**

**WATCH FOR IT!**

## MODULAR SCOPE

Modular construction is not confined to TV. The Du Mont oscillograph in the photograph below is said to be the first electronic test instrument using ceramic wafer unit construction. Each module is a complete circuit unit and instruments can be repaired very easily by discarding a faulty module and replacing it with a new one.



A report on Sylvania's **6-Million-Hour Field Test** in receiving tubes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# TRANSISTOR RADIOS

*Part I—crystal detectors—transistor-amplifier circuitry*

By I. QUEEN
EDITORIAL ASSOCIATE

TRANSISTORS have supplanted tubes in many circuits and instruments and are now well established in the broadcast radio field. Many simple receivers designed by experimenters and hobbyists have been described in various magazines. Kits to build them are available. Transistor *superhets* are only a little more than a year old but already half a dozen manufacturers have put them on the market.

Semiconductor theory is difficult but fortunately very little is required to build and understand transistorized radio circuits. A transistor acts like a tube in many respects, especially when connected in grounded-emitter fashion (Fig. 1). The emitter is the source of charged particles so it is equivalent to a filament or cathode; in a p-n-p transistor (shown with arrow pointing toward the base) it emits positive "holes." The base corresponds to a grid because its bias controls the flow of charges through the transistor. In an efficient semiconductor only a small fraction of the total current flows through the base. The collector is the plate; that is, the output current is drawn by it to flow through the external load.

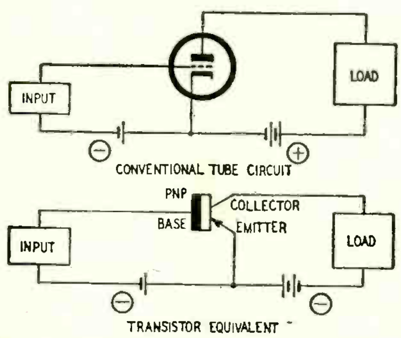



**Fig. 1—Diagram shows comparison of vacuum tube and transistor circuits.**

As a convenient short cut (but not short circuit) for our thinking, we may assume that the positive charges are emitted into the transistor and flow directly to the collector. This element, being negative, attracts them. The base element is between the emitter and collector so it controls the flow. When the base is more *negative* (or the emitter more positive) more charges can flow.

In a p-n-p semiconductor, both power supplies (for the base and the collector) must be negative; in an n-p-n type, these are both reversed.

The input circuit of a transistor has a low impedance, for example, 600 ohms. This differs considerably from a tube where the input is an open circuit (between grid and filament). This low impedance is due to the fact that the emitter-base junction (which acts as a diode) is biased in the *forward* (conducting) direction (emitter is more positive than the base). The transistor output has relatively high impedance, ordinarily about 1 megohm, since it is biased in the *reverse* direction (collector is more negative than base).

Fig. 1 shows two separate battery supplies to bias the elements. For convenience, it is customary to use one battery; Fig. 2 shows a simple arrangement. Resistor R is returned to the negative battery terminal to provide forward bias to the emitter-base circuit. The resistor may be determined by trial and error or may be chosen for a particular need. For example, if the battery is 3 volts and the required bias is 100 microamperes (.0001 amp) R must be 3/.0001 or 30,000 ohms. Normally this bias would support any signal varying from nearly zero to 200 microamperes if the transistor characteristic is linear at and near that point.

Better regulation is provided by the circuit of Fig. 3 where bias is provided by voltage divider R1, R2 across the battery. With the usual low voltages (3 to 6 volts) applied to transistors, their ratio should equal 4 or 5 to 1 for class-A operation. For example, R1, 10,000 ohms; R2, 2,000 ohms. This does not mean, however, that the base voltage will be one-fifth of the collector supply. Current also flows *from the base* into R1 so that the bias will be smaller than indicated by the ratio of R1 to R2.

The voltage-divider method is often used to bias high-frequency and class-B amplifiers, as we shall see later.

Certain precautions should be observed when handling transistors. They are very sensitive to temperature. Don't keep them in a warm place or put a soldering iron near them. When soldering directly to a transistor lead, hold it with a pair of pliers to prevent the heat from passing into the semiconductor. Many experimenters prefer to use sockets rather than solder directly to the transistor. This permits quick insertion and removal. A five-pin subminiature in-line socket should be used.

Before connecting the power supply make sure it is correctly polarized, that is, negative toward the collector of a p-n-p, positive toward the collector of an n-p-n. Also check the voltage—many types are limited to 20 or 22.5 volts on the collector. Some of the newer high-frequency types require 6 volts or less.

## Crystal detectors

In regions where broadcast stations are well separated frequency-wise, selectivity is not a problem. Here, a

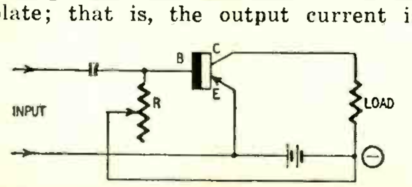



**Fig. 2—A simple method of biasing.**

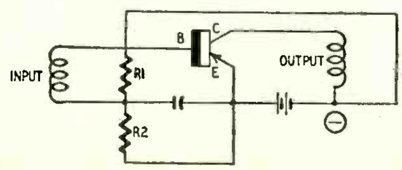



**Fig. 3—Biasing with voltage divider.**

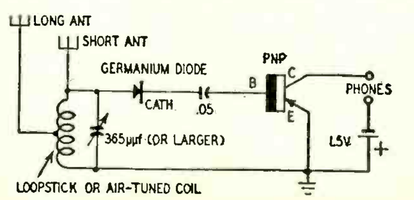



**Fig. 4—Crystal set with audio stage.**

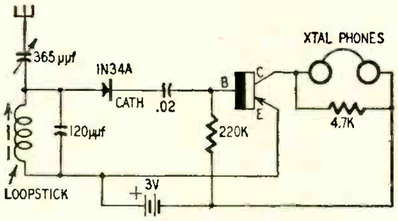



Fig. 5—Variation of Fig. 4 circuit.

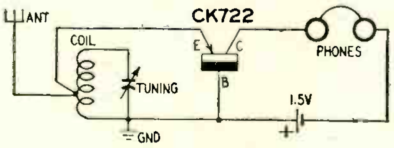



Fig. 6—Circuit uses printed wiring.

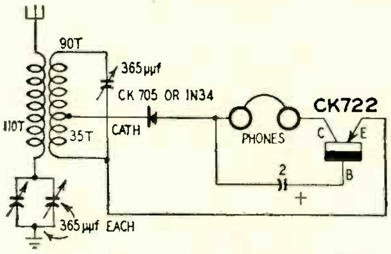



Fig. 7—Schematic shows crystal set using no apparent power supply.

crystal set with an amplifier may provide very satisfactory reception. The antenna should be at least 50 feet long and preferably longer since a crystal detector has low gain. However, its selectivity is not too great so there can be no sideband cutting. This means higher fidelity and low noise pickup.

Fig. 4 shows a simple yet practical crystal set with one stage of audio. It contains a ferrite-rod or equivalent antenna coil. The tap is not necessary but is advantageous in that it permits a good match to a long antenna if one is available. If the antenna is short—40 feet or less—connect it to the end of the coil.

The diode may be any rectifier type such as the CK705, 1N34, etc. The transistor is a p-n-p type such as the CK722. Modulated rf from the antenna is rectified by the diode. The capacitor is large enough so that it does not impede the rf. However, there is considerable impedance to the audio modulation. Therefore, the capacitor charges and discharges in accordance with the audio component of the signal, thereby varying the bias applied to the transistor.

Note that the diode polarity is such that the base is always more *negative* than the emitter. The audio output is amplified by the transistor and then fed to an earpiece or headphone set. Carefully check diode and battery polarities. The unit in Fig. 4 may be purchased in kit form (Philmore No. TR101).

A somewhat similar circuit is shown in Fig. 5. This is also available as a kit (Lafayette KT-80), and is designed to fit a small plastic pocket-size box measuring about 1 x 2 x 3 inches. This circuit contains a *flat* variable capacitor to peak the antenna circuit. Ordinarily, the variable is the most bulky item in a radio and would hardly be expected to fit into a pocket-size box. The earpiece is shown as a crystal type and a resistor is added to shunt the dc component around it. When a signal arrives, it charges the .02-uf capacitor and combines with the bias already established by the resistor.

The circuit of Fig. 5, like that of Fig. 4, is a combination crystal diode and transistor amplifier which can provide excellent reception of stations within a radius of 50 miles. In favorable locations stations up to 500 miles can be received. The current drain on the batteries is so low that an on–off switch is not necessary—the radio will operate for the approximate shelf life of the batteries.

An interesting feature of this circuit is the double-tuned antenna stage—a high-Q loopstick to select the station and the flat 365-µµf variable capacitor to peak the response curve of the station selected.

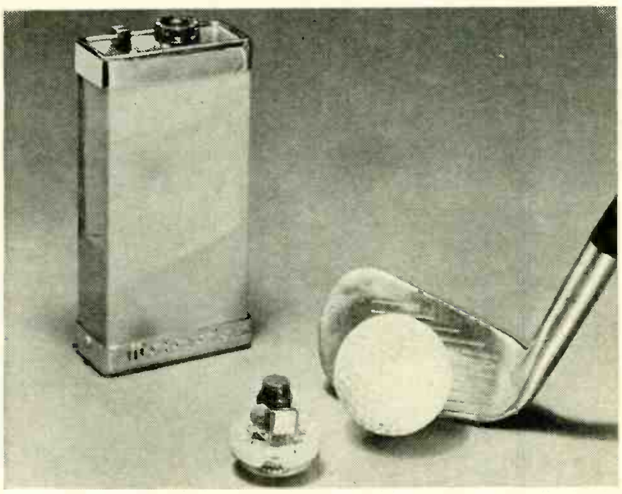
The Lafayette kit version of this crystal–grounded-emitter amplifier unit is connected and operated through six holes drilled in the plastic case—two small ones on one side for the antenna and ground wires, three medium-sized holes on the opposite side to permit mounting of the earphone jacks and the loopstick, one on top for the shaft of the variable capacitor.

Allied makes a printed transistor circuit as shown in Fig. 6. Copper stripes, bonded on a plastic board, are the conductors between components. This simplifies the wiring to some extent. A 50-foot antenna should be used in metropolitan areas. In rural areas where most of the stations may be distant, a 75–100-foot antenna may be required. The ground lead may be connected to a cold water pipe or a rod buried in the ground. The ground lead should make a good electrical connection.

No switch is shown in the diagram. When the phone tips of the headset are removed from their jacks, the battery is automatically switched off. The first transistor acts as a detector and amplifier in this circuit, and the designer found no advantage in adding a crystal diode.

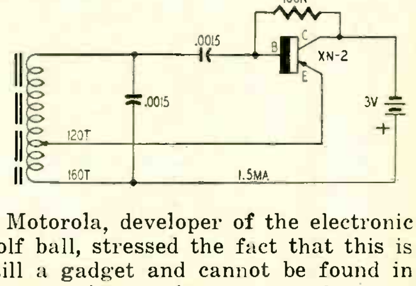
One rather unusual crystal set, designed by William H. Grace, Jr., consists of a crystal detector (Fig. 7) followed by a transistor with no *apparent power supply*. The collector returns through phones to one terminal of a large capacitor. The diode is connected opposite in polarity to those of Figs. 4 and 5. Thus the large capacitor charges with its left terminal *negative* so it can bias the collector properly. This offsets what was said previously about having it charge with its right terminal negative. However, the convenience of a *battery-less* receiver is the big feature in this case and it does have reasonable gain. TO BE CONTINUED

## TRANSISTORIZED GOLF BALL

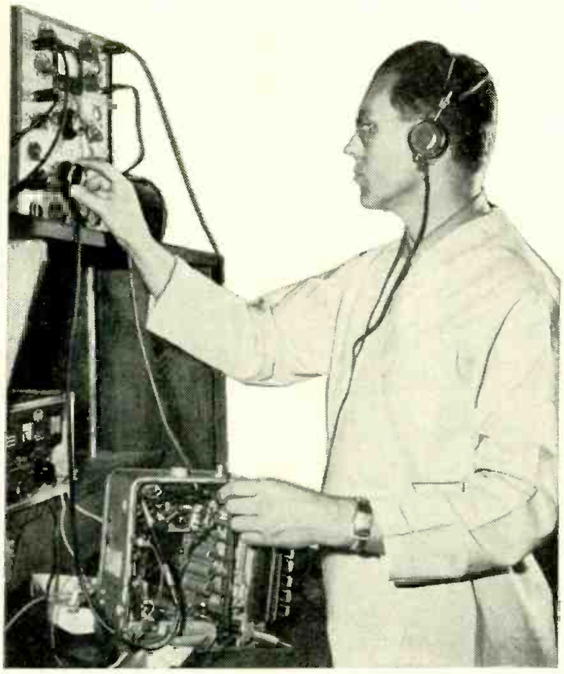


Divot diggers take heart, a nonlosable golf ball has been invented. Lost balls resulting from those hooks and slices into the rough may become a thing of the past with the development of a transistorized golf ball that transmits a sufficiently strong r.f. signal to be picked up by a portable pocket-size receiver (see photo). By merely rotating the receiver as a direction finder, a golfer can "home" on the elusive sphereoid. The diagram shows circuitry of the transistorized golf ball.

An experimental p-n-p type transistor is used in a simple Hartley oscillator circuit, with the number of turns on the oscillator coil as indicated in the schematic. The unit is powered by a small 3-volt battery. Of greater importance than this application is the fact that the extreme ruggedness of transistors is demonstrated—on teeing off, a golf ball is figuratively "shot from a gun."




Motorola, developer of the electronic golf ball, stressed the fact that this is still a gadget and cannot be found in any sporting goods stores at the present time.



Author aligning automobile receiver.

# ALIGNING BROADCAST RECEIVERS

*Speed and accuracy are features of this tuned-signal-tracer method*

By JAMES E. DALLEY

THE alignment method described here has been used for many years with good success. It is very popular with technicians who have learned to use it because of its simplicity, speed and accuracy. It is easier on the nerves than the standard method using a tone-modulated signal generator and output meter.

It is faster because only one probe need be connected to the receiver and it must be moved only once (no ground connection is needed); the low-frequency padder can be tuned in directly without "rocking" the tuning capacitor and because the set can be aligned as a normal routine while tracing the signal through to hunt for other troubles.

It is more accurate because it uses the signal directly from the broadcast station which is crystal-controlled. The local oscillator cannot interfere and give false indications. And since only the normally received signals are used, the circuits are not apt to be overloaded.

It is pleasant because you can usually listen to music while you are working. Even soap operas are easier to listen to than a monotonous 400-cycle tone.

The only piece of equipment necessary is a tuned signal tracer. The calibration does not have to be too accurate because broadcast signals are used and their frequency is accurately controlled. Frequencies of all local stations should be memorized. The setting of the intermediate frequency will depend on the calibration of the signal tracer, but it isn't serious if the intermediate frequency is changed a few kilocycles. The signal tracer must be sensitive enough to pick up local stations with just an alligator clip or a few inches of wire on the end of the probe. The probe, cable and entire instrument must be well shielded from stray pickup. Selectivity should be fairly good and the signal tracer must have some form of an output indicator such as an electron-ray tube or a meter.

Commercial tuned tracers are not too common today, though a number of the beacon receivers sold on the surplus market are excellent for the purpose, being accurately calibrated already. Or one can be constructed from an old broadcast receiver without much trouble, replacing the if trimmers with large variable capacitors and supplying an extra input direct to the if stages, bypassing the front end.

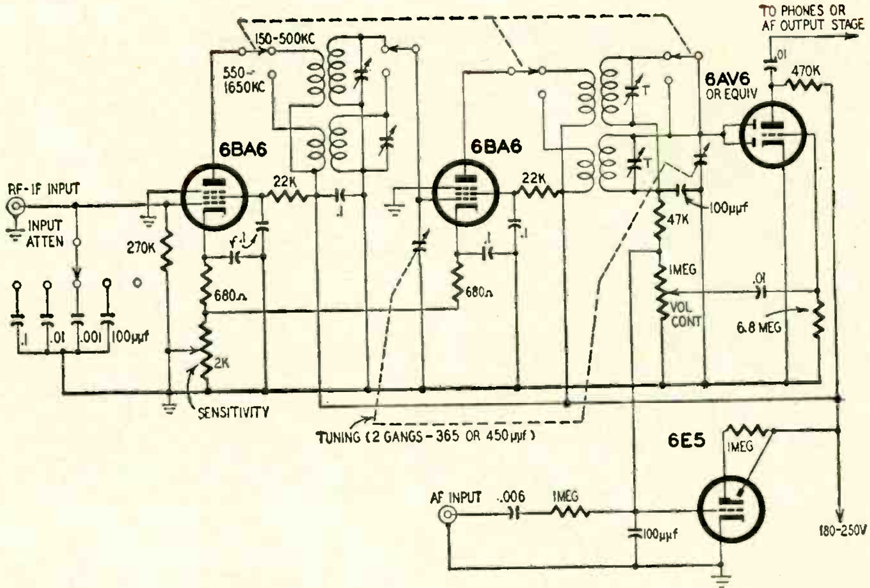
A permanent unit for the shop can be built without too much trouble. If made specially for the purpose, it should be designed to have a frequency range which would run from below the lowest if (there are still a few sets operating on a 175-kc if) to above the highest frequency you need. Ideally the range should be from 100 kc to 2 mc.

(Fig. 1 is a simple signal tracer covering from approximately 150 to 1600 kc in two bands. One like it can be built from an old trf receiver or from standard parts. The two-band coils are rf transformers for the aircraft-beacon and standard broadcast bands. Trimmers on the long-wave coils should be loosened or removed entirely so the circuits tune to at least 480 kc. An af output stage can be added if desired.—*Editor*)

In a superheterodyne receiver the intermediate frequency is produced by mixing and detecting the signals from the radio station and the local oscillator. In broadcast receivers the oscillator frequency is always above the station frequency by an amount equal to the intermediate frequency. For example, if a radio is tuned to a station on 600 kc and the local oscillator is tuned to 1055 kc, the intermediate frequency will be 455 kc. The intermediate frequency is found by subtracting the station frequency from the oscillator frequency. If the station and intermediate frequencies are known, the oscillator frequency can be found by adding them together. As different stations are tuned in, the difference between the oscillator and the station frequency must always equal the intermediate frequency. The adjustments to be made in aligning a receiver are: the dial pointer, the oscillator trimmer, the rf and mixer trimmers, the oscillator padder or coil slug, the if transformers. Most receivers do not have a low-frequency adjustment for the oscillator (padder or coil slug) or an rf stage. We will discuss the procedure to be used when both of these adjustments are included and they can merely be omitted when the set does not have them.

The radio and the signal tracer should be turned on and warmed up for 10–15 minutes before starting the adjustments. During this warmup period the radio dial can be "indexed" by turning the tuning capacitor to the low-frequency stop and adjusting the dial pointer to coincide with the lowest

Fig. 1—Diagram of simple signal tracer—covers 150–1600 kc in two bands.




mark on the dial. If the pointer is cemented to a dial cord, it may be necessary to use cement thinner to loosen it. The pointer should be cemented in place again after it has been adjusted. Turn the volume control of the receiver all the way down.

## Front end—high-frequency adjustments

1. Connect the if probe of the signal tracer to the plate of the mixer (point 1) in the receiver (see Fig. 2.)
2. Adjust the dial on the signal tracer to the intermediate frequency of the receiver.
3. Set the dial of the receiver to the frequency of a local station near 1400 kc. The receiver dial should be set to the correct frequency whether the station is heard there or not.
4. Adjust the oscillator trimmer (B) until the station is heard through the signal tracer. Make sure you have the right station by listening on another radio, or by tuning the signal tracer to the station frequency and identifying the program material. Be sure to return the dial of the signal tracer to the intermediate frequency if it is changed.
5. Continue to adjust oscillator trimmer B until a peak reading is obtained on the visual indicator of the signal tracer.
6. Adjust rf trimmer A (if used) and the mixer trimmer for peak reading on the signal tracer.
7. If the receiver has a low-frequency adjustment, proceed to the if; if not, tune across the dial and check the sensitivity of the stations especially at the low frequencies. If the sensitivity is good on the low end of the dial, proceed to the if adjustments. If it is not, the outside rotor plates of the oscillator and rf tuning capacitor can be bent to improve response.

## Front end—low-frequency adjustments

There are usually no rf adjustments for the low frequencies. This means that we must find where the low-frequency stations come in best through the rf circuits and adjust the oscillator for the proper difference frequency. In the signal generator–output meter method we make adjustments and check the results while rocking the tuning dial of the receiver until the proper combination of adjustments is found. With this method we can go directly to the proper adjustment. The procedure is as follows:

8. Tune the signal tracer to a local station near 600 kc.
9. Leave the signal tracer connected to the plate of the mixer. Enough signal should get through for this adjustment even though the signal tracer is connected across a circuit tuned to another frequency—the intermediate frequency.
10. Tune the radio to the same station. The radio dial will probably not indicate the exact frequency of the station but this should be disregarded and the radio tuned until maximum

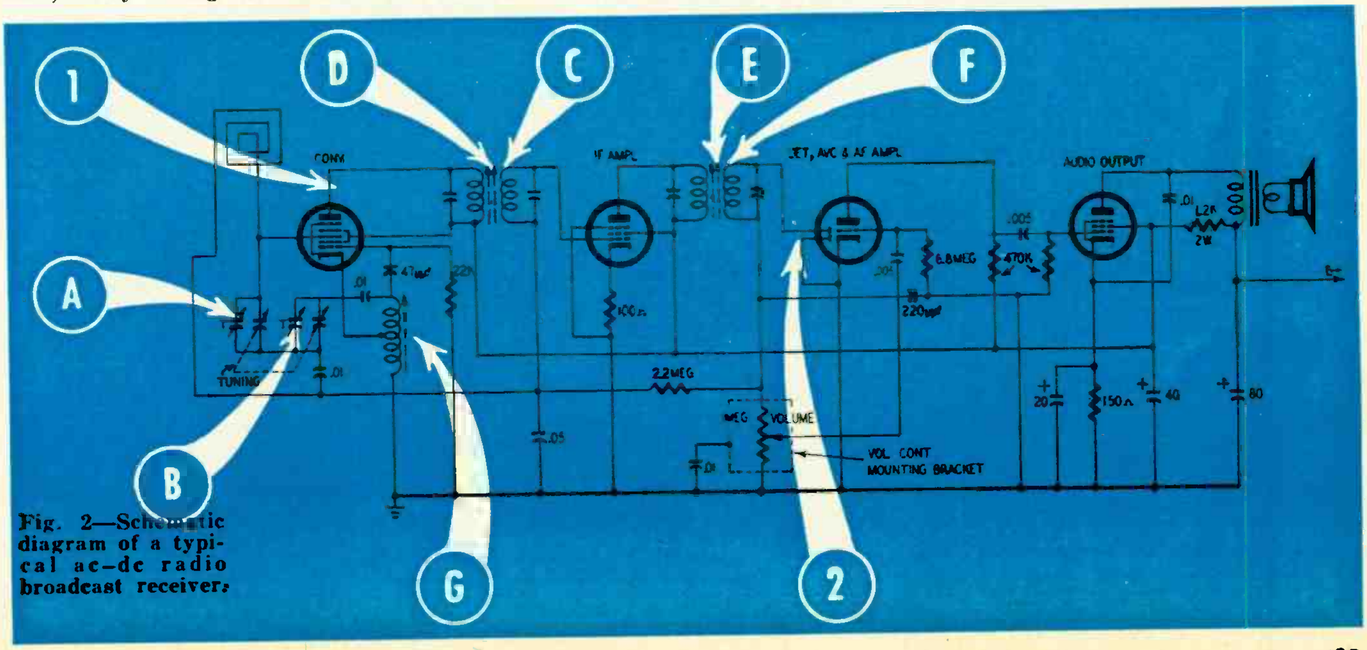



Fig. 2—Schematic diagram of a typical ac-dc radio broadcast receiver.


*Superior's New Model TC-55* **TUBE TESTER**

**FOR**
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**Speedy, yet efficient operation is accomplished by:**

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2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

**You can't insert a tube in wrong socket**
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

**"Free-point" element switching system**
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap".

**Checks for shorts and leakages between all elements**
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

**Elemental switches are numbered in strict accordance with R.M.A. specification.**
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

**$26.95 NET**

*Superior's new Model TV-11* **TUBE TESTER**

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★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

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**ALSO TESTS TRANSISTORS!**

*Superior's New Model TV-12* **TRANS-CONDUCTANCE TUBE TESTER**

**TESTING TUBES**

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

**TESTING TRANSISTORS**

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

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We do not make nor do we recommend use of C.R.T. adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a makeshift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensable instrument.

Incidentally, the Model TV-40 is the ONLY low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electro-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

*Superior's New Model TV-40* **C. R. T. TUBE TESTER**

**Tests ALL magnetically deflected tubes... in the set... out of the set... in the carton!!**

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
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EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (Ion trap need not be on tube). Throw switch up for quality test... read direct on Good-Bad scale. Throw switch down for all leakage tests.

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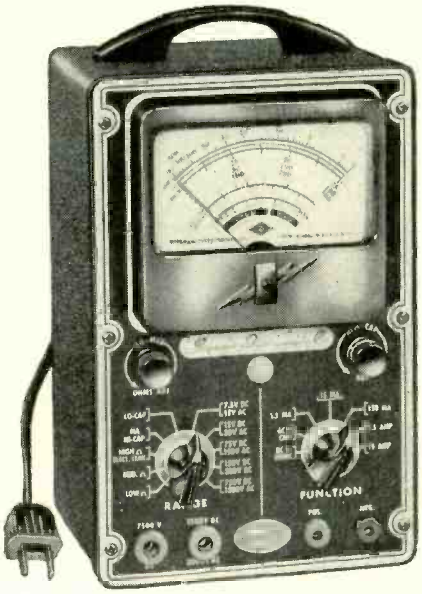
Superior's new Model 670-A

# SUPER METER



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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. (Good-Bad scale for checking quality of electrolytic condensers)

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Superior's New Model TV-50

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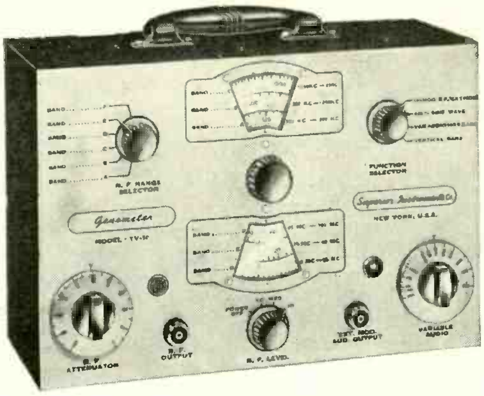

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- ✓ Audio Frequency Generator
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- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

**R. F. SIGNAL GENERATOR:** The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

**VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

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indication is obtained on the signal tracer. This step tunes the rf stages to the exact frequency of the station.

11. Set the dial on the signal tracer to the intermediate frequency. Be sure not to disturb the radio dial setting.

12. Turn the oscillator padder (or slug) G for maximum reading on the same station used in step 8.

13. Steps 1, 3, 4 and 5 will now have to be repeated. If the oscillator trimmer is very far out, the low-frequency adjustments will have to be repeated and the high-frequency adjustments done a third time.

Remember to start and end with the high-frequency adjustments and keep going until very little change is needed for the oscillator trimmer adjustment. If the radio dial cannot be read accurately, step 6 will have to be repeated in the high-frequency adjustments too.

### Intermediate-frequency adjustments

The intermediate-frequency transformer trimmers are next adjusted as follows:

14. Move the signal tracer probe to the diode detector plate (point 2). Unless the if transformers are too far out of alignment, enough signal can be picked up by clipping the probe to the insulation of the plate lead rather than making direct connection. This gives better isolation which prevents detuning the circuit with the probe capacitance.

15. Leave the signal tracer tuned to the intermediate frequency.

16. Leave the radio tuned accurately to the local station near 1400 kc.

17. Adjust the if trimmers C, D, E and F for maximum indication on the signal tracer. Do not take too much time on this adjustment as only an approximate setting is required. The order of adjusting the trimmers is not important.

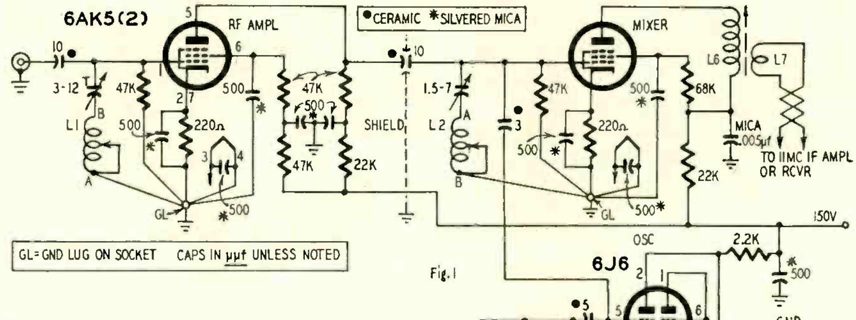
18. After all of the if trimmers have been adjusted to their approximate settings, repeat the adjustments for exact maximum readings. It is necessary to make the adjustments twice because the settings of the primary and secondary trimmers (or slugs) affect each other. If the set starts to oscillate during the if adjustments, it usually indicates that the if transformers cannot be operated exactly on maximum settings and the trimmers should be stagger-tuned slightly until maximum gain with good audio quality is obtained without oscillation.

Disconnect the signal tracer and turn up the volume control. Tune across the entire dial and check the number, strength and quality of the stations received against comparable sets.

This alignment method follows the natural signal through the set in a logical manner. After a little practice this outline can be discarded and no notes of any kind will be needed on most receivers. Variations for peculiar conditions can easily be worked out after the basic method of alignment is understood. END

# 50–240-mc Converter–Receiver Using Helical Type Inductuner

MANY readers have expressed interest in circuit applications for helical type Inductuners that they have purchased through the bargain or surplus pages of mail-order radio supply catalogs or salvaged from old TV receivers. The basic tuning range of these Inductuners is 50 to 240 mc but it may be shifted higher by using shunt inductors or lowered by inserting fixed inductors in series with the variable elements. These units may be used as tuning elements in signal generators, frequency meters and monitors, receivers, converters, boosters and other devices.



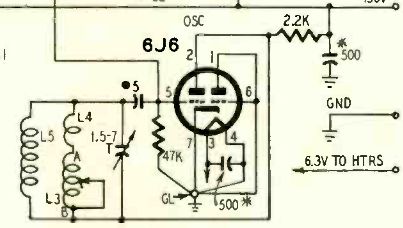



Fig. 1 is the diagram of a 50–240-mc converter that was described in a Mallory technical bulletin on the helical type Inductuner. The 11-mc if output of the converter can be fed to a receiver tuned to this range or to an 11-mc if strip designed for either AM or FM reception.

L1, L2 and L3 are the rear, center and front sections, respectively, of the Inductuner. L4 and L5 are end and shunt inductors required to shift the oscillator tuning range to 61 to 251 mc —assuming an 11-mc if L4 consists of ½ turn of No. 18 copper wire, with a radius of about ¾ inch, soldered between terminal A on the front section of the Inductuner (see Fig. 2) and a ceramic standoff insulator installed next to the 6J6 oscillator socket. This insulator serves as the tie point for the junction of the 5-μμf 6J6 grid capacitor, end inductor L4, the 1.5–7-μμf oscillator trimmer and shunt inductor L5.

L5 consists of 28 turns of No. 30 enameled wire closewound on a ¼-inch diameter polystyrene rod. Converter output coil L6 may be the primary of a 10.7-mc if transformer or approximately 49 turns of No. 28 enameled wire closewound on a National XR-50 form. L7 is a three-turn link of hookup wire wound around the ground end of L6.

Hum is minimized by bypassing the heater supply lead and running it above the chassis to isolate it from the hum-sensitive grid circuits.

An absorption type wavemeter or grid-dip oscillator is used for alignment. Connect a 25-ma meter between the B plus end of the oscillator plate resistor and the 150-volt line. Tightly couple the wavemeter to L5 and tune the Inductuner to the maximum counterclockwise position. Tune the wavemeter through the range of about 40 to 80 mc and note the wavemeter frequency setting when oscillator plate current rises sharply. Vary the oscillator trimmer capacitor so the meter reading peaks at 61 mc (60.7 mc for 10.7-mc if's).

Now, tune the Inductuner to the extreme clockwise end of the range and check the oscillator frequency at around 251 mc. If the wavemeter shows the oscillator frequency to be higher than 251 mc, spread the ½-turn inductor (L4) to increase its inductance and lower the frequency. Squeeze the sides together if the oscillator frequency is low.

Return to the low end of the dial and touch up the trimmer capacitor and

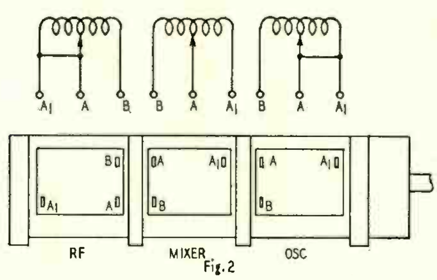
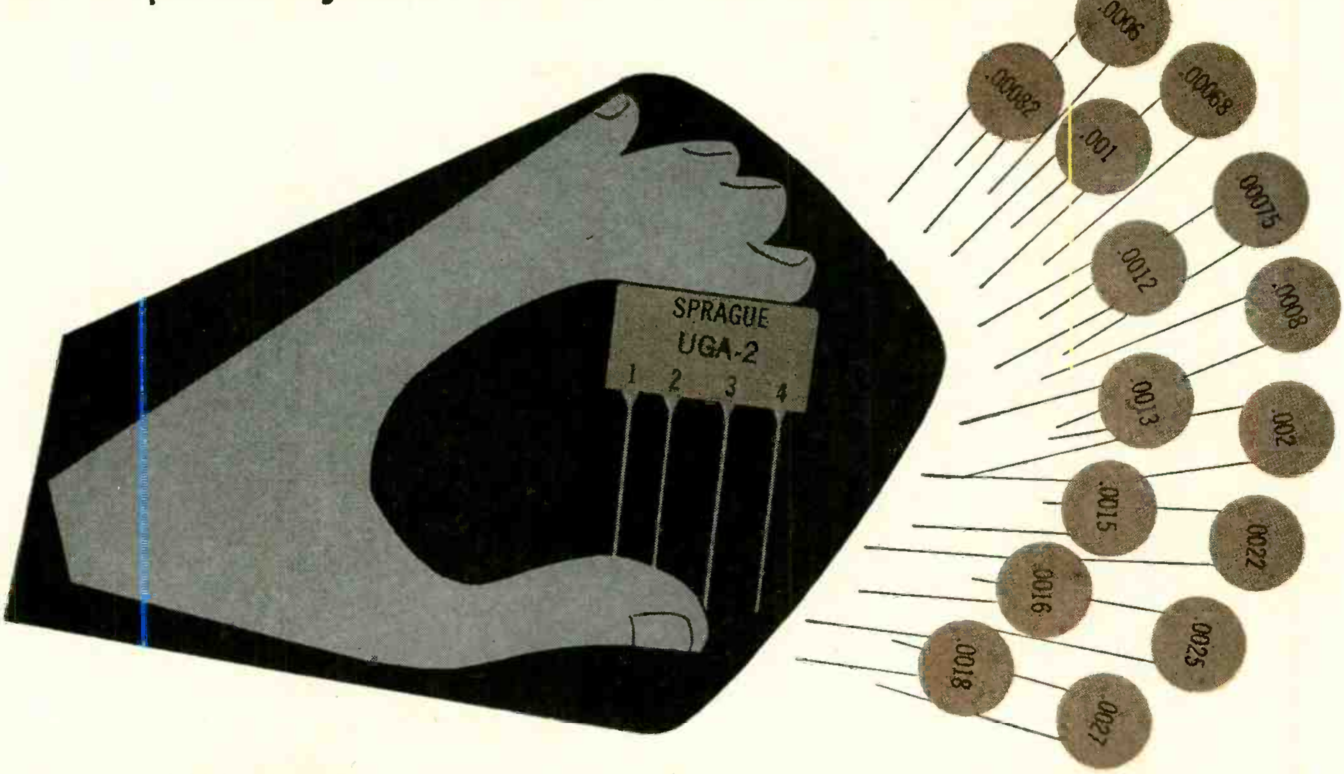


Fig. 2

then check the high end again. Repeat the high- and low-end adjustments until the oscillator tuning range is exactly 61 to 251 mc.

Connect the converter output to a receiver tuned to 11 mc and peak L6 for maximum tube hiss. Set the Inductuner three full turns from the low-frequency end. Connect an antenna to the converter and feed in a signal from a signal or marker generator set in the range between 63 and 65.7 mc. Adjust

## the capacitor you DREAMED about is HERE!




# this ONE new ceramic capacitor does the work of FIFTEEN

NOW . . . you can handle a big percentage of special value and standard value ceramic replacements with a few Sprague "Universals". Just four of these remarkable new capacitors take the place of forty-two regular capacitors, with capacitance values from 400 $\mu\mu$F to .015 $\mu$F. You can also use them to replace molded mica, ceramic tubular, and paper tubular capacitors in many bypass and coupling applications.

Sprague 'Universals" are easy to use! No complex arithmetic involved. One look at the handy reference card packed with each capacitor tells the complete story . . . which "Universal" to use . . . how to wire the leads for the capacitance required.

Type UHK-1, with seven needed values from .001 to .004 $\mu$F, is a High-K capacitor for use where rated capacitance is the lowest value permissible. Type UGA-1, with twelve values from .0004 to .0013 $\mu$F, is a general application unit with a capacitance tolerance of $\pm 20\%$. UHK-2, covering eight values from .0025 to .015 $\mu$F, is a High-K capacitor like UHK-1. Type UGA-2 covers fifteen values from .0006 to .0027 $\mu$F, and is a general application unit with a $\pm 20\%$ capacitance tolerance.

Put Sprague "Universal" ceramic capacitors on your "want" list now. Your customers won't ever have to spend another night without television for lack of a simple ceramic replacement.

A FEW EXAMPLES OF HOW FOUR "UNIVERSAL" CAPACITORS MEET 90% OF ALL CERAMIC REPLACEMENT NEEDS

**For .0004 $\mu$F**
Cut leads 2 and 3 from a UGA-1 "Universal". Use leads 1 and 4 as terminals. UGA-1

**For .005 $\mu$F**
Cut leads 2 and 4 from a UGA-1 "Universal". Use leads 1 and 3 as terminals. UGA-1

**For .001 $\mu$F**
Cut lead 2 from a UGA-2 "Universal". Solder lead 3 to lead 4. Use leads 1 and 4 as terminals. UGA-2

**For .002 $\mu$F**
Cut lead 4 from a UGA-2 "Universal". Solder lead 2 to lead 1. Use leads 1 and 3 as terminals. UGA-2

**For .0033 $\mu$F**
Cut lead 4 from a UHK-1 "Universal". Solder lead 3 to lead 1. Use leads 1 and 2 as terminals. UHK-1

**For .01 $\mu$F**
Cut lead 1 from a UHK-2 "Universal". Solder lead 4 to lead 2. Use leads 2 and 3 as terminals. UHK-2

**For .015 $\mu$F**
Solder lead 3 to lead 1 on a UHK-2 "Universal". Solder lead 4 to lead 2. Use leads 1 and 2 as terminals. UHK-2

**don't be vague . . . insist on**

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Sprague Products Company • Distributors' Division of the Sprague Electric Company • North Adams, Massachusetts.

the mixer and rf amplifier trimmer capacitors for maximum output from the receiver.

Set the signal source to 210 mc and tune the Inductuner one-half turn from the extreme-high-frequency end. Readjust the rf and mixer and trimmer capacitors for maximum signal output. If capacitance must be increased, add a small amount of inductance between the trimmers and their respective grids. If the trimmer capacitance must be decreased, the stray inductance is too high. You can reduce it by shortening grid leads and by using ⅛-inch wide strips of No. 20 copper to replace the bus bar in the grid circuits of the associated tube.

Fig. 3 shows the circuit of an 11-mc if strip with a superregenerative second detector and one stage of audio voltage amplification. L9 and L10 are the same as L6. L8 is the same as L7. Adjust the coupling capacitor between the if amplifier and the detector for optimum detector performance. Detector sensitivity increases and selectivity decreases as loading is increased. Adjust the regeneration control for a smooth soft hiss. END

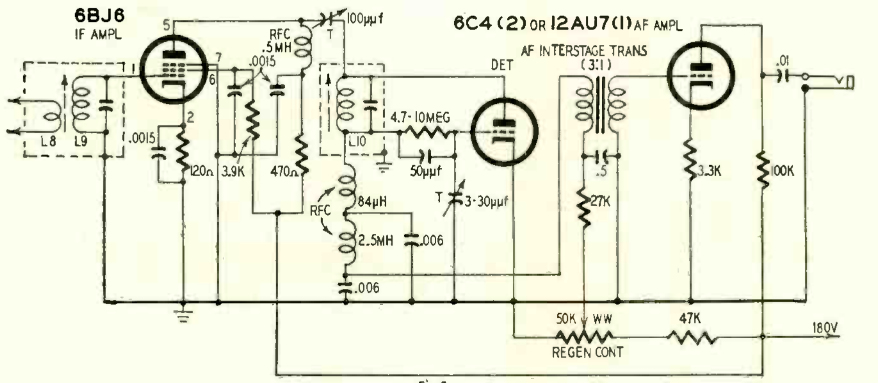



Fig. 3

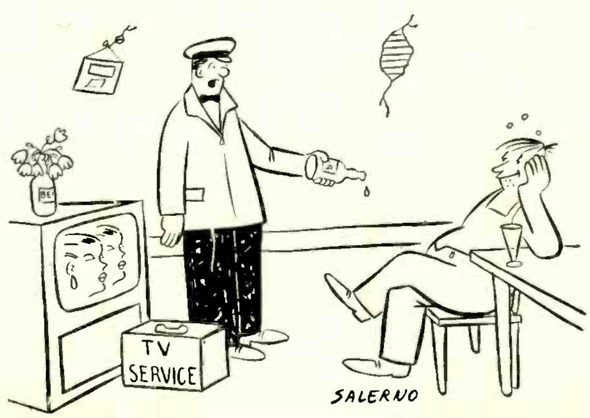
## HELP WANTED

Ordnance engineering cuts across many fields of science and technology and information for design work is drawn from many diverse fields of knowledge. If there is some chance that your subject field might be of interest in ordnance work and if you have either formal or informal collections of terminologies, glossaries, specialized dictionaries or even references to them—please contact:

Allen Kent, Associate Director
Center for Documentation and Communication Research
School of Library Science
Western Reserve University
Cleveland 6, Ohio

The Army Ordnance Corps is preparing a comprehensive *Ordnance Engineering Design Handbook* to summarize fundamental principles and basic design data. It is planned that the handbook will consist of approximately 180 sections of about 100 pages each. During the Korean war it became evident that a central reference of ordnance design information would have materially speeded design, development and production of new military weapons. In a future conflict, need for such available publications may become even more acute.

It is a matter of considerable importance that uncertainties as to the meaning of terminology and nomenclature do not impede ordnance design and development. It is no easy matter to establish definitions for many ordnance terms that are also used in other areas of science and technology. Cooperation in avoiding confusion as to meanings of terms should prove helpful not only to designers and users of ordnance, but also to you. END




"Here's your double images Mr. McQueade."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RADIO

# IDENTIFYING TRANSISTORS

By HENRY A. KAMPF*

THERE are more than 15 transistor manufacturers in the United States today and the total number of transistors manufactured has been estimated in excess of 50 million. The industry has grown rapidly with new processes developed daily and new types of transistors being put on the market every few weeks. However, very little energy has been directed at standardizing transistor type or lead designation with the result that almost every manufacturer has a different way of identifying his transistors. This necessitates having a complete manufacturers' data sheet for each type of transistor before it can be used.

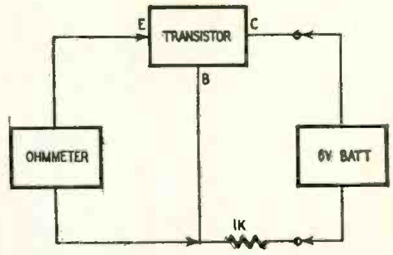
In many instances the transistors have been available while their data sheets were, for some reason or another, not to be had for any price. This usually happens if the manufacturer decides to discontinue the transistor type and it becomes obsolete. These transistors can still be used by applying the method described here to determine the lead connection and transistor type. This will provide the starting point for measuring the other transistor characteristics should they be required.

The following information may be obtained:

1. The base lead
2. Polarity (p-n-p or n-p-n)
3. The emitter and collector leads
4. Type (point contact or junction)

The procedure listed below requires 10 simple resistance measurements made using an ohmmeter similar to the Simpson model 260 VOM (20,000 ohms per volt). Any given pair of leads of the transistor will show diode action; the resistance measured with the ohmmeter connected one way will be much lower than with the leads reversed. The low resistance is called the forward resistance, the high the back or reverse-bias resistance. The resistance measurements should be made with an ohmmeter whose lead polarity is known. If the ohmmeter leads are not marked, they can be determined by using another voltmeter.

* Engineering Div., Link Aviation, Inc.




**Determining type of transistor.**

# MOST ACCEPTABLE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Universal vibrator transformers, produced through the combined electronic skills of Delco Radio and General Motors, meet the requirements of nearly every model of auto radio. Each is designed for easy installation and complete customer satisfaction. Laminated core inserts are stamped out of low-loss silicon steel and heat treated to maintain correct magnetic properties. Coils are precision-wound on special machines. All models have ample leads. Your UMS-Delco Electronic Parts Distributor can supply you with all models. Call him today. Remember, the Delco Wonder Bar Radio is being nationally advertised in leading consumer publications . . . so you are tuned in on a constantly increasing service.

**Uncased Models 6055, 6065, 6067 do not include filter network**

Cased Models 6060, 6064 and 6066 are made with "A" line filter network consisting of an "A" choke and .5 mfd. capacitor. Easy-mount drilling template, plus three self-tapping screws are included for your convenience.

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WONDER BAR
**RADIO**

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

GM GENERAL MOTORS PARTS SALES

A GENERAL MOTORS PRODUCT—A UNITED MOTORS LINE
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## RADIO

CAUTION: Do not permit a current larger than 1 ma to flow through the transistor. If the current delivered by the ohmmeter is not known, it should be checked with a milliammeter. Some ohmmeters use currents as high as 100 ma. The Simpson model 260 is usable if only the two highest resistance ranges are used.

1. The first lead determined is the base lead of the transistor, found by measuring the three forward resistances of the transistor from lead to lead. The highest *forward* resistance is that between the emitter and collector. Therefore, the unused lead is the base lead of the transistor.

2. The transistor may now be classified as to polarity, p-n-p or n-p-n. With the negative lead of the ohmmeter connected to the base, connect the positive terminal of the ohmmeter alternately to the other two transistor leads. If forward-resistance measurements are obtained, the transistor has a p-n-p polarity. Note that the real positive lead of an ohmmeter may be the nominal negative (common). Check the leads with a dc voltmeter.

3. The emitter and collector leads have been identified as a pair and can now be individually identified. Connect the ohmmeter to them to read the forward resistance and note the position of the positive lead. If the polarity of the transistor is p-n-p, the positive lead will be at the emitter; if the transistor is an n-p-n type, the positive ohmmeter lead will be at the collector.

4. A point-contact transistor can easily be distinguished from a junction transistor by its negative emitter-base resistance. Connect the ohmmeter as shown in the diagram to measure the emitter-base forward resistance. (The positive lead is connected to the emitter for p-n-p polarity.) Momentarily connect the 6-volt battery so that it will give a reverse bias to the collector. The emitter-base forward resistance for a *junction* transistor will drop to about one-half its value when the reverse bias is connected to the collector. However, if the transistor is a point-contact type, the resistance indication will go past the zero point and indicate a negative resistance when this reverse bias is applied. END

# new Records

MONITOR

**Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.**

**SCHUBERT: *Sonata in A minor***
***Sonata in A major***
**Friedrich Wuhrer, pianist**
**Vox PL-9130**

A really faithful reproduction of the piano is still the hardest thing to find on records. Because Mr. Wuhrer does not believe in wasting delicacy where he feels the composer calls for brawn, he does a particularly good job in bringing out that very difficult bass end of the keyboard with some resemblance to the genuine in-the-flesh article. He is one pianist who can make the piano sound forte and bring out the characteristic sympathetic resonances and beat notes. This is one of the best and should please both lovers of the piano and high fidelity. It is played in a live room and when played back in a moderately dead one sounds as if the loud pedal were held down continuously—proof that hangover and room resonance are fraternal twins.

**HAYDN: *The Creation***
**Soloists, Chorus and Vienna State Opera Orchestra, Mogens Woldike, conducting**
**Vanguard VRS-471/2**

If, like myself, you have never cared much for oratories, cantatas and the like, here is a version of one of the greatest of all of them which may well convert you if you give it a chance. As usual it is sung in the original German, but the commentary includes text in German and immediately beside it a literal English translation making it easy to follow the sense, particularly since the diction is much clearer than usual. With an understanding of the words the music acquires meaning and delightfulness and it is easy to see why it has been for so long one of the classics. But whether one understands the words or not, the overall effect of the sound is notable for the excellent balance of voices and orchestra and the fine definition. If you want to demonstrate to a choral conductor or teacher, this is superb fare.

**MILLOECKER, Karl: *The Beggar Student***
**Soloists, Chorus and Vienna State Opera Orchestra, Paulik conducting.**
**Vanguard VRS-474/5**

Milloecker was a contemporary of the Viennese Strausses and *The Beggar Student* was a highly popular comic operetta of the day; it is still popular on the continent. It is sung in German but English and German texts side-by-side make the plot easy to follow. The music has the authentic lilt and the recording is highly exceptional.

***Flamenco***
**Solo guitar played by Mario Escudero**
**Folkways FP-920 (10-inch LP)**

Virtuosos of the Spanish guitar are almost incredible in their agility and provide some exceptional demonstration and test material, particularly the various transients which accompany picking, slapping and plucking the instrument. This is not as good in this latter respect as the Almeida disc (Capitol P-8295) but evidences a more effortless mastery of the instrument. The machine-gunlike bursts of tran-

NEW RECORDS *(Continued)*

sients in spots, are, however, most demanding and provide a good measure of transient response. The disc comes with a booklet which tells the story of the flamenca and the guitar's part in them in detail.

**SIBELIUS:** ***Symphony No. 4***
***Pohjola's Daughter***
**Anthony Collins and London Symphony Orchestra**
**London LL-1059**

Since this year celebrates the 90th birthday of Sibelius there will, no doubt, be a flood of Sibelius recordings and a brilliant Sibelius record such as this London recording would make an appropriate gift. Like most of Sibelius' music this is somber stuff with not too memorable melodies. But from a hi-fi point of view it gives the double basses a nice workout and with a horn or other large speaker should vibrate the floor nicely. Also notable are the typically snarling Sibelius brass chords, especially in the *Pohjola's Daughter*. The strings have the characteristic ffrr sharpness.

***Erin o Erin***
**A Thomas Moore Suite, Richard Ellsasser at the Baldwin Organ**
**MGM E 3205**

The Irish especially will enjoy this potpourri of classic Irish songs but the Baldwin organ will sound impressive on any fair to middlin' hi-fi outfit, particularly because the bass is well furnished with harmonics to energize small speaker systems and provide the illusion that they are radiating a real pedal fundamental.

### Vocals

Voices provide fine tests for naturalness because all of us are more familiar with their natural sound than we are with that of musical instruments. Unfortunately, in operatic and recital vocals the voice is too artificial in style to be familiar and popular vocals are so gimmicked up with miking tricks, echo boxes, etc., that any resemblance to the genuine human voice is coincidental. Here, however, are a few late records which do provide excellent examples of ungimmicked human voices and therefore good test material for naturalness, presence, etc.

***Paris After Midnight***
**Liane with Boheme Trio**
**Vanguard VRS-7025**

***Night and Day (Cole Porter Songs)***
**Liane with Boheme Trio**
**Vanguard VRS-7029**

If you like your music as background to romancing, this over a fine hi-fi outfit can be as good an ally as you can find. The music is of the romantic mood type. The piano is very nice, the guitar is delicate, the double bass is unobtrusive but deep and well defined. As for Liane, her voice is so natural in its husky continental intimacy and emotional shading you may think it is being softly sung in your ear by your companion.

***The Mitchell Boys Choir***
**Hifirecord R-301**

The featured solo voices especially are presented with tremendous presence and naturalness — assuming you can picture yourself in the conductor's position — and the nuances of each youthful voice are wonderfully defined. The organ accompaniment has a fine pedal bass. The music consists of an even dozen favorites like *Come Back to Sorrento, The Happy Wanderer, Oh What a Beautiful Morning, El Rancho Grande.*

***Dick Stewart Sings***
**Hifirecord R-401**

Stewart is a crooner but this recording is free of the usual crooner effects with the result that the voice is so natural that its inadequacies of tone, pitch and volume are all too clearly defined. The accompanying Wurlitzer, electric guitar, drums, harp, bass and sax provide some listenable and impressive high-highs, bass, percussive, etc. The organ high-highs on the 1-inch pipes are especially sharp. END

*Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records,* RADIO-ELECTRONICS, *154 West 14th St., New York 11, N.Y.*

## THE FUND REACHES $12,019.36

# HELP - FREDDIE-WALK FUND

THE Help-Freddie-Walk Fund has just received a very encouraging letter from Herschel Thomason, service technician of Magnolia, Ark., and father of 8-year-old Freddie, who, as most of our readers know, was born without arms or legs.

Freddie was fitted with legs some time ago and has learned to use them almost as well as any normal child. A short while ago he was fitted with his first arm, and it has opened up a new world of experience for him. As the accompanying photo shows, Freddie is learning to feed himself.

His father writes: "He is still doing very well with his arm and uses it all the time. He can wear it all day long without tiring and, as far as the basic movements are concerned, he has mastered it completely.

"He also walks very well on the new legs he received on his last trip. They are about 3 inches longer and quite a lot bigger than the previous ones. When he has his arms and legs on now, he really looks grown up."

Freddie has received some wonderful letters in the last 3 months. Bobby Hoffman, of Richmond, Va., writes:

"I was born the same day and the same year that you were (March 31, 1948). I hope that you are being taken good care of. I hope that you receive much greater help than my dollar from many, many more friends."

And another friend of Freddie's, who prefers to remain anonymous, has written to the Fund: "I am indeed happy to read of the good progress little Freddie is making. Glad to see that the Fund is growing and that you are still promoting this wonderful endeavor—it is a brilliant ray of light, shining through this age which tends toward overcommercialism."

Mr. W. H. Nicholson, of Voiture 370 of the 40 and 8 Society, sent the following along with their donation: "The primary purpose of our organization is child welfare and we are always interested in giving our help so that it will benefit some child.

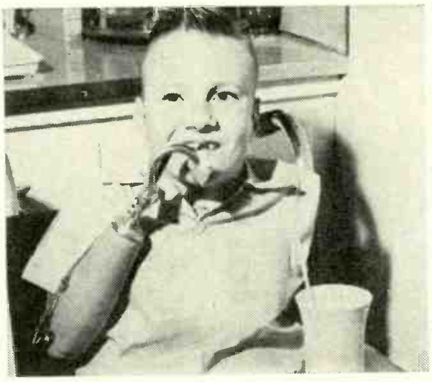
"We feel that your Fund is an excellent cause and by unanimous vote the membership of Voiture 370 expressed its desire to assist in some small way. Please accept this donation with our best wishes."

We would also like to make special note of contributions received from the Philadelphia–Camden Chapter of the National Radio Institute Alumni Assn. and from the Newport County Radio Club, Newport, R. I., whose members are making their second donation to the Fund.

The Fund has now topped $12,000, but thousands more will be needed before Freddie's growth is complete. The mechanical limbs, upon which he will be dependent all his life, must grow as he does. Therefore we again ask our readers to be as generous as they can in support of this worthy cause.

Any contribution you might be able to make will be acknowledged and sincerely appreciated, no matter how large or small it may be. *Make out all checks, money orders, etc., to Herschel Thomason.* Send all contributions to:

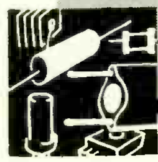
Help-Freddie-Walk Fund
% RADIO-ELECTRONICS
154 West 14 Street
New York 11, New York



**Freddie Using His New Arm**

| | |
|---|---|
| RADIO-ELECTRONICS Contributions as of Jan. 10, 1956 | $11,272.23 |
| FAMILY CIRCLE Contributions | 602.50 |
| Anonymous, Ontario, Canada | 2.00 |
| Anonymous, APO 858, New York, N.Y. | 10.00 |
| Anonymous, Aberdeen, Wash. | 50.00 |
| Joe Apathy, Sacramento, Calif. | 2.50 |
| "Beets," Buffalo, N.Y. | 5.00 |
| Corner Drug Store, Lawrence, Mass. | 5.00 |
| Dyna Company, Philadelphia, Pa. | 10.00 |
| Thomas B. Harvey, St. Louis, Mo. | 10.00 |
| Bobby Hoffmann, Richmond, Va. | 1.00 |
| Clyde Hudson, Cloverdale, Ore. | 2.00 |
| R. Kelly, Richmond, Va. | 10.00 |
| La Societe des 40 Hommes et 8 Chevaux, Voiture No. 370, New Britain, Conn. | 10.00 |
| H. C. Matzinger, Wyandotte, Mich. | 2.00 |
| Howard Merrylees and Family, La Mesa, Calif. | 2.00 |
| Newport County Radio Club, Newport, R.I. | 5.00 |
| Philadelphia–Camden Chapter of the National Radio Institute Alumni Assn., Philadelphia, Pa. | 5.00 |
| Robert Price, Chicago, Ill. | 2.00 |
| T. P. Roche, Rock Island, Ill. | 1.00 |
| Mr. and Mrs. Luis M Ruiz, Camden, N.J. | 2.00 |
| Fred K. Unick, Rockford, Ill. | 2.00 |
| Robert G. Watson, Xenia, Ohio | 4.13 |
| Herbert J. West, New York, N.Y. | 2.00 |
| TOTAL CONTRIBUTIONS as of April 10, 1956 | $12,019.36 |

# new Devices



**TV ANTENNA KITS,** do-it-yourself jobs in display box include instructions. 26 hardware kits labeled from A to Z make up over 150 antenna packages. 6 basic Tescon conical antenna types used: 3 single-bay antennas and stacked versions of each single-bay unit. Hot-dipped galvanized masts complete pre-

assembled all-aluminum antenna construction. Every kit contains all hardware, lead-in wire, mast and other items necessary for complete installation.—**Tescon TV Products Co., Inc.,** Springfield Gardens 13, N. Y.

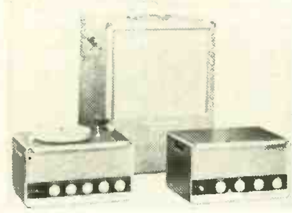
**DUAL AUTOMOBILE RADIO AERIAL** for rear-deck installation. Each handy, compact green and yellow display carton contains 2 chrome-plated aerials,


mounts, extension leads, clips and all fasteners. Compact base assembly for top mounting permits simple, speedy installation in restricted space. Sturdy, 3-section aerial masts extend to 30 inches. Built-in antirattlers.—**Delco Radio,** Div. of General Motors, Kokomo, Ind.

**CERAMIC CARTRIDGE** weighs 4½ grams. Uses osmium stylus for 33⅓- and 45-rpm and sapphire for standard 78-rpm re-

cordings. Turnaround throw-away cartridge snaps in without use of tools.—**Elgin National Watch Co.,** Elgin, Ill.

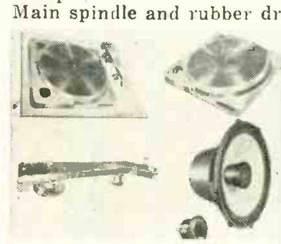
**COMMERCIAL AMPLIFIERS.** *Pacemaker* line of 8 models and various accessories: 10-watt ac amplifier; 10-watt system comprising 10-watt ac amplifier and speaker; 20-watt ac amplifier; 33-watt ac amplifier; two 6-volt



20-watt mobile amplifiers, with single- and 3-speed phono tops. 10-watt models have peak of 18, 30-watt models peak of 28 and 33-watt amplifier peaks at 48.—**Bell Sound Systems, Inc.,** 555 Marion Rd., Columbus 7, Ohio.

**HI-FI EQUIPMENT,** *PK-100* transcription turntable, *PK-90* viscous-damped transcription tone arm and *SK-58* 12-inch coaxial speaker.

Main spindle and rubber drive

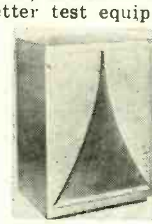


wheel of transcription turntable ball-bearing mounted. Four-pole shaded motor. Variable speed within ±7% for 33⅓, 45 and 78 rpm. Wow less than 2%, flutter less than .05%.

PK-90 viscous-damped tone arm has plug-in solderless cartridge holder accommodating all standard cartridges including turnover G-E. Accepts records up to 16 inches; arm height fully adjustable.

SK-58 12-inch coaxial speaker's frequency range 30 to 15,000 cycles; rated at 20 watts maximum input. Cone of specially processed fiber suppresses circular and radial nodal vibrations. Crossover network built in. Voice-coil impedance 8 ohms. —**Lafayette Radio,** 100 Sixth Avenue, New York 13, N. Y.

**IMPROVED SPEAKER ENCLOSURE,** *Karlson 15.* Tested with better test equipment and



microphones than were available for earlier enclosure. Few slight changes in internal dimension gave considerable improvement. Available in kit and finished


# HE PROVED IT FOR HIMSELF!

The new Pyramid Imp is smaller, yet better than any other molded paper tubular capacitor; Operates at full rating of 100°C (212°F—boiling point); Exceeds moisture resistance requirements of U. S. Government specifications MIL-C-91A; Copperweld leads are securely imbedded to withstand 4 360° bends without breaking.

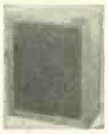
These features, plus an almost indestructible thermo-setting plastic encasement make Pyramid Imps your best molded paper tubular capacitor.

*For full information on Pyramid capacitors and rectifiers, see your local distributor or write to*

DISTRIBUTOR DIVISION
**PYRAMID** ELECTRIC COMPANY
1445 Hudson Blvd., North Bergen, N. J.

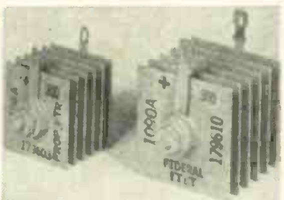
form.—**Karlson Associates, Inc.,** 1610 Neck Rd., Brooklyn 29, N. Y.

**RANGE EXTENDING KIT,** *SS-1B*, forms 4-way speaker system when used with model *SS-1*, 2-speaker kit. Super tweeter and 15-inch woofer. Functions between 35–600 cycles and 4,000–16,000 cycles. Combined frequency response of *SS-1* and



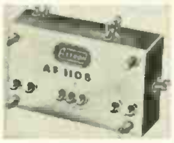
*SS-1B* ±5 db from 35 to 16,000 cycles. Exposed panels furniture-grade plywood suitable for light or dark finish. Precut and ready for assembly. Instruction manual. Speakers ready for installation and crossover circuit with balance control included.—**Heath Co.,** Benton Harbor 20, Mich.

**SELENIUM RECTIFIERS,** high-current density type, almost 50% smaller and lighter than



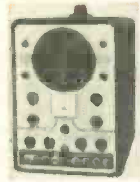
conventional selenium stacks. New process enables current density in forward direction to be considerably increased while maintaining same voltage drop as conventional cells. Cell size for given output can be reduced. Operate safely at higher voltages and temperatures than before. Mechanical ruggedness of conventional cells while permitting miniaturization.—**Component Div., Federal Telephone & Radio Co.,** 100 Kingsland Rd., Clifton, N. J.

**NOISE-SUPPRESSION FILTER,** *AF1108*, miniaturized rf type. Surpasses requirements of specification MIL-1-11748. 14 toroids and 8 capacitor sections, suppression range of 0.15 to 1,000 mc. Withstands great



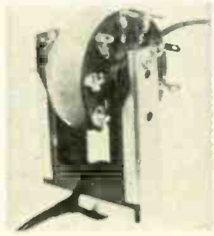
amounts of shock and vibration as well as high temperatures. Hermetically sealed, extremely small size and lightweight. Can be custom-engineered without shape limitations. For portable field equipment.—**Astron Corp.,** 255 Grant Ave. E. Newark N. J.

**OSCILLOSCOPE,** *model 3441-A*, 5-inch instrument featuring multivibrator type sweep generator with rates to 60 kc, retrace blanking, meter for 0–3 and 0–10-volt peak-to-peak calibrations, Z-axis modulation, trace inversion and a 4-position compensated vertical attenuator. Narrow-band vertical response



10 cycles to 200 kc, wide-band response ±3 db from 10 cycles to 4.5 mc in 3 positions of the input attenuator. Vertical input impedance: 2.2 megohms shunted by 20 μμf with low-capacitance probe and 2.2 megohms shunted by 45 μμf at input terminals. Horizontal response 20 cycles to 150 kc with sensitivity of 0.15 volt rms per inch.—**Triplett Electrical Instrument Co.,** Bluffton, Ohio

**HORIZONTAL TRANSFORMER,** *HVO-58* high-voltage output, exact replacement for Zenith parts Nos.: S-15015, S-15709, S-15911, S-15912, S-16191, S-



16204, S-16566, S-17130, S-17140, S-17233, S-17244, S-17245, S-17265, S-17435, S-17646, S-17669, S-17767, S-17812, S-17925, S-17939, S-18125, S-18487, S-18537, S-18930, S-20908.—**Merit Coil & Transformer Corp.,** 4427 N. Clark St., Chicago 40, Ill.

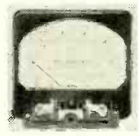
**PICTURE TEST TUBE AND YOKE ASSEMBLY** permits quick positive checks without removing parts from set. 5AXP4 tube, universal yoke and 6-foot extension leads for extending C-R tube socket, anode and yoke

connections. Lightweight leatherette case. Each part can be used as separate unit or in combination. Self-focusing and works with electrostatic or electromagnetic designs and with 52, 70, 72 and 90° yokes. Requires no ion trap. Complete unit or as assembly without tube.—**Telematic Industries Inc.,** 16 Howard Ave., Brooklyn, N. Y.

**3½-INCH RECTANGULAR CUSTOM METER,** features die-cast bezel finished in either pol-

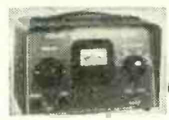
ished chrome and black or solid black. Obtainable in colors to match or blend with panels. Self-illuminated if desired. Metal case will not chip, shatter or warp, and gives antimagnetic shielding. Available in all standard ranges and may be ordered with special ranges.—**Phaostron Instrument & Electronic Co.**, 151 Pasadena Ave., S. Pasadena, Calif.

**4⅝-INCH RECTANGULAR METERS**, *models 68* and *69*, ac and dc models for semiflush panel-mount applications, sup-



plied with or without illumination. External zero adjust provided in all cases. Wide variety of ranges. — **Hickok Electrical Instrument Co.**, 10531 Dupont Ave., Cleveland 8, Ohio

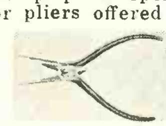
**SELENIUM RECTIFIER TESTER**, *Win-Tronix model 610*. Gives complete test by continuously pulsing rectifier under actual load conditions. Flashing red light acts as monitor to show pulsing action. Rectifier quality as well as shorts, leakage and



open-circuit conditions indicated on multicolor good–bad meter scale. 5 fixed resistor loads calibrated to test rectifiers from 20 to 1,000 ma. Fixed resistor loads avoid instrument burnouts and give increased accuracy.—**Winston Electronics, Inc.**, 4312 Main St., Philadelphia 27, Pa.

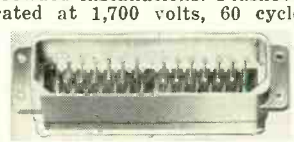
**8 NEW REPLACEMENT FLYBACKS** for Admiral, Emerson, Motorola, Philco, Wells-Gardner, Westinghouse, Airline, Firestone, Raytheon, Truetone, Bendix TV receivers. Electrically and mechanically interchangeable with original equipment.—**Triad Transformer Corp.**, 4055 Redwood Ave., Venice, Calif.

**KLEIN SPRING PLIERS.** Coil spring keeps pliers open. Available for pliers offered in past



with leaf or volute springs.—**Mathias Klein & Sons**, 7200 McCormick Rd., Chicago 45, Ill.

**CONNECTOR**, rack and panel type, 40 contacts. Narrow for crowded installations. Flashover rated at 1,700 volts, 60 cycles

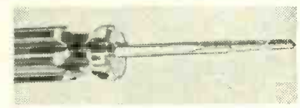


at sea level. Weight of mated connector 0.381 pound.—**Cannon Electric Co.**, 3209 Humboldt St., Los Angeles 31, Calif.

**LIGHTNING ARRESTER**, G-C No. 8642, intended for use with

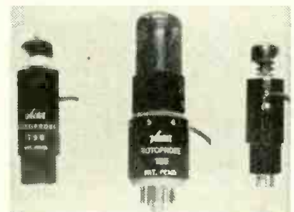
every type of vhf and uhf TV lead-in lines. Universal type. Can be used either indoors or outdoors.—**General Cement Mfg. Co.**, 919 Taylor Ave., Rockford, Ill.

**TRI-TAP** cleans or cuts any of 3 most common thread sizes in



conventional electrical boxes, fixtures, gutters, etc., without changing taps. Contains 6/32, 8/32, 10/32 taps.—**Hunter Tool**, Box 564, Whittier, Calif.

**UNUSUAL TEST ADAPTER**, *Rotoprobe*, facilitates measuring socket voltages, resistances and waveforms from above chassis. Adapter inserts between tube and socket. Built-in test lead

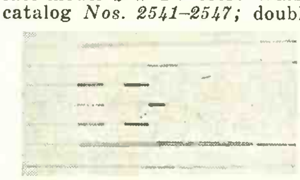


connects to measuring equipment. Outer shell of adapter rotated to switch to desired tube element or pin connection. Available in 7-pin miniature, octal and 9-pin noval types.—**Vector Electronic Co.**, 3352 San Fernando Rd., Los Angeles 65, Calif.

**WAVEGUIDE SWITCH**, *model G14H2AX*, vswr 1.05 maximum in position, 1.15 maximum during switching; crosstalk 45 db minimum; actuator, 28 volts dc;

actuation time, 0.5 second maximum; power-handling ability approximately 0.35 megawatts CW.—**Electronics Div., Thompson Products, Inc.**, 2196 Clarkwood Rd., Cleveland 3, Ohio

**7 ALIGNMENT TOOLS** for quicker servicing of color and late-model b-w TV sets: Walsco catalog *Nos. 2541–2547*; double-



ended; have hex-end diameters varying from .075 to 0.125 inch for fitting all currently used slug openings. Ends undercut on one side. *No. 2541* for TV sets using if cans with smaller than standard openings. *No. 2544–2547* 11 inches long to minimize hand capacitance—**Walsco Electronics Corp.**, 3602 Crenshaw Blvd., Los Angeles 16, Calif. END

All specifications given on these pages are from manufacturers' data.

# new Tubes Transistors

This month has proved especially fruitful with the unveiling of some highly interesting items. Of special interest is a picture tube having a one-piece funnel and faceplate assembly, a lightweight 14-inch 90° picture tube, an improved cadmium-sulphide photocell and a miniature twin-pentode.

### 9-inch picture tube

Representing a radical departure from standard cathode-ray design a 9-inch rectangular picture tube (see photo), used in G-E's personal TV receiver, has a one-piece funnel and faceplate assembly made with high-speed glass-blowing machinery. The tube was described as offering minimum weight

and maximum viewing area for any given diagonal.

An electrical-grade lead glass is used in the neck and yoke region of the tube with the anode lead coming through the base—a procedure made possible by the relatively low design-center second-anode voltage of 6,800.

Data on the yet unregistered tube are: screen size, 6 x 7½ inches; screen area, approximately 45 square inches; overall length, 13 1/16 inches; magnetic deflection, electrostatic focus; recommended second-anode voltage, 5,500; 7-pin base.

### 14RP4

Intended primarily for low-cost, lightweight, portable TV receivers, RCA's 14RP4 is a short, directly viewed, rectangular, glass picture tube. It is a low-voltage electrostatic-focus and magnetic-deflection type. Its spherical faceplate has a screen of 12⅛ x 9⅝ inches (about 108 square inches).

A deflection angle of 90° permits an overall length of only 14 9/16 inches. An external conductive bulb coating



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forms, with the internal conductive coating, a supplementary filter capacitor. Maximum ultor voltage is 14,000 and a single field ion-trap magnet is needed. The 14RP4 weighs only 8½ pounds.

### 6694-A

A tiny cadmium-sulphide photoconductive cell of the head-on type, the 6694-A, announced by RCA, features high luminous sensitivity, very low dark current, extremely low background noise and signal output approximately proportional to the incident light intensity. The cell is useful where a single, tiny photosensitive device is desired—light-controlled relay applications and light


meters for measuring the brightness of small luminous spots.

The 6694-A (see photo) has a radiant sensitivity at 5,000 angstroms of 415 microamperes per microwatt, a luminous sensitivity of 1 ampere per lumen and a luminous intensity sensitivity of 4 μa per foot-candle. Sensitivity is directly proportional to the applied voltage between terminals within the cell's rating. Dynamic sensitivity falls off with increase in frequency. Its upper limit is about 500 cycles.

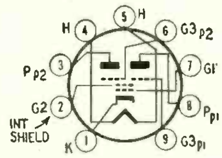
### 6DQ6-A, 12DQ6-A

Glass octal types, the 6DQ6-A and 12DQ6-A are high-perveance beam power tubes. Announced by RCA, they are intended especially for use as horizontal deflection amplifiers in television receivers.

These tubes have maximum ratings substantially higher than those of the 6DQ6 and 12DQ6: maximum dc plate voltage (including boost), 700; dc grid-2 voltage, 200; average cathode current, 140 ma; grid-2 input, 3 watts. These higher ratings together with a high operating ratio of plate current to grid-2 current adapt these tubes into circuits providing deflection for 90° picture tubes. The 12DQ6-A is like the 6DQ6-A except that it has a 12.6-volt 600-ma heater for use in series-string circuits. The 6DQ6-A draws 1.2 amps at 6.3 volts.

### 6BU8, 3BU8

Miniature 9-pin twin pentodes, the 6BU8 and 3BU8 have separate plates and suppressor grids (see base diagram) for the two sections, and a common screen grid, control grid and



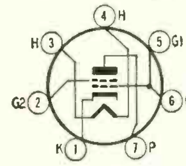

6BU8-3BU8

cathode. Combining the function of the 6BE6 and 6AU6, they are intended for use as a combined sync-agc tube in TV receivers; one section as a sync separator and clipper, the other to generate the agc voltage. By using a common control grid, noise pulses can be suppressed from both sync and agc circuits. Except for heater ratings, the 3BU6 is identical to the 6.3-volt 300-ma 6BU6. The 3BU6 draws 600 ma at 3.15 volts.

Maximum ratings as released by General Electric include: plate voltage, 300; screen grid voltage, 150; dc cathode current, 12 ma; plate dissipation, 1.1 watts; screen dissipation, 0.75 watt; negative control-grid dc voltage, 50.

### 12K5

A seven-pin miniature tetrode has been developed by Tung Sol. It is intended for use as a power amplifier




12K5

driver where the heater, plate and space-charge grid potentials are obtained directly from an auto battery. Typical operating conditions (see diagram) are: heater voltage, 12.6; plate voltage, 12.6; control-grid voltage, –2; space-charge grid voltage, 12.6; plate current 8 ma; space-charge grid current, 85 ma; plate resistance, 800 ohms; amplification factor, 5.6; transconductance, 7,000 micromhos; peak af control grid voltage, 2.5; power output, 35 milliwatts. END

# Technicians' News

### GUILD SEES COLOR TV

A color TV receiver using the one-gun Lawrence tube was demonstrated to a large meeting of the Long Island Radio & Television Guild at a meeting in Garden City, N. Y., as a part of a lecture on simplified color TV.

Ray Popkin-Clurman, who heads Telechrome, Inc., builders of a number of receivers using the Lawrence tube, stated that the tube could be produced for $75 or possibly $50 if manufactured in lots of 100,000 or more.

The set demonstrated had 22 tubes, although Popkin-Clurman stated that the circuit could be designed to use only 18. It was one of a group of receivers produced on contract for Chromatic Television Laboratories, maker of the experimental Lawrence tubes used in the receivers.

### MARTS HAS NEW LAWS

The Milwaukee Association of Radio & Television Services made several important changes in their bylaws at the recent annual meeting. The most important was to provide a period of probation for new members. During the "tryout" period the provisional member is observed as to whether he obeys the MARTS Code of Ethics. A clean record with distributors was also made a requirement of membership as a part of the cooperation between MARTS and the local distributors. Two new classes of membership, patron and associate, were introduced. The patron membership is designed to accommodate distributors, manufacturers, TV stations and others, while the associate membership is for employes of member firms who want to attend MARTS functions as more than mere guests. The new slate of officers includes:

Walter Gregg, president; Gerald Hall, vice president; Mrs. Perry P. Cody, executive secretary and manager of the complaint bureau; Larry Zechel, secretary, and Ned Alpert, treasurer.

### KANS. GROUP INCORPORATES

The Television Electronic Association of Kansas has been incorporated as a nonprofit organization under the laws of Kansas, we are informed by E. A. Redman, secretary of the organization. At present TESA-Kansas has three chapters at Wichita, Salina and Great Bend.

The Salina chapter has appointed a committee to investigate the possibility of setting up a plan for self-licensing and investigation. The Great Bend group (Midwest chapter) was still in the formative stage when Mr. Redman wrote. It expects to have more than 50 charter members at the conclusion of the membership drive.

TESA-Kansas was formerly RSDA of Kansas and has inherited its records and traditions. The new organization is affiliated with NATESA.

## FTC ACTS

The Federal Trade Commission (which has local jurisdiction in the District of Columbia) has taken action against Credit TV Service, Washington, D. C., charging it with misrepresenting that its charge for servicing and repairing a TV set in the home is 99 cents and that shop estimates are free.

Typical advertising, the complaint alleges, states:

> Mr. and Mrs. TV Owner
> ATTENTION
> 99c House Call 99c
> All makes serviced in your home or in our shop. Free shop estimates.

In fact, the complaint alleges, the charge for servicing or repairing a set in the home is "greatly in excess" of 99 cents. If sets are not left for repair, a charge is made for shop estimates.

Claims to the contrary, the complaint concludes, deceive the public and violate the FTC Act.

## LICENSE IN DETROIT

A law requiring a license for all who operate a business of installing and servicing television equipment has been enacted in Detroit by unanimous vote of the City Council. To be licensed as a service dealer, one must be a certified technician or employ a full-time certified technician. Fees for a service dealer are $25 and for a certified technician $10 annually.

According to the present law, a dealer must employ one certified technician. Other employes under the direction of the certified man would not require licenses. The situation on outside jobs is not as clear but the ordinance states that students or apprentices accompanied and supervised by a certified technician are not required to have licenses but must carry identification cards. This implies that—as understood at the present moment at least—the law would prevent sending uncertified men alone on the outside repair or installation jobs.

A board of examiners is to be appointed to test applicants for the technician license. The board is to consist of three service dealers, a TV instructor and an engineer from a local TV station. Candidates for certification must be over 21 years of age, have 4 or more years' experience in servicing or have technical training equivalent to 2 years, plus 1 year's practical experience. The requirements for a dealer license were not stated in any news report available at the time of writing.

Detroit service technicians and companies were reported as being "interested" in the new law, and some expressed the opinion that its usefulness or otherwise would be determined by the way it is administered. END

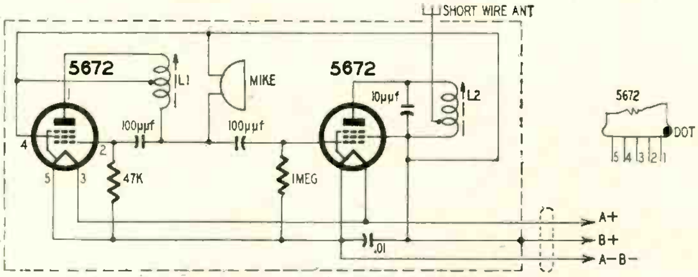
# Patents

## SECRET TRANSMITTER

**Patent No. 2,710,345**

*Robert Lee Stephens, Los Angeles, Calif.*

Actors and others can use this tiny transmitter which radiates effectively for about 100 feet. It is a low-power FM circuit that easily fits a pocket so that the user may move about without losing contact with a nearby radio receiver. Both may be tuned to about 50 mc.




The figure shows the two-tube transmitter. The first pentode stage is a Colpitts oscillator. It is frequency-modulated by a capacitor microphone across the lower portion of L1. This coil may have 24 turns (No. 31 enameled) on a ¼-inch form, tapped at 11 turns, and is tuned to 25 mc. Output is coupled to the grid of the second tube, a frequency doubler. L2 may be wound with 8½ turns (No. 24 enameled) on a ¼-inch form, tapped at 1 turn. Both coils may be slug-tuned. The tubes' heaters require 1.25 volts at 50 ma. Maximum plate potential is 67.5 volts.

The transmitter may be less than 2 inches high, and is normally installed in a small case that can be carried in the vest pocket of a coat. The batteries, in a slightly larger case, can be carried in a side pocket. The transmitter is highly stable because of the frequency-doubling feature. Tests show that it can deliver a signal-to-noise ratio of better than 57 db. Response is flat from 20–15,000 cycles. The output of a 5672 tube is about 65 mw.

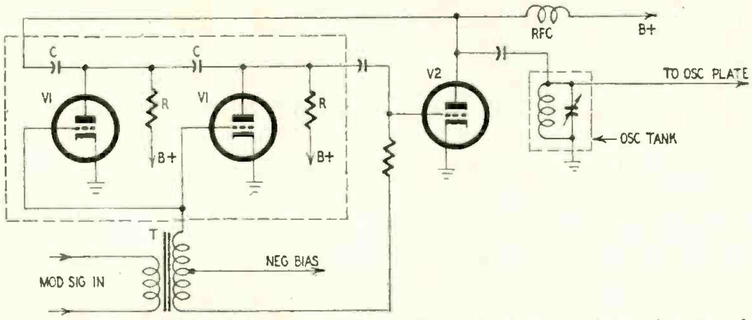
## REACTANCE-TUBE MODULATION

**Patent No. 2,716,218**

*Alvan Donald Arsem, Liverpool, N. Y. (Assigned to RCA)*

A reactance-tube modulator has limited frequency swing because it is truly reactive over only a narrow band of frequencies. Any large deviation results in a *resistive* as well as reactive component and the oscillations become damped. This new circuit uses control tubes to maintain pure reactance over a wide band.

Reactance tube V2 shunts an oscillator tank as usual. Plate voltage is fed back to the grid through an R-C phase network including control tubes V1. The network is designed for an overall lag of 90° at the center or carrier frequency. Under this condition $I_p$ leads $E_p$ by 90° and V2 behaves like a pure capacitance across the tank. This capacitance can be increased by raising tube amplification and decreased by reducing gain.




Modulation transformer T drives the grid of V2 in opposite phase to the grids of V1. Its center tap provides bias for all tubes. Now let the modulating signal drive the grid of V2 positive, increasing its $G_m$ and its effective capacitance. This lowers the oscillator frequency. At this reduced frequency, the C component of the phase network has higher reactance. This must be matched by proportionally higher R if the same 90° lag is to be maintained. This is done automatically for, when the grid of V1 goes positive, the control-tube grids go negative. This *raises* the resistance of the tubes shunting the phase-shift network.

It easily follows that when the modulating signal reverses its polarity the oscillator frequency goes higher. During this time both control tubes (V1) have *lower* shunting resistance as required to maintain the desired 90° lag. If the modulating signal is audio this circuit forms the basis of an FM transmitter.

## PHOTOGRAPHIC FLASHTUBE

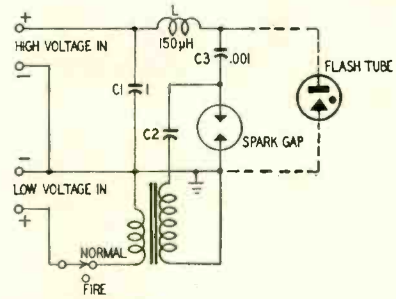
**Patent No. 2,722,631**

*James Normal Bowtell, Wembley, England. (Assigned to General Electric Co.)*

This circuit can trigger a two-element flashtube through as much as 15 feet of cable. Furthermore, the trigger power is not hazardous since it is supplied by a capacitor, not a battery or power supply.

The flash tube may be one that fires at 2,500 volts or more. The main capacitor C1 is charged to about 2,000 volts prior to the flashing instant. It may be charged from the line through a high-voltage rectifier. A low-voltage dc source is connected across the primary of the transformer through the switch. The switch is normally closed and current flows in this circuit while C1 is being charged.

It is opened to fire the flashtube. This inter-




rupts the steady current and induces a high potential across transformer secondary, C2, and the gap tube. A spark flies across the elements of this tube and shock-excites L and C3, which resonate at about 1 mc. The rf across C3 flows into the cable (dotted lines) and adds to the voltage on capacitor C1 to initiate the discharge.

## LONG-STORAGE VOLTMETER

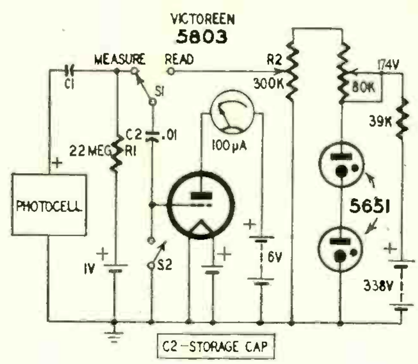
### Patent No. 2,721,978

*Elihu Craig Thomson, Wellesley, Mass. (Assigned to Electronics Corp. of America, Cambridge, Mass.)*

This circuit has a long memory. It deposits a charge on a storage capacitor which has polystyrene dielectric, which leaks only about ½% in an hour. The diagram shows the circuit for measuring the output of a photocell. The stored voltage corresponds to the *peak* value of the photocell. Whether this illumination arrives in pulse, square-wave or other form, the stored voltage corresponds to the *peak* value of the illumination.

The photocell is polarized to deliver *positive* output. This charges C1 and C2 (through the conducting diode consisting of the 5803 grid-filament circuit). When output falls off or disappears, C1 discharges through R1 but storage capacitor C2 is isolated. The charge is trapped because C2 acts through R1 to block the grid-filament diode.

To measure the voltage across C2, S1 is thrown to READ. It connects C2 in series with a part of R2 and both are now between grid and ground.




R2 is adjusted, starting with its contact at the ground end, until it delivers a voltage *equal and opposite* to that stored on C2. (Potentiometer output comes from a well-regulated dc source.) When the potentials of R2 and C2 are equal and opposite, they cancel. Grid bias at the 5803 is then zero and current begins to flow through the meter.

R2 should be calibrated. Thus, as soon as the meter deflection reaches some standard or predetermined value, the voltage across C2 may be read off directly, without loss of charge from the capacitor.

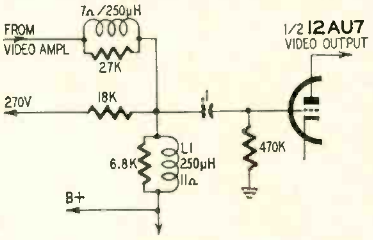
After completing the measurement, C2 is discharged by closing S2, automatically charging C2 (through R1) to 1 volt. This remains as bias for the tube when S1 is again thrown to MEASURE and S2 opened. END

# Technotes

### RCA KCS84

Weak picture, poor definition and smear in this chassis often result from a partial short in peaking coil L1 (see diagram). This 250-μh coil has black-black as identifying marks.

Resistance checks show no appreciable difference from normal. However, a scope check at the plate of the first video amplifier indicated considerable distortion. Replacing the coil completely cleared the trouble. — *James A. McRoberts*




### OPTICAL SOUND TRACK

A Kodak Pageant movie projector with optical and magnetic sound-track facilities was sent to our shop with a complaint of distortion when played on the optical sound track at high output levels. An oscilloscope revealed sharp spikes in the output when a pure 250-cycle sine wave was applied to the input terminals (not directly to the first grid). These spikes were traced to the ionization of the neon *record level* indicator despite the fact that one side is disconnected when on optical playback. One of the neon leads is about 4 inches from the grid of the first stage where the pickup was taking place. Relocating and shielding the lead removed the trouble. The ultrasonic oscillator tube, which supplies voltage to the optical sound-track lamp, was removed during these measurements since pickup from it is normal.

One thing learned from this trouble is that neon level indicators may cause distortion in any high-gain audio amplifier. Ionization of these lamps sounds like speaker rattle. — *Joseph Stephany*

### TVI RADIATION

Recently a customer complained that when his TV set was operating, all radios in the house were blanked out. All that could be heard on the radios was a whistle.

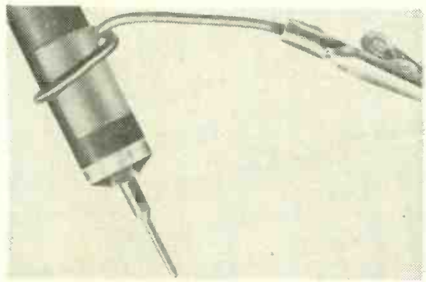
Checking showed the TV set was putting out a beautiful blanket radiation. Without bothering to analyze the interference, we used a sure-fire remedy for whatever the trouble might be. With 30 cents' worth of copper window screen, using the shop staple gun, we covered the inside of the TV cabinet, grounding it to the chassis with copper braid. The shielding removed the radiation completely.

Coming across a similar case later, we asked the lady of the house for her box of household aluminum foil, and did the same job then and there (leaving some holes for ventilation), with the same results.

Old-timers may remember that some early TV sets came with shielding inside the cabinet. Some even had bottom plates for the chassis to harness radiation.—*Ben Crisses* and *David Gnessin*

## GROUND-LEAD INDUCTANCE

At the high frequencies used in the front ends and intermediate-frequency amplifiers of television receivers, the inductance of ground leads used with probes will often produce misleading patterns and readings. The ground lead should be short and direct to the point



under test. A particularly glaring fault can be seen in the photo showing a crystal probe with its ground lead looped around the tube. The inductance formed by this arrangement may often be greater than the inductance of the circuit under test and could considerably distort its waveform. — *L. A. Williams*

## MOTOROLA TS 292

This set had a defective selenium rectifier after replacement 3 months earlier. The voltage-doubler arrangement of the low-voltage power supply is shown in Fig. 1. The 265-volt output will drop to 200 or less if the back current from the rectifiers becomes exces-

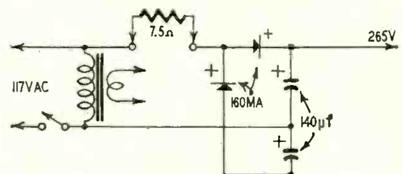



Fig. 1

sive and will modulate the B-plus line with a hum component which will cause a weave in the picture and a hum bar (60-cycle type) on picture and raster.

The brute-force method of preventing future trouble is to use higher-current-rating selenium rectifiers.

One cause of this trouble is excessive current drain in the horizontal output tube whose circuit is not "tuned" properly by a linearity coil — absent in this chassis. The substitute for this linearity coil is L1 and C1 (Fig. 2). The value of C1 may be raised or lowered by shunting or adding series capacitance. The proper value is the lowest

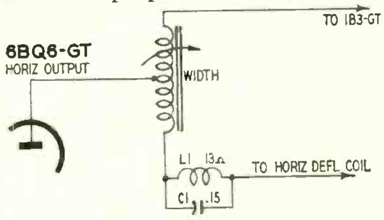



Fig.2

current reading to the horizontal output tube which can be metered by opening the lead to the damper plate or to terminal 3 of the flyback transformer. A 200-ma meter is needed—a panel lamp drawing 0.25 ampere can be used instead of a meter.—*Lucian Palmer*

## PHILCO 51-1730 RADIO

When the complaint on this set is fading and a check reveals no B plus when the sound disappears, the trouble is usually an open 20-μf 150-volt electrolytic capacitor. This component is part of a voltage-doubler circuit and is in series with the ac line to the plate and cathode of the 7X6 rectifier. — *Miguel Vega*

## CONDENSATION

After repairing an RCA KCS47B I called the customer to pick up his chassis as he had brought it into my shop. He put it in his car on this particularly cold night and went visiting. Returning to his steam-heated apartment he put the chassis in the cabinet and turned it on. After a few minutes he heard a hissing and the picture started to act up.

By the time he got to the back of the set to see what the trouble was, the high-voltage transformer had arced across the windings and started to burn. He pulled the plug but the damage was done.

The condensation caused by bringing the cold chassis into the heated room was too much for the flyback transformer and it broke down. The insulation had burned through so I was not able to repair it. Thus, one new horizontal output transformer because I forgot a word of caution to someone who could know no better. Thus, under similar conditions it may often pay you to let the set rest for several hours or overnight before turning it on. — *Fred W. Rodey*

## WARPED RECTIFIER MOUNT

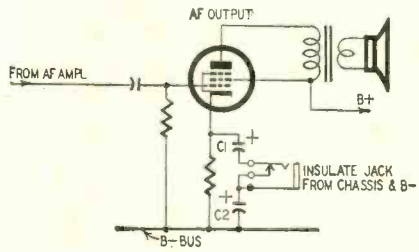
The high-voltage rectifier mounted underneath the chassis of a Motorola TS 118B is a source of trouble. The plasticlike insulation supporting the rectifier socket often warps and makes the already-small clearance between the cap end of the rectifier tube and the remainder of the chassis and components still less. The result was corona on humid days. Repair was made by replacing the socket mounting support with Bakelite instead of the rubber tape used by the amateur on the job previously. — *A. P. Monroe* END

# try This one

## AC–DC SET AS TUNER

The diagram shows how I convert ac–dc table-model radios for use with external power amplifiers. Cathode bypass capacitor C1 is connected to the leaf of a closed-circuit phone jack. A second capacitor (C2) is connected between the jack frame and B minus as shown.

When a phone plug is inserted in the jack, the stage is converted to a partial cathode follower with C1 serving as a blocking capacitor while C2 isolates the other side of the output line from B minus or ground. With this connection, ordinary unshielded line can be used to feed the amplifier without loss




of highs, but shielding may be needed in some cases to minimize hum pickup.

When using the receiver as a tuner for a wide-range system, you will probably have to increase the filtering in its plate supply to reduce hum and take steps to improve the frequency response of its audio system. (See "Table Radios Into Hi-Fi Tuners" and "Improving Your TV Audio" in the January, 1956 issue.)

If the receiver does not have a cathode bypass on the output stage, C1 and C2 should be about 40–50 μf each. C1 may be rated at around 25 volts and C2 at 150 or higher.

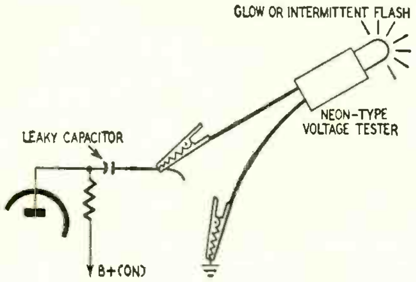
A switch may be connected in the secondary circuit of the output transformer to cut out the speaker and cut in a 5-ohm 5-watt resistor when using the receiver as a tuner. Or, you can use the receiver as a tweeter. In this case, you can reduce the values of C1 and C2 to around 10 μf.—*Frank Bodine*

## DRIVING GROUND RODS

Hard or rocky ground makes it difficult to drive the conventional Copperweld TV ground rod without bending it. We overcome this by first forcing a short length of ¾-inch pipe into the ground and then inserting the rod into it. When the rod has been driven down several feet, the pipe can be removed and the rod driven home readily.—*Harry J. Miller*

## QUICK CAPACITOR CHECK

A quick test for dc leakage in capacitors, especially coupling capacitors, can be made with an ordinary neon test lamp. Disconnect the cold end of the capacitor and connect the tester from the cold end to ground or B minus. With the B-plus power on the light will glow or flash intermittently on leaky capac-

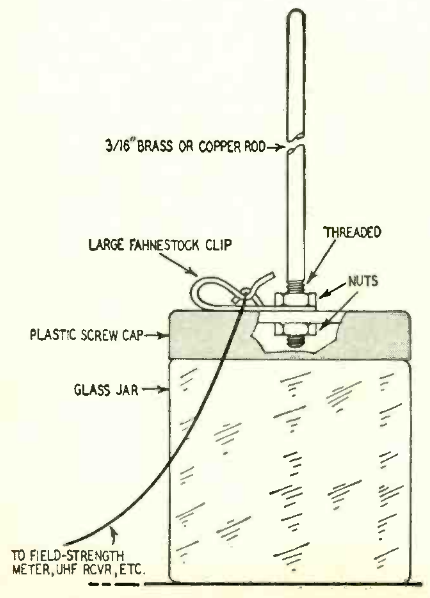



itors. This test will detect leakages of several megohms. Though not as sensitive a test, on voltages lower than the ionizing voltage of the lamp a dc voltmeter can be used. Be careful to set it on a scale high enough to avoid pinning the needle on the initial charging "kick."
—*Paul Harwood*

## SIMPLE UHF ANTENNA

Short vertical antennas are often used for field-strength meters and for various uhf experiments. Since supporting clamps and insulators are often inconvenient and cumbersome, I use glass jars with plastic caps to support and insulate the antenna rods.

Brass or copper rods 3/16 inch in diameter and up to 4 feet long can be supported by a 3-inch diameter jar without tipping. The rod is threaded at the bottom so it can be fastened to the jar cap with two hexagon nuts as shown in the illustration. A Fahnestock clip or soldering lug can be clamped between the top nut and cap for connecting to the antenna. The jar can be held in the hand and moved around without serious body-capacitance effects.

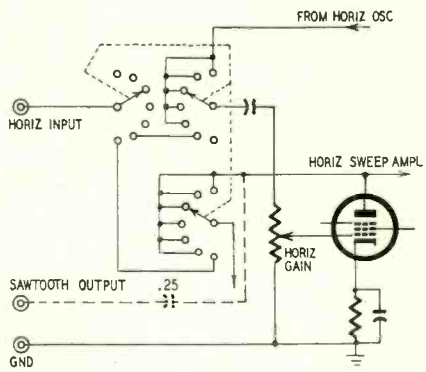



If a jar with a metal cap is used, scrape the enamel off the top of the cap and solder the rod directly to it. Before soldering, make a small loop in the end of the rod and bend it at right angles to the rod. This provides a broader base for the rod and a greater area for soldering.—*Arthur Trauffer*

## SAWTOOTH GENERATOR

Most electronic technicians and experimenters have had, at one time or another, a need for a sawtooth-wave source variable in frequency and amplitude. It usually is needed when there is neither time nor inclination to construct one "from the ground up." However, if the experimenter owns an oscilloscope, there is a very easy and inexpensive way to provide just such a source.

The diagram shows a partial circuit of a typical oscilloscope with the modification shown in dashed lines. The only parts necessary are an insulated pin or banana jack and a 0.25-μf 600-volt capacitor. The jack is mounted in the front panel near the ground post on the horizontal amplifier side of the panel. Insulate the jack from the panel. The capacitor connects the jack to the plate of the horizontal amplifier tube. The frequency is controlled by the coarse and fine frequency scope controls and the amplitude by the horizontal gain control.




A cable can be made up by using a length of coaxial line long enough to suit the needs of the user with appropriate lugs, clips and plug attached.

In use, there has been no discernible depreciation in the performance of the scope by making this modification, provided the cable is disconnected from the scope when it is not being used as a sawtooth source.

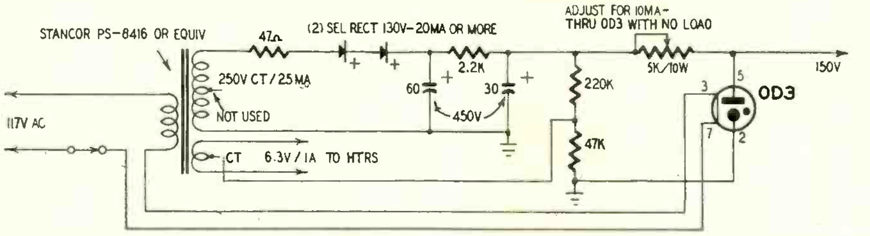
A very practical use for this modified equipment is in determining whether the trouble in the horizontal sweep section of a TV receiver lies in the oscillator or output stage. By disconnecting the horizontal drive trimmer and the coupling capacitor from the grid of the output tube (be sure the grid resistor is left connected) and feeding the sawtooth wave into the grid, a few voltage checks on the output and damper tubes will reveal if the output stage is functioning normally. If it is, then it can be assumed that the trouble lies in the horizontal oscillator section.—*Frank D. Mowery* END

# Question Box

## CONTROL UNIT POWER SUPPLY

*I plan to construct the Golden Ear control unit and would like to include a built-in power supply so it can be used with almost any power amplifier. Please show the circuit of a suitable supply.—R. G. A., Chicago, Ill.*

This circuit will serve nicely when constructed as a separate unit or when built into the control unit. The power transformer is a Stancor PS-8416 or equivalent. The unit is wired so the primary of the power transformer is opened when the 0D3 voltage regulator tube is removed from the socket. Set the slider on the 5,000-ohm adjustable resistor for about 10 ma through a milliammeter inserted temporarily between pin 2 on the socket and ground.




## 155-MC CONVERTER

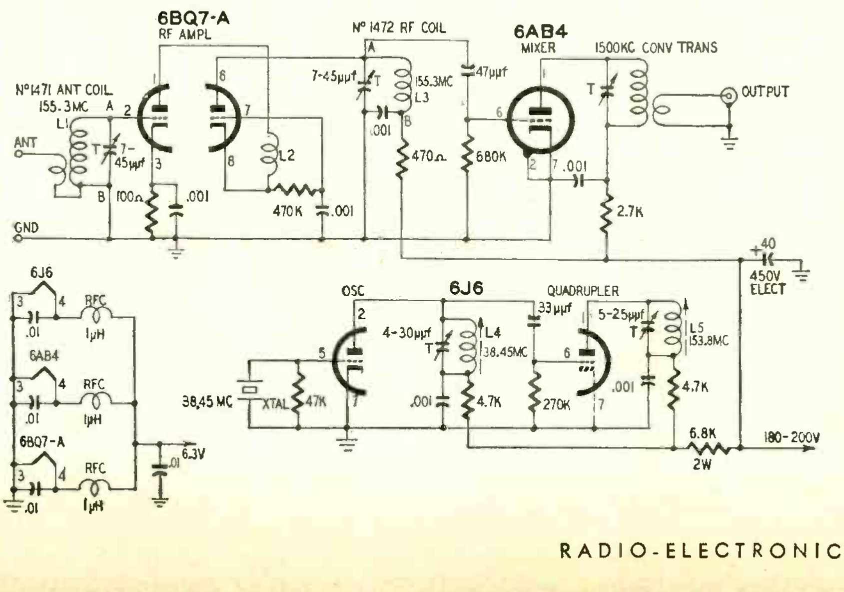
*Please print or tell me where I can find a diagram of a converter for receiving 155.3-mc signals on an automobile radio. This frequency is used by our local volunteer fire department.—J. C. H., Kenmore, N. Y.*

This converter will work into any receiver tuned to 1500 kc. A cascode rf amplifier and triode mixer are used for low-noise performance. The crystal-controlled oscillator minimizes drift and simplifies operation. Coils L1 and L3 are J. W. Miller types 1471 and 1472, respectively. L2 is 6 turns of No. 18 enameled wire on a ¼-inch form. The turns are spaced for minimum noise output. L4 is a CTC (Cambridge Thermionic Corp.) LS3 30-mc coil and L5 is a National type AR-2.

The rf chokes in the heater leads may be Miller type 4602 or equivalent 1-μh coils or 28 turns of No. 24 enameled wire closewound on a ½-watt 68,000-ohm resistor and connected in parallel with it.

This circuit can be used for almost any spot frequency between about 50 and 250 mc. The mixer injection frequency—the output of the multiplier following the oscillator—is 1500 kc above or below the desired signal. The oscillator operates on the fundamental of the crystal so the injection frequency is divided by 2, 3, 4, 5 or 6 to obtain a frequency in the range of readily available crystals.

The coils specified for L1 and L3 cover a range of from 110 to around 235 mc. The upper limit is determined by wiring and tube capacitances and the lower limit by the size of the tuning capacitor. For L4 you can use the CTC



30-mc coil to tune from around 18 mc with 100 $\mu\mu$f to around 70 mc with 15 $\mu\mu$f. The National AR-2 coil tunes from 70 mc with 100 $\mu\mu$f to 220 mc with 10 $\mu\mu$f.

A grid dip meter will be useful for prealigning the rf and oscillator circuits. In many instances, stray wiring capacitance and the proximity of the multiplier and mixer circuits will provide sufficient injection voltage to the mixer. In other cases a 2-$\mu\mu$f capacitor or a twisted wire gimmick may be used between the mixer grid and the multiplier plate.

## RESISTOR TYPES

*Resistors with ratings to about 2 watts are available in carbon-filament, deposited-carbon, boron-carbon, carbon-film, wirewound and noninductive wirewound types. In most instances parts lists do not specify the type. How can I determine the type to use for different circuits?—J. H. U., Youngstown, Ohio.*

The most commonly used resistor is the general-purpose carbon-filament type. It consists of a thin rod or slug of carbon encased in a composition or ceramic case for insulation and protection against humidity and mechanical damage. These are generally available in RETMA preferred values ranging from 2.7 ohms to 22 megohms in ½-, 1- and 2-watt sizes with tolerances of 10 and 5%. They are used where there is no need for exceptional stability or special low-noise characteristics.

Carbon-film, deposited-carbon and boron-carbon types are usually made by depositing a thin film of carbon or carbon compound on a ceramic body and then covering the whole with an insulator that seals the unit against moisture. These types are available in values ranging from around 10 ohms to 100 megohms with tolerances of 5, 2 and 1% and wattages ranging from ½ to 2. The full range of resistances may not be available from one manufacturer or in all wattages. These are used in low-noise preamplifiers and in applications where high stability and precision are required.

This type is ideally suited for use in the Williamson amplifier and similar circuits where high-quality and matched components are recommended. They are widely used in attenuators, bridges, test instruments and as meter multipliers and shunts. Generally, deposited-carbon resistors are much less expensive than wirewound types of the same tolerance, wattage and resistance.

Small wirewound resistors like the IRC BTW types are available in a much smaller range of values than are carbon-filament types. Generally, the values range from 0.24 to 820 ohms at ½ watt, 0.47 to 5,100 ohms at 1 watt and 1 to 8,200 ohms at 2 watts. Tolerances: 5 and 10%. This type is almost mandatory for values below about 10 ohms and is used—within its range of values—when the circuit requires resistors with greater stability and lower noise than carbon-filament types. Applications are the same as deposited-carbon types with the same ratings. However, they should not be used in rf and video circuits.

Noninductive wirewound resistors below 5 watts are usually precision types with tolerances around 1%. They are available in values between 0.1 and 500,000 ohms and are often used as meter shunts and multipliers.

Noninductive power resistors of 5 watts and higher, such as the Sprague NIT types, are often used as plate, screen and cathode resistors in high-powered video amplifiers, as grid leaks in high-powered class-C amplifiers and in other circuits where the inductance of a standard wirewound resistor cannot be tolerated.

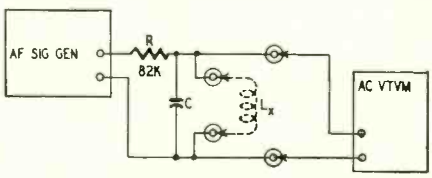
In RADIO-ELECTRONICS parts lists we consider that resistors will be a carbon-filament type with 10% tolerance unless otherwise specified. When the make or type is not specified, precision resistors may be either wirewound or carbon types and power resistors will be the standard (inductive) type.

## UNMARKED INDUCTORS

*I have a number of surplus audio and filter chokes whose inductance is unknown. I have a scope, signal generator and vtvm. Is there any way that I can use these instruments to measure the inductance of the chokes?—W. M. C., Elizabeth City, N. C.*

If an audio signal generator is available, connect the test circuit as shown with the vtvm across the unknown inductor. Vary the frequency of the generator between about 30 and 1,000 cycles and use different values of C until you get a peak deflection on the meter. Calculate the inductance from the formula

$$L = 25{,}000/f^2C$$




where f is the frequency in cycles, C the capacitance in microfarads and L the inductance in henries.

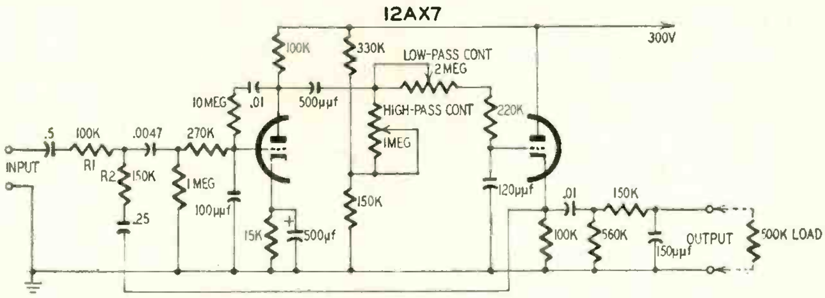
If a variable-frequency audio generator is not available, you can use the 400-cycle output of the signal generator or 10 volts or so from the 60-cycle line. The L-C circuit must now be tuned to resonance by varying the capacitance in the circuit. You can use a capacitance decade or a number of known capacitors in parallel. The inductance of iron-cored coils varies somewhat with frequency so filter chokes should be checked in the range of 60–120 cycles and audio chokes at 400 or 1,000 cycles. The value of R should be adjusted for a good sharp deflection on the meter. If too low, it loads the tuned circuit and the resonance curve is low and broad; if too high, deflection will be small. END

# radio-electronic Circuits

## VARIABLE BANDPASS FILTER

Bandpass filters with variable high- and low-frequency cutoffs are widely used in communications networks as sound-effects filters for recording and broadcast applications and may be used as combined rumble and scratch filters in phonograph amplifiers. The unusual bandpass filter shown in the diagram was used as an example in the article "The Design of Filters Using Only R-C Sections and Gain Stages" in *Electronic Engineering* (London, England).

In this circuit, the bandpass effect is obtained by inserting variable-frequency high- and low-pass filters in the feedback loop around a two-stage amplifier. The filters have slopes of approximately 18 db per octave. The cutoff (3-db point) of the high-pass filter is variable from 35 to 100 cycles and the low-pass element has a cutoff variable from 5,000 to 14,000 cycles. This results in a bandpass circuit with a minimum bandwidth of 100 to 5,000 cycles and maximum of 35 to 14,000 cycles. Bandpass is widest when the low-pass control is set to minimum and the high-pass control to maximum resistance. Circuit gain is unity and response is flat to within 0.5 db with the controls set for widest response. The circuit can be fed from any source of approximately 100,000 ohms and is designed to work into a load of around 500,000 ohms.

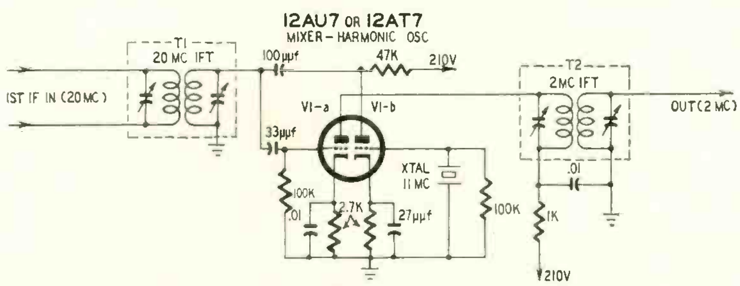



## NOVEL MIXER CIRCUIT

Double-superheterodyne type receivers are widely used for vhf and uhf reception. The first if is high to provide good image rejection; the second, much lower, one provides greater amplification and selectivity per stage than the first. In most double superhets, the second converter or mixer stage uses a pentagrid converter tube in a circuit very much like that used in broadcast sets. This novel mixer circuit is the invention of Roy A. Beers, Jr. and Wm. L. Gensel and is described in patent No. 2,713,634. It is designed to reduce the number of components normally used in second-converter circuits and to use a frequency-doubling crystal oscillator without extra tuned circuits.

In this arrangement, the first if is 20 mc and the second is 2 mc. V1-b is a crystal oscillator with a shunt-fed plate circuit. The secondary of the 20-mc if transformer (T1) serves as the oscillator plate tank. Its resonant frequency is sufficiently close to the second harmonic of the crystal (22 mc) to provide sufficient impedance for frequency doubling.

The incoming 20-mc if signal and the second harmonic of the crystal appear across the secondary of T1 and are capacitance-coupled to the grid of mixer V1-a. These two signals beat in the mixer and the difference frequency (2 megacycles) appears across the primary of T2.

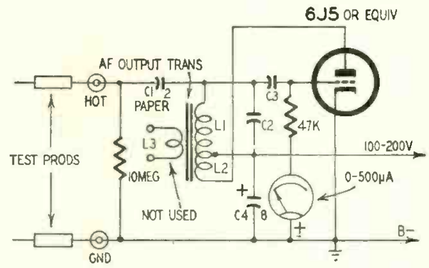


## FLYBACK CHECKER

Shorted turns in a TV flyback transformer or horizontal deflection coils are difficult to detect without special equipment, especially when the defect does not cause complete loss of brightness or raster. This simple flyback tester, described in *Radio Constructor* (London, England), can be constructed readily from parts taken from the junkbox or for around $15 or so with new parts.

The circuit is basically an L-C audio oscillator operating around 1 kc with a 500-μa meter to indicate grid current. When a flyback transformer with a shorted turn is connected across the test prods, it loads the tuned circuit and produces a sharp dip in grid current.

The oscillator is designed around an audio output transformer with a tap one-quarter to one-third the distance




from one end. The inductance of the transformer primary should be low so a miniature or small output transformer is recommended. (An ac–dc type transformer with a hum-bucking tap or a type designed for three-way portables with separate output tubes for battery and line operation will probably work nicely.—*Editor*)

In the circuit, L1 is the part of the primary with the greater number of turns. L2 is used as the feedback winding and L3 is the secondary. This winding is not used when testing transformers.

To set up the checker, temporarily use a 500-μμf capacitor for C3 and connect a pair of high-impedance phones or an amplifier with high-impedance input across L3. Adjust the value of C2 for a pure note of about 1,000 cycles—a scope will be handy here. Remove the 500-μμf capacitor used for C3. Starting with around 100 μμf, increase the value of C3 to find one that gives a reading of about three-quarters of full scale before squegging starts. Disconnect the phones or amplifier and tape the leads to L3.

Connect the test prods across all or nearly all of the primary of a good flyback transformer. This will cause a *slight* drop in grid current. Now, temporarily connect a jumper between two adjacent taps on the transformer to simulate a shorted turn. The meter reading should drop *sharply*. As a final test, remove the jumper from the taps and wind a single turn of wire around the core close to the primary and short the ends together. The grid current should drop sharply.

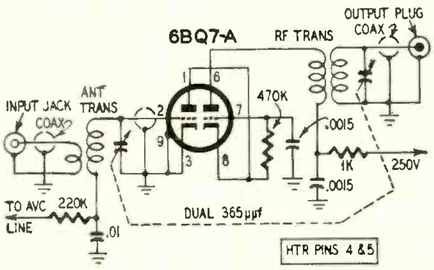
If connecting the test leads across the plate winding of a good flyback transformer causes a large dip in grid current, the inductance of L1 is too high and must be reduced by removing laminations from the transformer used in the oscillator circuit or the core gap must be increased. In any case, readjust the value of C2.

C1 is a blocking capacitor. The 10-megohm resistor eliminates the static charge that would appear on the hot test lead when the tester is turned on.

### BROADCAST BOOSTER

In an effort to increase the sensitivity of a 1936 superhet, I tried half of a twin triode as an rf amplifier. This helped but left much to be desired so I tried a cascode. After some experiment to get maximum gain I arrived at the circuit and values shown in the diagram.

Construction is simple and is not critical but I recommend that the layout be as compact as possible. Ground pin 9 of the tube socket and shield the lead to the grid (pin 2) of the input stage to prevent oscillations. Standard broadcast antenna and rf coils are used with a two-gang 365-$\mu\mu f$ capacitor. My




unit uses unshielded coils and is quite stable but shielded coils will provide added insurance against oscillation. Use coax or low-loss cable where shielding is indicated. Regular shielded cable attenuates the signal too much.

The unit requires 250 volts dc at about 20 ma and 6.3 volts at 600 ma. This can be taken from most sets or you can use a small power supply. I have not measured the gain but it does bring the weak stations up out of the noise.—*John M. Rhodes* END


**"Are you still on TV, Miss La Veri?"**

# Business

## Merchandising and Promotion

**Sprague Products Co.**, North Adams, Mass., has made window-sized blowups of its recent advertisement "Sprague Salutes the Independent Service Dealer." These will be made available to service technicians through parts distributors throughout the country.

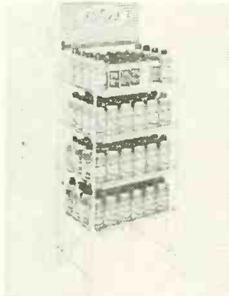
**RCA Tube Division**, Harrison, N. J., has designed a colorful new carton for its *Silverama* aluminized TV picture tubes. Tube numbers are printed in large type on the labels.


**Clarostat Manufacturing Co.**, Dover, N. H., is now packaging the several different sizes of its *RTV* matched-replacement controls in standard cartons which have been designed to provide for easier stocking.

**Tescon TV Products**, Springfield Gardens, N. Y., is marketing its "Do-It-Yourself" outdoor antenna kits in brilliantly colored new display containers.

**Gray Research & Development Co.**, Manchester, Conn., has planned a high-fidelity demonstration system to promote record sales. The systems are available to dealers on a liberal long-term rental plan.

**General Cement Manufacturing Co.**, Rockford, Ill., designed a new merchandising display for its *Spra-Koat* power spray chemicals for TV–radio service technicians.



## Production and Sales

**RETMA** reported the production of 588,347 TV sets and 1,078,624 radios in

January, 1956. This compares with 654,582 TV sets and 1,068,146 radios in January, 1955.

## New Plants and Expansions

**Shure Brothers** is now located in its own newly constructed plant in Evanston, Ill., which provides greatly expanded facilities for the manufacture of Shure's varied line of microphones, pickup cartridges, etc.

**Sylvania Electric Products** Parts Division, Warren, Pa., has purchased Formatic Machine Co., Naugatuck, Conn. The division also announced plans for a 110,000-square-foot plastics plant in Warren. The new building is scheduled to be completed and ready for occupancy by the end of this year.

**United Catalog Publishers, Inc.**, New York, established a West Coast sales office in Beverly Hills, Calif., under the direction of Charles H. Mitchell.

**Federal Telecommunication Laboratories**, Nutley, N. J., established a California branch in Los Angeles. Paul R. Adams, director of the Electronics Systems Laboratory, was named manager of the new branch.

**RCA** established an Advanced Development Laboratory in Needham, Mass. for work on ferrites. It will be under the direction of Dr. Francis E. Vinal.

**Mueller Electric Co.**, Cleveland, Ohio, broke ground for a 6,000-square-foot addition to its production floor space.

**Ebcor Electronics Co.**, Baldwin, N. Y., was established by Edward Berliant, formerly head of Ed-Berl Products, Inc. The company will package and distribute Dow-Corning silicone products as well as manufacturing antennas, test equipment, etc.

**Supreme Publications** closed its Chicago office and consolidated operations at its Chicago warehouse, 416 W. Huron Street, and Highland Park, Ill. facilities.

**Esco Electronics, Inc.**, Chicago, purchased the Electronics Division of Mitchell Manufacturing Co. of the same city. Esco will manufacture phonographs, radios and hi-fi equipment under the Mitchell brand name.

## Business Briefs

. . . **Raytheon Manufacturing Co.**, Waltham, Mass., has begun production on an 8½-inch TV picture tube designed for portables. Photo shows C. F. Adams, Jr. (center), Raytheon president, discussing the tube with Curt Hammond—


(right), manager of Raytheon's equipment tube sales, and F. E. Anderson, manager of distributor tube sales. END

**new!** *twins by* **ARKAY**

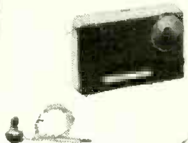
**Arkay Model HFT-7 Hi-Fi AM FM Tuner Kit**

Matching tuner which offers less than 1% distortion and a −70db hum level. Sensitivity is 6 uv for 20 db quieting on FM and 20 uv on AM. FM selectivity is 200kc . . . bandwidth 8db down; AM, 8kc bandwidth 5db down. A unit to suit the discriminating tastes.

With AFC control and defeat $29.95
Available in FM only $23.95
Less Cover

**Arkay Model FL-10-Hi-Fi Amp-Pre Amp Kit**

Williamson type super-linear amplifier with built-in pre-amp. Pushpull 12 watt output frequency response ±1 db, 10 to 40,000 cps with extremely low IM and harmonic distortion. An amplifier to be proud of. $28.95



**Arkay Miniature Radio**

Superheterodyne circuit and hearing aid type ear piece. 5¼" x 3¼" x 1". $12.95

**Arkay Model A-12 Hi-Fi Amplifier Kit**

12 watt output . . . 5 inputs. Master controlled at front panel. $22.95

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Servicing Record Changers
By Harry Mileaf
Gernsback Library Book No. 59. 224 pages. Illustrated.
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Hard cover ed. $4.60

## JUST OFF THE PRESS!

There's money in servicing record changers, and this new Gernsback Library book shows you how to get it! Discusses each functional assembly as a unit, so that even if you're a rank beginner as far as changers go, in no time at all you'll be able to tackle any and all types. Many special line drawings illustrate all the details of automatic record-changer mechanisms. A basic book, it is nevertheless an excellent reference for those familiar with changers. Put in your bid for that extra servicing money now—order your copy today.

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NEW. Build pocket radios. 5 selected plans, 50c. COOK. 4003-R Roosevelt, Midland, Texas.

DIAGRAMS FOR REPAIRING RADIOS $1.00. Television $2.00. Give Make. Model. Diagram Service, Box 672-RE. Hartford 1, Conn.

NEW! Versatile "No-Disturb" TV extension SPEAKER 4"x4"x2". Three-way remote control. Details. ELECTRONIC, Box 1142, Lancaster, Pa.

FREE PLASTIC CARD CASE!!
WITH YOUR ORDER FOR 1000 PROCESS EMBOSSED BUSINESS CARDS. AS YOU LIKE! ONE OR TWO COLORS!
Every business man—and professional man as well—knows the impression created by his appearance. Most important is the card you present. A "Showmanship" Business Card is an important factor. You know the right impression is created when you proudly present—an Exclusive, Distinctive, Expensive-Looking EMBOSSED Card. Raised printing—done by Mastercraftsmen—with "know how." A card with Raised Letters—with the "feel" and Character of Fine Engraving. Leading Executives use Showmanship Cards, creating the impression of Position, Prestige and SUCCESS! Yet—our cards cost you less than the ordinary cheaply printed cards. It's easy to order cards from us. Simply PRINT or TYPE whatever you want to appear on the card—on any handy slip of paper. Pin to a money order or check for just $4.95—and rush it to us—by fast mail. You'll get prompt service. Cards will be rushed to you prepaid. With your FREE Plastic Card Case. Get your order in the mail—NOW! FAULTLESS ORGANIZATION, 684 N. Sangamon St., Chicago 22, Ill.

TUBES—TV, RADIO, TRANSMITTING, AND SPECIAL PURPOSE TYPES BOUGHT, SOLD AND EXCHANGED. Send details to R. E. Gensler W2LNI, 512 Broadway, N.Y. 12, N.Y.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND TESTING equipment repaired. Write for free catalogue on new and used instruments at a savings. Hazelton Instrument Co., 128 Liberty Street, New York, N.Y.

TRADE IN TV SETS $14 up. JONES RADIO, 1115 Rambler, Pottstown, Pa.

TAPE RECORDERS, tapes; Wholesale prices. KARSTAN, 215 E. 88 St., New York 28, N.Y.

WANTED: AN/APR 4, other, "APR.", "TS-", "IE-", ARC-1, ARC-3, ART-13, BC-348, etc. Microwave Equipment. Everything Surplus. Special tubes. Tec Manuals, Lab Quality Equipment, Meters. Fast Action, Fair Treatment. Top Dollar! Littell, Fairhills Box 26, Dayton 9, Ohio.

JAPAN DIRECTORY. 100 Japan exporters, plus opportunity mail. Just $1.00 today. NIPPON ANNAI, 920-3rd Ave. Seattle 4, Wash.

WANTED—Tech. Manual or alignment instructions for R-28/ARC-5 VHF recvr. A. M. NOHE, 246 W. 6 Ave., Huntington, W. Va.

DIAGRAMS: Professional Model Timers, Counters, Intercoms, Organs, etc. $1.00 each. List free. Parks, 101 S.E. 57th, Portland 15, Oregon.

RADIO, RADAR, TELEVISION instruction leading to Licenses. Port Arthur (Texas) College.

FOREIGN jobs list. Technicians needed. $1. RATHE, Box 173, New Orleans 3, La.

WANTED—All types of electronic tubes: broadcast, transmitting, receiving, Magnetrons, Klystrons, also all varieties airborne equipment: ADF-70; ARC-1, -3, -4, -12, -15, -27, -33; ARN-6, -7, -12, -14, -18; BC-312, -342, -610E, -788C, -2121; I-152, ID-48; MN-24C, -31C, -36, -42, -53, -58, -61, -85, -97F, -100A; RA-18; TA-18; 17-L3; 51-R, -R3; 51-V1, etc. TOP DOLLAR PAID. Write to ROBERT E. SANNET, W6REX, 1524 S. Edris Dr., Los Angeles 35, Calif.

FOR ALL YOUR HI-FI REQUIREMENTS: Speakers, Amplifiers, Tuners, Turntables, etc. COMPLETE STOCK. Shipments Prepaid. Write us your requirements TODAY. SOUND MART UNLIMITED, INC., 63-03 39th Ave., WOODSIDE 77, N.Y.

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GET INDUSTRIAL ELECTRONICS in Questions and Answers by Edward Bukstein, RADIO-ELECTRONICS writer, for complete knowledge without systematic studies. Just published, $3.95. FREDERICK UNGAR PUBLISHING CO., 105 E. 24 St., New York 10, N. Y.

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# People

**Maurice V. Odquist** joined Sylvania Electric Products, New York, as director of new product sales. A well known marketing and advertising executive, he was formerly associated with C & C Super Corp., Newell Emmett Co., Kenyon & Eckhardt, and Biow Co.

**Russell D. Gawne**, promoted to general sales manager of General Cement Manufacturing Co., Rockford, Ill., had been sales manager of the G-C Electronics Manufacturing Co.

**Richard A. Kleine** was appointed sales manager of Rohn Manufacturing Co., Peoria, Ill., tower and mast manufacturer. He comes to Rohn from Baker Manufacturing Co.

**Jay Carver** (left), former advertising manager of Cabinart, joined Electro-Voice, Inc., Buchanan, Mich., to handle wood product sales, including hi-fi loudspeaker enclosures and do-it-yourself enclosure kits. **Frank Stroemple**, formerly with Radiart, joined Electro Voice as assistant manager of the Distributor Sales Division.

**Jim Johnson** (left), former Electro-Voice sales engineer, was appointed assistant manager of Manufacturers Sales Division.

**Douglas A. Battin** joined Turner Co., Cedar Rapids, Iowa, as its assistant sales manager. He had formerly been in the Sales Department of the Collins Radio Co.

PEOPLE *(Continued)*

Donald E. Smith (left), Midwestern district sales manager for CBS-Hytron, was promoted to Central district manager of CBS-Hytron Sales Corp. with headquarters in Chicago. **Walter J. Fitzpatrick** (right), Southern California district manager, was appointed West Coast regional manager, with headquarters in Los Angeles.

## Obituaries

**Dr. Eugene Casson Crittenden**, internationally known scientist and expert on standards of physical measurement, in Washington, D. C., at the age of 75. Chief of the National Bureau of Standards' Electrical Division from 1921 to 1946, he retired as its associate director in 1950 and served as a consultant up to the time of his illness.

**Lloyd L. Spencer**, a retired vice president of Stromberg-Carlson Co. and associated with the phonograph and radio industries for over 30 years, recently at his home in Hudson, Ohio.

**Rudolph F. Blash**, founder and chairman of the board of Webster-Chicago Corp., Chicago, at the age of 70, in Fort Lauderdale, Fla.

## Personnel Notes

...**Emanuel Sacks**, vice president of RCA and NBC and vice president and general manager of the RCA Victor Record Division, will now devote full time to NBC and RCA. **Lawrence W. Kanaga**, vice president and operations manager of the record division, succeeds Sacks as vice president and general manager.

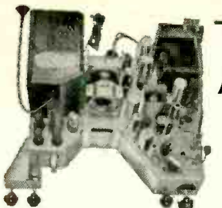
... **K. L. (Ken) Bishop** joined the Electronics Division of Thompson Products, Cleveland, as president and general manager of Bell Sound Systems, Columbus, Ohio, a subsidiary. He had been general sales manager of V-M Corp. Other members of the Bell management team are **W. H. Bunce**, operations manager; **H. H. (Pete) Seay**, sales manager, and **Floyd W. Bell**, in charge of engineering.

... **Paul V. Galvin**, president of Motorola, will be awarded the 1956 Medal of Honor by RETMA during its Convention in Chicago June 12–14. END

## CORRECTION

The text describes the Daystrom "Tiny Tim" miniature wirewound potentiometer ("What's New?," page 48, April, 1956) as a trimming capacitor. As readers have no doubt guessed, the unit is used as a trimming *resistor*—usually in connection with a fixed or semi-adjustable resistor.

We thank Mr. Philip Dempster of Sedona, Ariz., for this correction.



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**#630 SUPER DELUXE 31-TUBE TV KIT**

OPERATES 16" to 21" PICTURE TUBES • Engineered in strict adherence to the genuine RCA #630 plus added features • FULL 4MC BANDWIDTH • CASCODE TUNER • COSINE DEFLECTION YOKE • LARGER POWER TRANSFORMER • KEYED AGC • 12" SPEAKER • CONDENSERS and RESISTORS at rated capacities and tolerances. You receive a COMPLETE SET of PARTS and TUBES, everything needed is included (less CRT & wire). All I.F. Coils and Transformers are factory pre-aligned and tuned. You will enjoy building it with "LIFE-SIZE easy to follow step-by-step ASSEMBLING INSTRUCTIONS" included with each KIT.

**Slashed to $99.99**

**Similar KIT for 24" or 27" CRT slashed to $110.39**

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**MANHATTAN $53.43** **WESTCHESTER $88.70**

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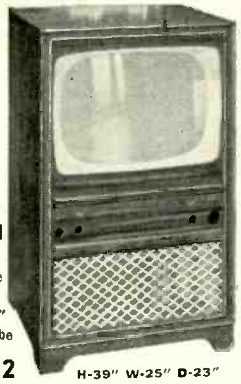
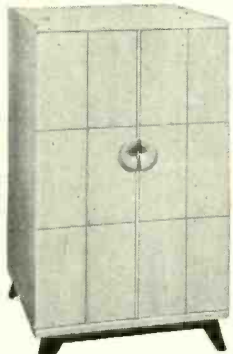


H-39" W-25" D-23"



H-41" W-26" D-25"

H-25" W-26" D-22"

**GEM** also available for 24" or 27" picture tube **$59.54**

## DUMONT OR THOMAS PICTURE TUBES

BRAND NEW in Factory Sealed Cartons — With a Full Year Guarantee

**17"** #17BP4A **$22.66** | **21"** #21EP4B Aluminized **$32.21** | **24"** 90° #24CP4A Aluminized **$48.99** | **27"** 90° #27EP4A Aluminized **$74.31**

## GEM TV CABINET FRONT

Similar to front of GEM TV Cabinet (above) and complete with mask, safety glass and undrilled knob panel for any TV fit. Beautifully finished in mahogany or blond.

Save money by building a TV Cabinet with it, simply by adding sides, top and bottom.

Use it for mounting Receiver flush with wall.

**Mahogany . . . $19.44** **Blond . . . $21.38**

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**Brand New Factory Guaranteed Stock**
1 oz. mag. on 3" to 6", heavier mag. on 8" & 12"

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| 3" | $ .98 | 6" | $1.58 |
| 4" | 1.17 | 8" | 2.64 |
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## SELENIUM RECTIFIERS

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| .02—400v | 5c | .25—600v | 14c |
| .047—400v | 7c | .001—1000v | 11c |
| .1—400v | 9c | .01—1000v | 14c |
| .25—400v | 12c | .035—1000v | 16c |
| .005—600v | 7c | .05—1000v | 18c |
| .01—600v | 8c | .1—1000v | 22c |
| .02—600v | 8c | .5—400v | 28c |
| 20 mfd—150v | 27c | 8 mfd—450v | 26c |
| 40/40 mfd—150v | 38c | 40 mfd—450v | 49c |
| 50/30 mfd—150v | 39c | 80 mfd—450v | 56c |

## CARBON RESISTORS

Regular factory stock in. Stackpole, I.R.C. Speer. Order any ohmage from 2.2 ohms to 10 meg in the desired tolerance. Deduct 10% on lots of 100 or over.

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|---|---|---|---|
| ½ WATT | 5%....5c | 10%....4c | 20%....3c |
| 1 WATT | 5%....6c | 10%....5c | 20%....4c |
| 2 WATT | 5%....9c | 10%....7c | 20%....5c |

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Values up to 85c each

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Finest, most accurate and the easiest Kit to install in any make TV RECEIVER including the No. 630. Improves performance and insures a steady picture on all channels.

**COMPLETE SET OF PARTS $2.99**
Including 6AU6 tube & Instructions

## #630 SUPER DE LUXE TV CHASSIS

LICENSED UNDER RCA PATENTS
**COMPLETE READY TO PLUG IN AND PLAY**
Similar in features to the 16" to 21" TV KIT above.

**Slashed to $142.27** (less CRT)

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## STANDARD CASCODE TUNER

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Complete with tubes and Brooks CASCODE MANUAL with step-by-step instructions and all extra parts needed. **$15.97**

## FLYBACK TRANSFORMER

Latest single 1B3 type, for the 21" and all 70° Picture Tubes. It is similar to the popular No. X-053 and goes up as high as 16KV. With it you receive easy-to-follow instructions and schematic diagrams that apply to build, convert or improve practically all makes of TV Receivers **$4.86**

## COSINE DEFLECTION YOKE

The latest achievement in the 70° type, with complete wired network. Will add new life to any TV Set, in brilliance, clarity and sweep. This is the same type we supply with our Kits, with it you receive easy-to-follow instructions and diagrams ........ **$4.92**

## 18KV FLYBACK TRANSF.

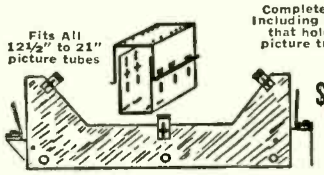
This new Flyback Transformer now makes 90° conversions easy on any make TV Set. Customers report excellence on 24" and 27" TV sets built or converted with this Transformer. Instructions and schematic diagrams included ........ **$5.24**

## COSINE DEFLECTION YOKE

NEW 90° TYPE, with complete wired network. It solves all problems formerly sought for, in 90° Yokes, for undistorted clear pictures and ease of overall sweep. Instructions and schematic diagrams included for building, replacing and converting ........ **$5.98**

## UNIVERSAL Picture Tube MOUNTING BRACKETS

Fits All 12½" to 21" picture tubes



Complete — Including band that holds picture tube

**$4.97**

## 21" TV CONVERSION KIT

NOW . . . Anyone with even a limited knowledge of TV—can Convert any Size, any Make TV RECEIVER to operate 21" or any 70° Picture Tube.

COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 70° COSINE DEFLECTION YOKE and TODD HV FLYBACK TRANSFORMER, FOCALIZER, 20KV FILTER, DRIVE TRIMMER, LINEARITY COIL, CONDENSERS, RESISTORS.

Your price... **$13.97** List Price $33.50
Incl. CONVERSION MANUAL with Step-by-Step Instructions & Diagrams.

Similar Kit for 24", 27" or any 90° CRT **$15.98**

## 27" TV CONVERSION KIT

Convert any Size any Make TV RECEIVER to operate the 27", 24" or any 90° Picture Tube.

COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 90° COSINE DEFLECTION YOKE and TODD 18KV FLYBACK TRANSFORMER, 30KV FILTER, 6AX4 TUBE, YOKE BRACKETS, WIDTH CONTROL, CONDENSERS, RESISTORS.

Your Price... **$15.98** List Price $39.75
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Illustrations for mounting TV Sets flush with wall extending into garage, closet or wall recess included.

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Write us which type you need and let us show you that Brand New factory sealed

**DUMONT PICTURE TUBES**

are your best bet, yet inexpensive.

## SPECIAL TV PUBLICATIONS

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|---|---|---|
| Brooks LIFE-SIZE TV INSTRUCTIONS for building any #630 TV Receiver from the original 10" to the latest 27" | $1.25 | postpaid |
| 90° TV CONVERSION MANUAL, how to convert any TV SET to 24", 27", etc. | 50¢ | postpaid |
| 70° TV CONVERSION MANUAL, how to convert any TV SET to 17", 21", etc. | 50¢ | postpaid |
| HINTS FOR BETTER PERFORMANCE on your #630 TV receiver | 50¢ | postpaid |
| Brooks CASCODE MANUAL, how to install Cascode Tuner in any make TV set | 25¢ | postpaid |
| A.G.C. STEP-BY-STEP INSTRUCTIONS, how to add A.G.C. to any make TV Receiver | 25¢ | postpaid |

**FREE CATALOG mailed on request**

# BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.

TELEPHONE COrtland 7-2359

# technical Literature

### BROCHURE ON MANUAL

A 4-page circular describes the newly published *1956 Television Manual*, Vol. TV-11 of the TV series.

*Supreme Publications, 1760 Balsam Rd., Highland Park, Ill.*

> Any or all of these catalogs, bulletins or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears.
> UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

### TRANSFORMER LAMINATIONS

Detailed information and drawings on 100 standard lamination shapes are given in the seventh edition of *Transformer Laminations* in a revised and expanded edition of 120 pages. Such items as direction of grain, count and weight of laminations, magnetic and mechanical dimensions, lamination die layout as well as other important data are included in the book.

*Sales Dept., Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.*

### REPLACEMENT GUIDE

An automobile radio replacement guide *AR-56* lists recommended Triad replacement transformers for nearly 500 models of automobile radios including several 12-volt models.

*Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.*

### TIPS FOR SERVICE TECHNICIANS

A new publication *Tips* which is published "occasionally" contains articles of interest to the radio and TV service technician. International Rectifier Corp. offers a $25 defense bond to anyone submitting an article that is subsequently published in it.

*International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.*

### SPEAKER LITERATURE

The *Progressive Speaker Expansion Guide* contains detailed information for step-by-step expansion of speaker systems illustrated with simple color-coded charts. It includes data on the use of adjustable networks, dual-impedance woofers, adjustable-response woofers, mid-range speakers and tweeters. The complete line of University speaker and network components is illustrated with all important specifications included.

*Brochure 78A1* describes the Decor-

Coustic three-way speaker systems, including the new Master, Senior and Tiny-Mite cornerless-corner setups, and a feature story of the acoustic Baton. The deluxe Dean and Classic systems are also described.

*University Loudspeakers Inc., 80 So. Kensico Ave., White Plains, N. Y.*

### SELECTION CHART

A quick-selection chart *ETD-1163-A* lists G-E's 600-milliampere series-string receiving type tubes—all of controlled heater warmup design. It classifies the 48 tube types according to elements; lists typical service, heater voltages, maximum plate and screen dissipation ratings; gives average characteristics.

*General Electric Tube Dept., Schenectady, N. Y.*

### SPEAKER

The Tempo series of high-fidelity speakers is described in a four-page catalog. Among the speakers are the model F8J408, an 8-inch, single-cone unit; model F12J408, a 12-inch full-range single-cone speaker, and the 12-inch single-cone model F12L608.

*Oxford Electric Corp., 556 W. Monroe St., Chicago 6, Ill.*

### TAPE RECORDERS

A 4-page folder describes the VU Magnemite series of tape recorders. A variety of single-, two-, three- and four-speed models are listed and their respective recording characteristics are tabulated. A full description of the various mechanical and electrical components is given, with individual illustrations. The recorders' operations are explained clearly and concisely. Complete technical specifications and recommended accessories as well as direct factory prices are included.

*Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.* END

## Thirty-Five Years Ago
### In Gernsback Publications

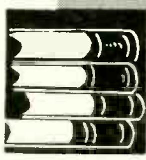
| HUGO GERNSBACK, *Founder* | |
|---|---|
| Modern Electric | 1908 |
| Wireless Association of America | 1908 |
| Electrical Experimenter | 1913 |
| Radio News | 1919 |
| Science & Invention | 1920 |
| Television | 1927 |
| Radio-Craft | 1929 |
| Short-Wave Craft | 1930 |
| Television News | 1931 |

Some larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

**In June 1922 Science and Invention (formerly *Electrical Experimenter*)**

The Odor Organ, by Joseph H. Kraus.
The Radio Science, by H. Gernsback.
Secret Phone Aids Public Speakers.
Building a Color Organ, by Manuel Comulada.
Church Broadcasts Own Sermons, by Archie Richardson.
Vacation-Time Radio Receiver, by Robert E. Lacault.
Radio for the Beginner, No. 4, by Armstrong Perry.
Radio-Frequency Amplification, by Arthur H. Lynch.
The Radio Oracle.

# Books



**TELEVISION FOR RADIOMEN (revised), by Edward M. Noll. MacMillan Co., New York, N. Y. 6 x 9 inches, 662 pages (black and white) and 116 pages (color). $10.**

This new edition adds material on transistors, uhf and color. It presumes that the reader understands radio and wishes to learn TV.

The major portion of the book (16 chapters) is devoted to black-and-white TV. There are four chapters on color. The author gives clear and complete discussions on the functions of parts and circuits and his topics are well-planned. Many illustrations show typical circuits and block diagrams.

Installation, adjustment and trouble-shooting receive two full chapters. They are all fully detailed with step-by-step procedures for the technician. There is also a step-by-step list for the viewer to guide him in turning on the set and adjusting for the best picture. Sweep oscillators, oscilloscopes and generators are also discussed.

One chapter shows the reader how to apply math in his work. The uhf chapter is comprehensive and includes basic information on antennas, tuners and test procedures.

The section on color provides a good groundwork of information on tubes and the NTSC system.

---

**ELECTRONICS: THE SCIENCE OF ELECTRONS IN ACTION, by A. W. Keen. Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. 5½ x 8¼ inches, 256 pages. $4.75.**

In their frenzied race toward extending electronics into new and hitherto improbable uses, a few engineers do worry about the increasing complexity of their work and its relationship to the lay public (for whom, after all, the research and work are being done).

There is no question that the fruits of electronics research are accepted. But this is not enough. What the author wants is acceptance with understanding. And so we have a book that describes how this new technology came into being and how it brings us many strange, wonderful and awe-inspiring new devices. Yet there is something missing. The developments are marvelous—the writing less so. The background history of electronics is made into a factual recital when it should be a mad rush of excited reporting. The author cannot leave his engineering training for any length of time so he brings his circuits, his wave-forms and graphs along for a reader-ship that will regard them as electronic abracadabra.

The author has written an excellent survey book on electronics—one that would be suitable for a freshman class in engineering. But the general public will have to wait. The Paul de Kruif of electronics has not yet appeared.—*MC*

---

**BASIC AUDIO COURSE, by Donald Carl Hoefler. Gernsback Library, Inc., 25 W. Broadway, New York, N. Y. (Book No. 66). 5½ x 8½ inches, 223 pages. $2.75.**

This is a complete and clear audio course on circuits, components and design procedure. Nonmathematical, it will be found useful by technicians and hi-fi fans.

The book discusses sound itself, amplifiers and power supplies, distortion, attenuators and filters, speakers and microphones and sound recording. The author shows how to work with logarithms and db, how to design amplifiers and how to understand and avoid distortion. The important subject of filters is covered in a large chapter. Another chapter gives adequate coverage to speaker enclosures and how to construct them. Placement and use of mikes and speakers are described. Recording information is given on tracking error, how to interpret the light patterns and faults revealed through a microscope. Tape head alignment and bias adjustment are also discussed.

Many useful charts, diagrams and tables are included. The chapter on pads and filters is especially rich in such data.

This is a happy combination—the author knows his subject very well and is adept at passing his knowledge along to the reader.—*IQ*

---

**HI-FI SPEAKERS AND ENCLOSURES, by Abraham B. Cohen. John F. Rider Publisher, Inc., 480 Canal Street, New York 13, N. Y. 5½ x 8¾, 368 pages. $4.60.**

This comprehensive work will round out the library of any hi-fi fan for it deals with the least understood of all audio subjects. The author, who is engineering manager for University Loudspeakers, Inc., uses no "engineers' talk" in his book. The language is clear and the diagrams are many. The only mathematics are detailed dimensions for enclosure design, numerical data for crossover networks, correct horn lengths, etc.

The book has three parts: speakers, enclosures and the room. The first covers in much detail the construction and characteristics of dynamic, electrostatic, crystal and ionic speakers. The next part shows the effect of baffles, horns, speaker resonance, etc. and how to determine their optimum value. The last shows how the room plays a definite and important part in hi fi. Speaker placement, reverberation and correct volume level are among the topics.

The appendix includes 20 pages of

diagrams with data for constructing enclosures for speakers from 8 to 15 inches.

**THE USE OF SELENIUM PHOTOCELLS AND SUN BATTERIES, by John Sasuga. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif. 6 x 9 inches, 58 pages, $1.50.**

Hard on the heels of the recent publicity flare-up on sun batteries, is this first modest catabook * on the subject. A small, though very definite step in the right direction, it is well written and contains a surprising amount of useful data.

Following a brief bit of introductory theory, the author supplies ciruits and construction data for a variety of projects—light-powered motors, oscillators, a batteryless radio powered by light, a light meter and others. It takes no Nostradamus to foresee that sun batteries, plus transistors, miniaturized components and printed circuits will open entirely new avenues of approach for the electronic hobbyist.—*MC*

* A coined word, extracted from *cata*log and *book*.

**SONICS, by Theodor F. Hueter and Richard H. Bolt. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 5½ x 9 inches, 456 pages. $10.**

Many radio technicians may not be aware that sonics (and this includes ultra sonics as well) means more than a sound wave in front of a microphone. Sonic vibrations are used in soldering, drilling, medical diagnosis, metal testing, locating fish and other objects under water, siren generators, etc. This college-grade text covers the entire field from a theoretical and practical standpoint.

After discussing the basic principles of vibration and radiation, the author describes piezoelectric and magnetostrictive transducers and receivers. These chapters are lengthy and include many diagrams and tables, also references for the aid of students.

A chapter on testing and analysis discusses standing waves and pulse techniques. Photographs include a sonic washing machine, therapy applicators, a siren and drill.—*IQ*

**MASTER GUIDE TO THEATRE MAINTENANCE, by Aaron Nadell. Aaron Nadell, 130-57 Lefferts Park Blvd., South Ozone Park, N. Y. 5¼ x 7¼ inches, 240 pages. $5.**

The author—known to readers of this magazine for some decades as a writer on electronics, with special emphasis on motion-picture applications—is an experienced motion-picture man. This book covers the range from financing and insuring theatres to "The Mechanics of Candy Selling." Four of the chapters are devoted to theater sound and acoustics; one to public address in the theater. Electronics and sound get into other chapters, specially the one on drive-ins and that on new developments. The glossary (which contains such terms as "color wheel" and Kerr cell) will interest electronics men.—*FS* END

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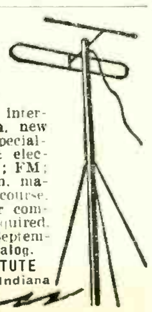

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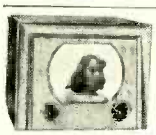

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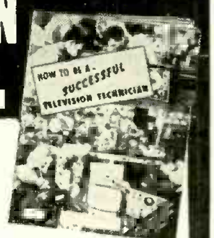


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# ADVERTISING INDEX

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**THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE**

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This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.
This tone arm is a quality companion to the PK-100 with matching finish. Shpg. wt., 2½ lbs.

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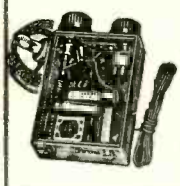

Packed into a 2½"x3½"x1¼" plastic case This Two Transistor plus crystal diode radio kit offers many surprises, utilizing a regenerative detector circuit with transformer coupled audio stage, gives you high gain and excellent selectivity. Pulls in distant stations with ease with more than ample earphone volume. Kit comes complete with two transistors, crystal diode, loopstick, Argonne transistor audio transformer, resistors, condensers, plastic case, etc. Including schematic and instructions.

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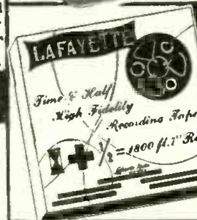


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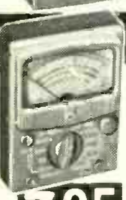

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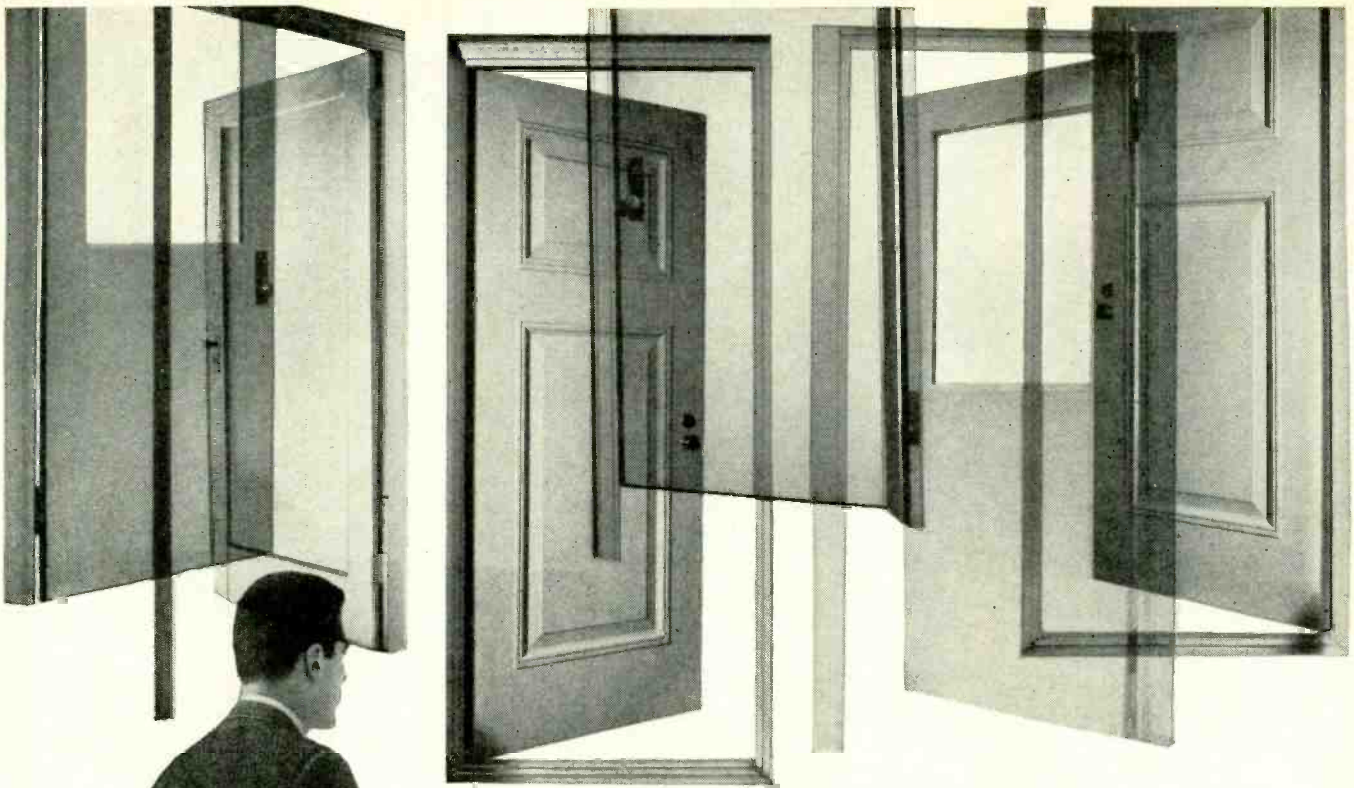

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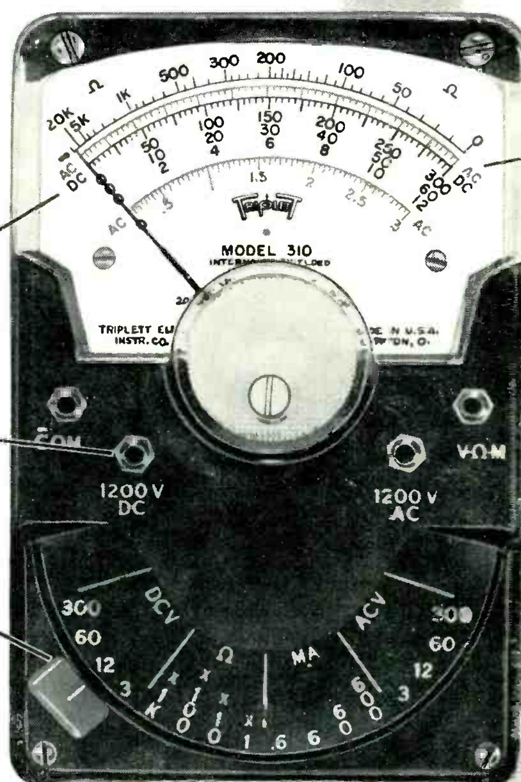


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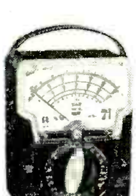

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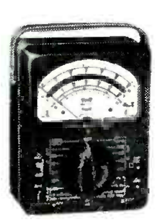

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