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Radio-Electronics

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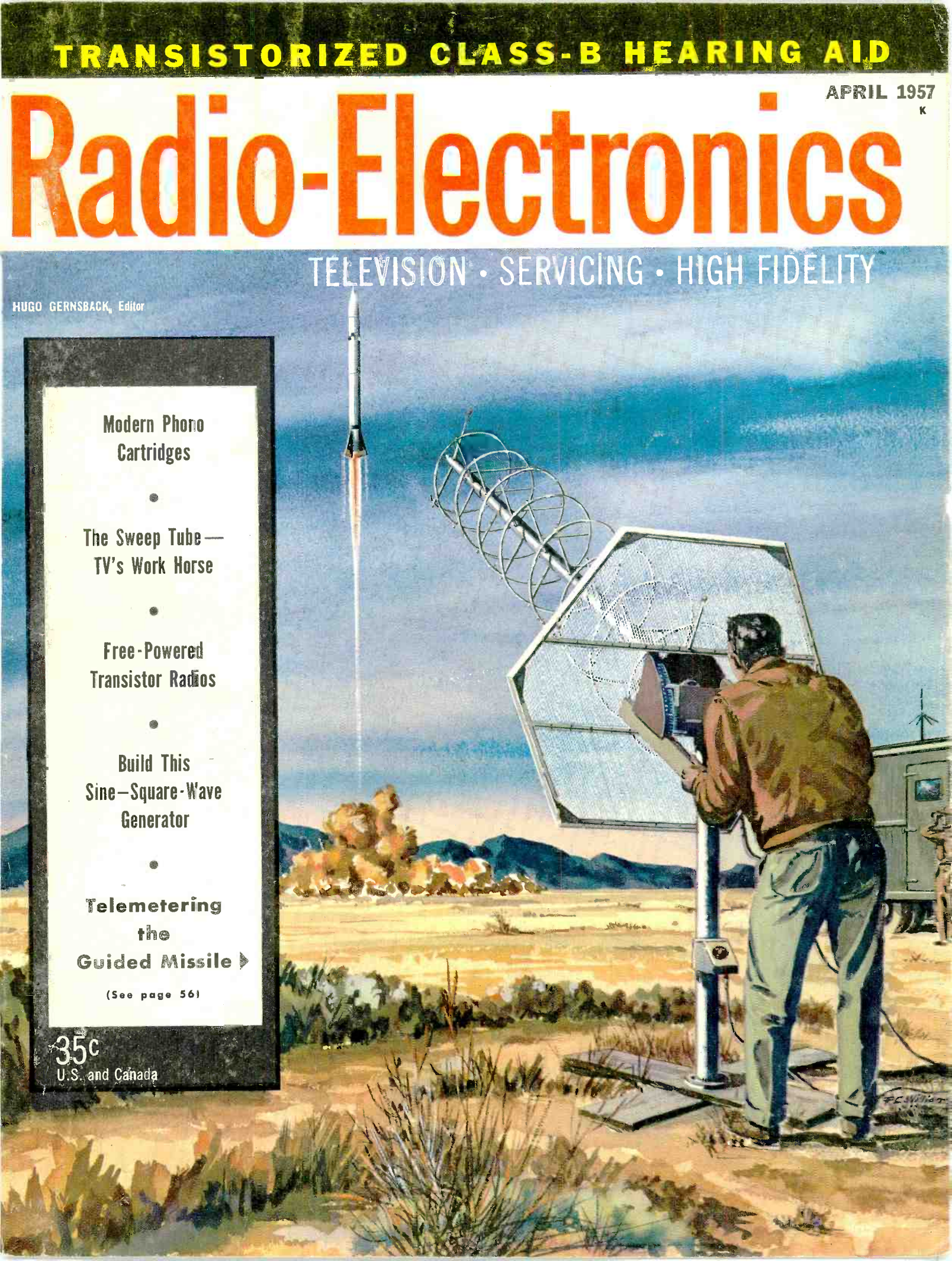
HUGO GERNSBACK, Editor



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The Sweep Tube—TV's Work Horse

•

Free-Powered Transistor Radios

•

Build This Sine–Square-Wave Generator

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(See page 56)

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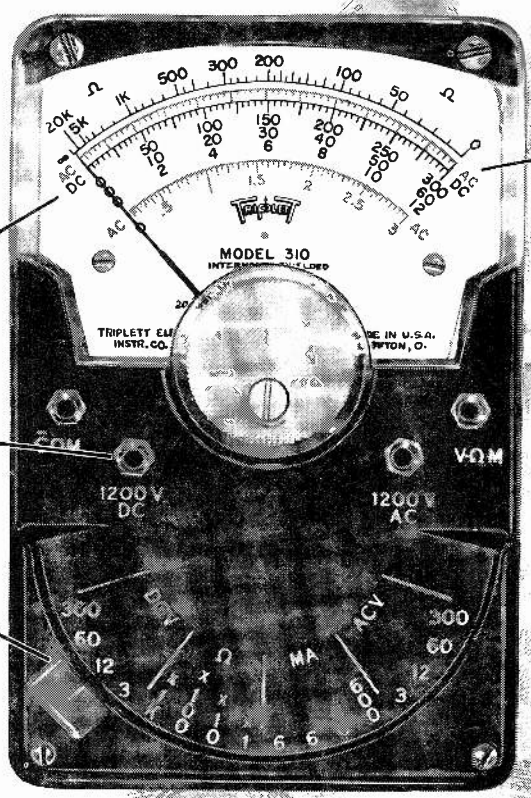

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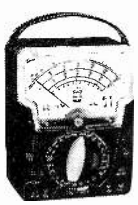

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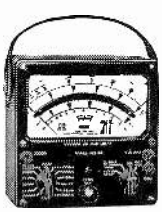

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ON THE COVER

(More on page 56)

The operator is keeping a helical antenna aimed at the guided missile, to receive signals used for telemetering. Scene is the testing grounds of the Jet Propulsion Laboratory, a division of the California Institute of Technology. Electronic equipment for amplifying and reproducing the signals is housed in the truck at right.

Original painting by Frank Chapman Williams

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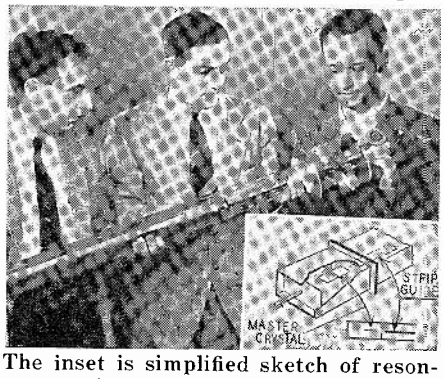
News Briefs

NEW AMPLIFIER TECHNIQUE may have far-reaching effects, especially on microwave frequencies. Signal–noise ratios 100 times better than those obtainable with any present techniques may well make it possible to amplify signals far weaker than can now be handled.

The technique was announced in almost simultaneous releases from Bell Laboratories and the Massachusetts Institute of Technology. Although there are some differences in the releases, it appears that both are discussing essentially the same thing. The Bell experiments, however, are the only ones clearly described, and we learn that the technique is that of stimulated emission of radiation—the "maser" principle (RADIO-ELECTRONICS, June, 1955, page 56). Electrons in the solid-state material placed in a magnetic field are at three different energy levels. By irradiating the material with microwave power large numbers of electrons are raised to higher



The inset is simplified sketch of resonant cavity and crystal in 9,000-mc oscillator. The solid-state device is held by three Bell scientists.

energy levels. A signal at a frequency corresponding to the energy difference between two of the states will knock down electrons from one state to another, stimulating radiation of energy. In the Bell Labs experiments the energizing frequency was 17,500 mc and that of the signal 9,000 mc.

The solid-state material consists of an ionically bound paramagnetic salt, combined with a diamagnetic material. Gadolinum ethyl sulphate and lanthanum ethyl sulphate were used in the Bell experiment, and a crystal of the material was placed in a waveguide which had two resonant frequencies, one equal to the frequency of operation (oscillation in this case) and the other to the frequency of the energizing source. The waveguide was inserted into a tube containing liquid helium at low temperature (1.20° Kelvin) to increase the efficiency of the action.

TV IN SCHOOLS can save $500 million a year, 100,000 teaching positions and provide better instruction, states Dr. Alexander Stoddard, retired Superintendent of Los Angeles Schools, in a report prepared for Ford Foundation.

In his 62-page report Dr. Stoddard recommends that all schools be TV-equipped and that no school be built without providing for two or three rooms equipped with TV receivers and a closed-circuit system. Building requirements for new buildings employing ful use of TV should include built-in coaxial cables and antenna lines, built-in 24-inch sets and a central sound system with a talk-back arrangement. For buildings now in use Dr. Stoddard recommended portable TV sets with large speakers in each room; installation of antenna, coaxial and wire leads; adaptation of radio circuit equipment and improvement of acoustics, lighting and ventilation when necessary.

Educational TV stations already in operation were praised in the report. After expressing appreciation for the cooperation of commercial stations Dr. Stoddard stated, "The schools and colleges must have their own stations. . . . All the time that can or will be given by commercial stations for educational programs is but a drop in the bucket of what will soon be needed."

JOHN VON NEUMAN, member of the U. S. Atomic Energy Commission and pioneer in electronic computer theory, died Feb. 8 at the age of 53. The impact of von Neumann's theories —on high-level scientific problems such as thermonuclear weapons and guided missiles, Air Force Strategy, giant computing machines, economic and sociological enigmas including stock market behavior, the operation of oil refineries and Weather forecast—was decisive. Dr. von Neumann studied and taught at leading European universities until he came to Princeton in 1930 to teach mathematical physics. He left Princeton University in 1933 to join the Institute for Advanced Study. In 1937, he became a U. S. citizen.

Von Neumann was an important figure in the wartime atom-bomb project. When the war ended, he continued to advise the Government and in 1955 became a member of the Atomic Energy Commission. He is responsible for today's thermonuclear thinking in matters of strategic warfare. He convinced the Department of Defense that a high-

(*Continued on page* 10)

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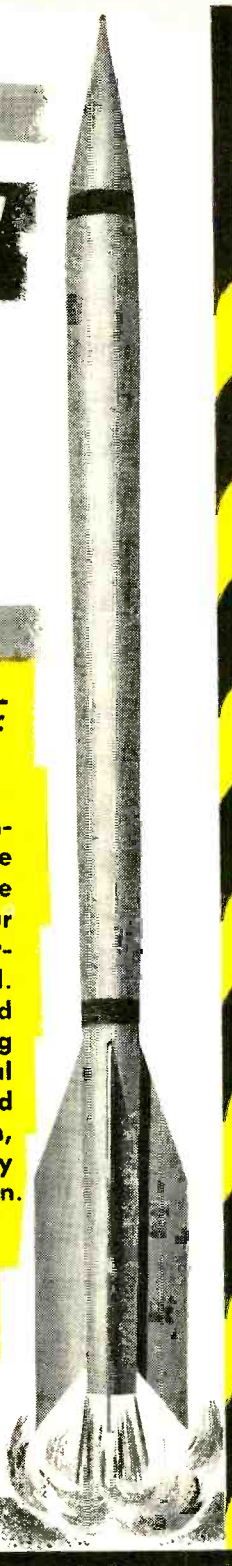

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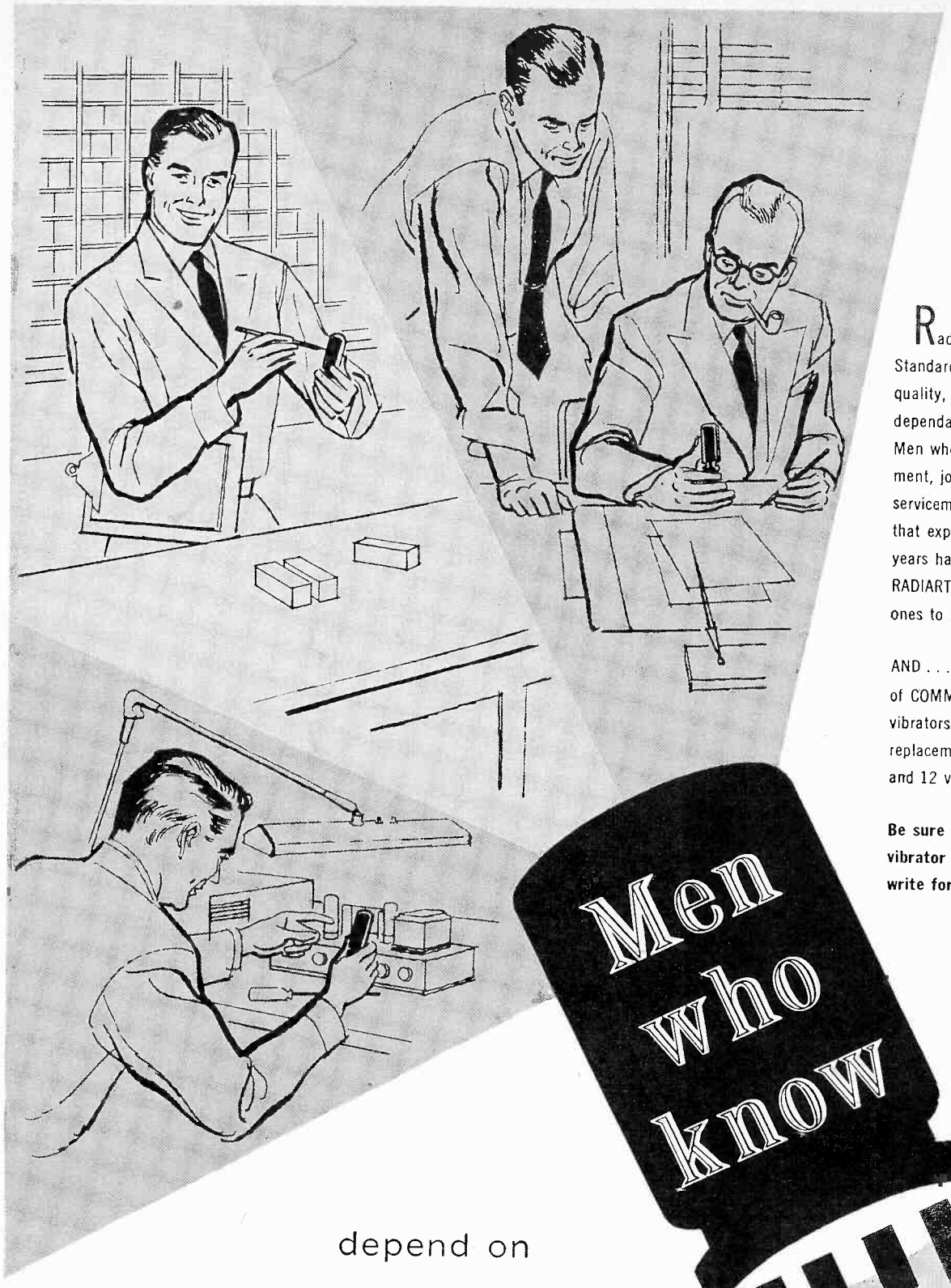

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 (Continued from page 6)

yield thermonuclear warhead could be made light enough to be carried across the ocean by a ballistic missile.

THE FIRST WOMAN to win General Electric's coveted Edison Radio Amateur Award for public service is Mrs. Mary (Mae) Burke, 45, who operates station W3CLU at her home at 265 Waverly Rd., Morton, Pa. Mrs. Burke won the award for voluntarily handling an average of 3,000 messages a month, principally for servicemen overseas.

At a banquet in her honor at the Mayflower Hotel, Washington, D. C., Mrs. Burke was presented with the trophy and a $500 check by L. Berkley Davis, general manager of the G-E Electronics Components Division which sponsors the annual award.

Mrs. Burke was chosen from a group of 50 amateurs nominated for this award, by a board of judges consisting of; Herbert Hoover Jr., Under Secretary of State; Rosel H. Hyde, Federal Communications Commissioner; E. Roland Harriman, chairman of the American Red Cross, and G. L. Dosland, president, American Radio Relay League.

TWO NEW TV STATIONS have begun telecasting since our last listing:

KUMV-TV, Williston, N. D..... 8
KONO-TV, San Antonio, Tex.....12

KWAB, Walla Walla, Wash., channel 8, has changed its call letters to KRTV, and WPSD, Paducah, Ky., channel 6, is now known as WPSD-TV.

The United States and its territories now have a total of 497 operating stations (401 vhf and 96 uhf), of which 23 are noncommercial (6 uhf).

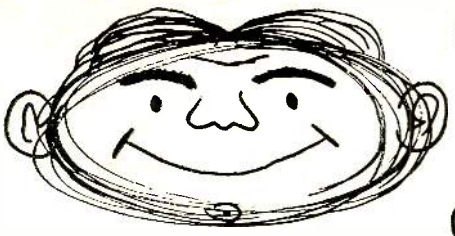
Canada has added a station to its roster, bringing its number up to 39:

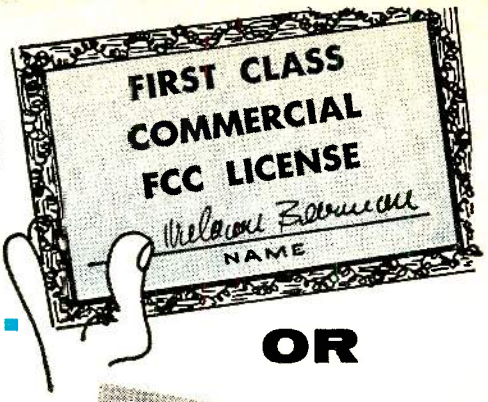
CKMI-TV, Quebec City..... 5

EXPANDING WORLD TV now lists 843 transmitting stations and 56 million receiving sets. Outside the United States there is a total of 327 stations and 14 million sets today—up from 196 stations and 10.5 million sets one year ago.

Italy is second only to the United States with 64 stations—although 41 of these are automatic satellites. Australia came out with a six-station

6 months from today





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Boyd Daugherty, Falls Church, Va.

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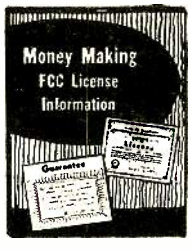

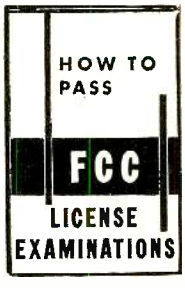

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NEWS BRIEFS *(Continued)*

system last November, with some of them on the air in time for the Olympic Games in Melbourne. Other countries that inaugurated TV in 1956 were Algiers, El Salvador, Iraq, Korea, Portugal and Uruguay. Nicaragua had a transmitter on the air for three months but closed down after President Somoza was assassinated and now has no definite plans.

TV's development behind the Iron Curtain has been slow. Russia—in a big expansion program—had 31 transmitters on the air at the end of 1956.

Foreign TV is rapidly becoming a big market for American equipment. Almost all countries with TV systems that have passed the experimental stage are using programs filmed in the United States and obtained from Voice of America and private TV film distributors.

Calendar of Events

AIEE Southern District Meeting, April 3–5, Heidelberg Hotel, Jackson, Miss.
High-Fidelity Music Show, April 5–7, Hotel Benjamin Franklin, Philadelphia, Pa.
14th Annual Radio & Electronic Component Show, April 8–11, Grosvenor House and Park Lane House, London, England.
Annual Industrial Electronics Educational Conference, April 9–10, Illinois Institute of Technology, Chicago.
Ninth Annual Southwestern IRE Conference and Electronics Show and Second National Simulation Conference. April 11–13, Shamrock-Hilton Hotel, Houston, Tex.
Convention of the Council of Radio & Television Service Associations of Philadelphia and Delaware Valley, April 12–14, Ritz Carlton Hotel, Atlantic City, N. J.
High-Fidelity Music Show, April 12–14, Statler Hotel, Buffalo, N. Y.
London Audio Fair, April 12–15, Waldorf Hotel, Aldwych, London, England.
National Symposium on Telemetering and Exhibits, April 14–16, Sheraton Hotel, Philadelphia, Pa.
Midwest Electronic Service Fair, April 12-14, Antlers Hotel, Indianapolis, Ind., sponsored by Indiana Electronic Service Association.
International Symposium on Role of Solid State Phenomena in Electric Circuits, April 23–25, Engineering Societies Bldg., New York.
Seventh Region IRE Conference and Electronics Show, April 24–26, Balboa Park, San Diego, Calif.
Eleventh Annual Spring Technical Conference on Television, April 26–27, Engineering Society of Cincinnati Bldg., Cincinnati, Ohio.
81st Convention of Society of Motion Picture & Television Engineers, April 28–May 3, Shoreham Hotel, Washington, D. C.
1957 Electronic Components Symposium, May 1–3, Morrison Hotel, Chicago.
Fourth Annual Conference for Engineers & Architects, May 3, Ohio State University, Columbus, Ohio.
Pacific Northwest Instrumentation & Automation Exhibit, May 9–10, Seattle, Wash.
Microwave Ferrites and Related Devices and Their Applications Symposium, May 9–10, Western Union Auditorium, New York.
National Aeronautical & Navigational Electronics Conference, May 13–15, Dayton, Ohio.
Second Annual Industrial Nuclear Technology Conference, May 14–16, Museum of Science and Industry, Chicago.
1957 Electronic Parts Distributors Show, May 20–23, Conrad Hilton Hotel, Chicago. (RADIO-ELECTRONICS and GERNSBACK LIBRARY will exhibit in Room 501.) Closed show for manufacturers, representatives and distributors. Admission by badge only.
National Telemetering Conference, May 27–29, Hotel Cortez, El Paso, Tex.

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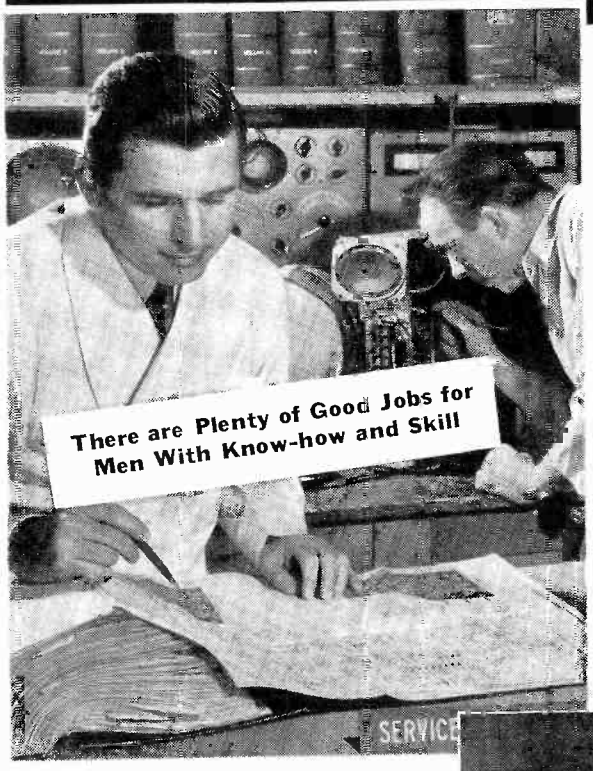

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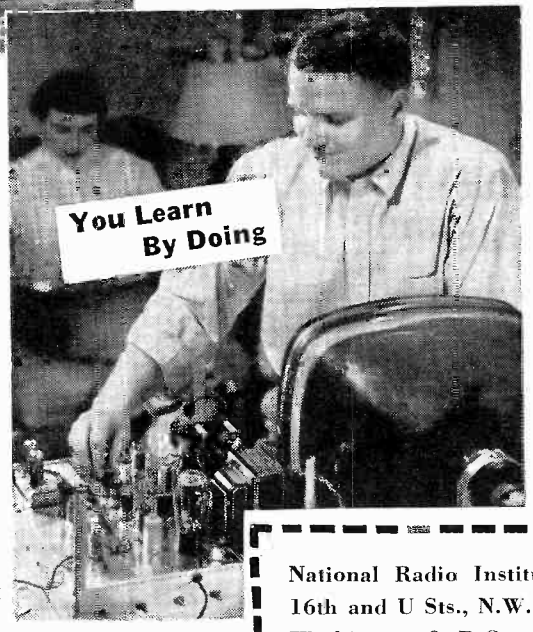

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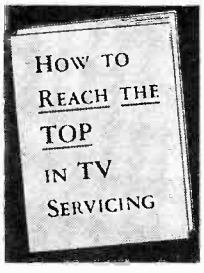

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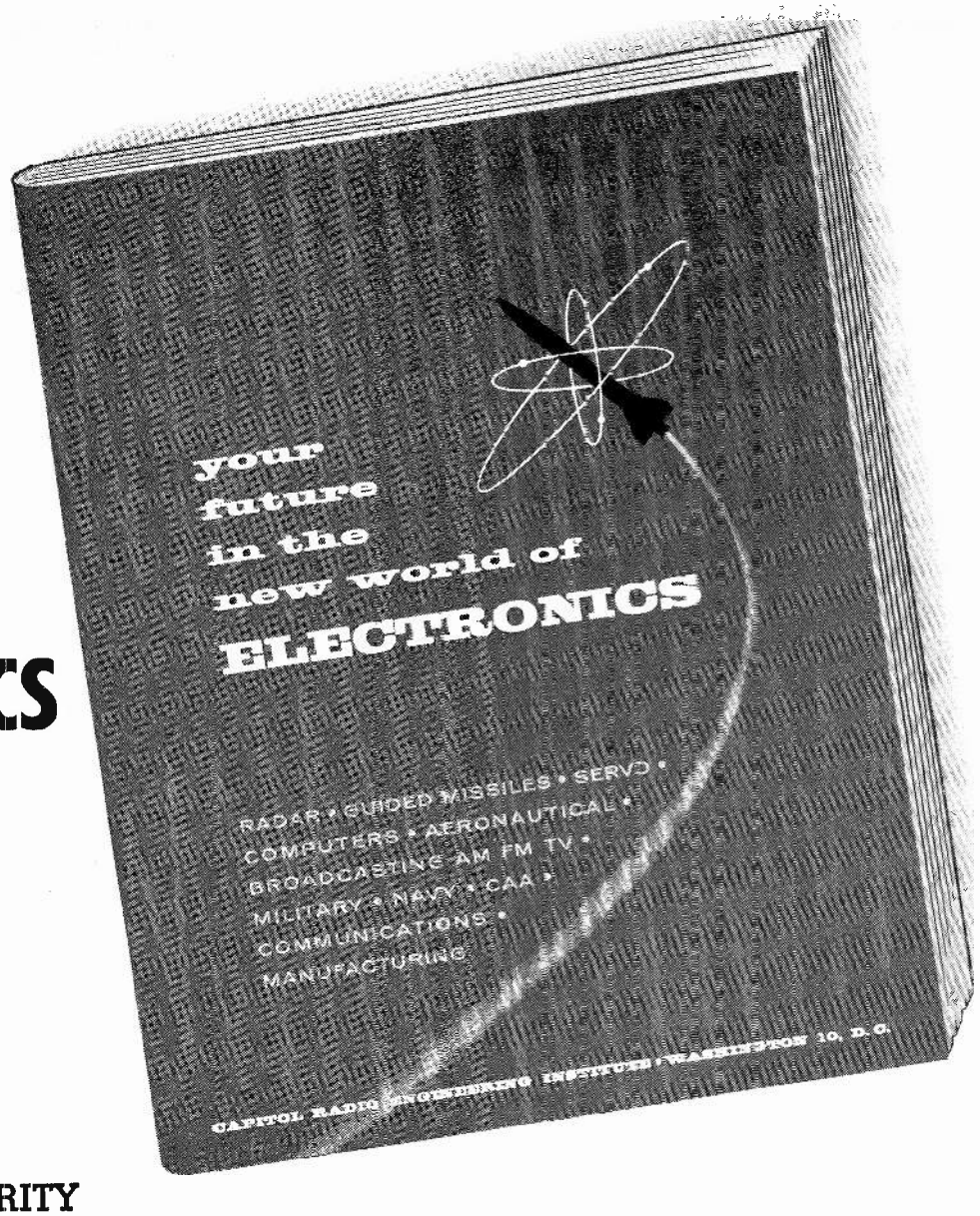

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Correspondence

THE DYNAFLEX RADIO

Dear Editor:

In the schematic diagram of my Dynaflex receiver, published in the February issue of RADIO-ELECTRONICS, a .005-μf ceramic capacitor should be shown connected across the primary of the audio output transformer T5. Apparently this capacitor was inadvertently omitted in my original drawing of the circuit. It is needed to give an optimum balance to the audio output and to prevent a slight tendency toward parasitic oscillation. This tendency will be most noticeable to a critical listener as a slight breaking up of high-frequency audio peaks. Such a capacitor is used across the transformer of many pentode or beam type power output stages and is especially desirable in the case of the 6CL6 because of its high transconductance.

This information will help your readers to build a better Dynaflex. Thus, I would appreciate your publishing it in RADIO-ELECTRONICS at the earliest possible date.

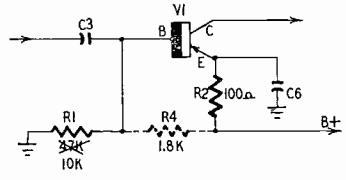
FRANK H. TOOKER

Lakehurst, N. J.

STABILIZING A RADIO

Dear Editor:

I have found that temperature changes cause a detuning effect in the receiver described in my article "Transistorized Radio Has Rf Stage," on page 104 of the November, 1956, issue



of RADIO-ELECTRONICS. This can be corrected by using conventional temperature stabilization. Simply change R1 to 10,000 ohms and add R4 (1,800 ohms) as shown.

J. E. PUGH, JR.

Menominee, Mich.

HIGHSTONE IS RIGHT

Dear Editor:

I would certainly like to shake the hand of H. A. Highstone for his excellent article "Voice of the Future" in the January issue. It shows clearly how miserably the manufacturers have failed to think of the service technician and how intent they are on producing anything that will make an extra buck for their own pockets.

Truly, 95% of the '56 and '57 models

Dealers Prove *Winegard Color 'ceptor* SELLS BEST!

Thousands of dealers have proved conclusively that the Winegard Color 'Ceptor outsells any comparable TV antenna! This is the simple test that has convinced them: They've shown their customers the glistening *gold-anodized* Color 'Ceptor right alongside competitive types . . . and, when given the chance to choose for themselves . . . the vast majority of their customers invariably selected the Color 'Ceptor! The explanation's simple! *Eye appeal* is what clinches the sale. Your customers are no different than you. They are used to buying products that present a *finished*, quality appearance. They instinctively reject an item that is dull, drab and lifeless.

Anodizing Is Much More Than a Mere Beauty Treatment

The diamond-hard toughness of this anodized finish provides positive resistance against corrosion—*prevents the Color 'Ceptor from ever turning black and ugly*, and locks in, permanently, all the superb performance engineered into the Color 'Ceptor. You can sell this longer-life feature as a big advantage—and it makes real sales sense to your customers.

Second to None in Performance

A Winegard Antenna *broke all long-distance reception records* in 1956 (see Radio-Electronics Magazine, Jan. '57). Equipped with optional signal-boosting Power-Pack and patented "Electro-Lens"* focusing, the gold-anodized Color 'Ceptor is unbeatable for long-distance reception . . . and clear, watchable pictures. Black-and-White or color! *If the Winegard Color 'Ceptor won't bring in a station you want to see . . . nothing will!*

Free Display Creates Sales Boom!

Here's the display that has sold thousands of Color 'Ceptors for dealers all over the nation. By getting the beautiful gold Color 'Ceptors out where folks can see them . . . dealers are building antenna sales volume they never realized existed! In fact, many dealers report they are now making more money selling Winegard antennas than they are on TV sets!

Get Full Information Now!

Don't you think it's time you shared in the spectacular success of America's most-wanted TV antenna? The coupon below will bring you eye-opening details. Mail it today!

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Dept. A 4, 3000 Scotten Blvd., Burlington, Iowa

Name _____

☐ Please rush me free 4-color descriptive literature on your gold-anodized Color 'Ceptor and information on display material.

☐ I'm interested in the complete line of new 1957 Winegard antennas.

Company _____

Address _____

City _____ State _____

Gold Anodized

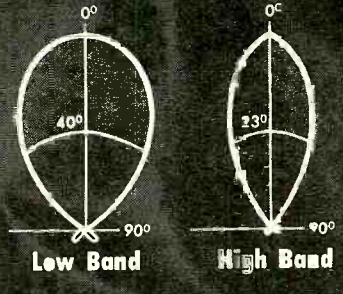
Winegard Color 'ceptor TV Antenna

all 12 VHF Channel Reception For Both Black-and-White and Color

Color so bright they sell on sight!

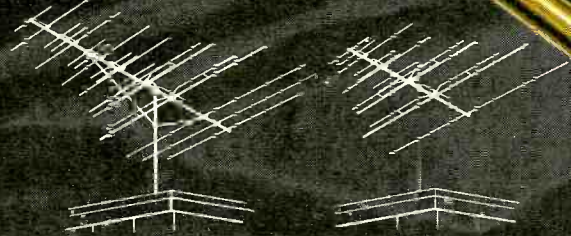
Note:
Each gold Color 'Ceptor you install helps sell another. Once folks see these bright gold antennas sprouting up in their neighborhood, they won't be satisfied until they own the gold antenna, too!

Horizontal Directivity



Low Band — High Band

Gain Chart
CL-4X with Power-Pack



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Color'Ceptor Model CL-4 — $29.95

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Winegard Color 'Ceptors are consistently advertised in leading national magazines your customers read!

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*Pat. No. 2,709,185

are so jammed together you have to be double-jointed to be able to get at any of the parts. I might even have to quit if it were not for my *Handy-Dandy Jiffy Canopener* which I find indispensable for the new steel-cabinet models.

"Trusting you are the same."

JOHN EDWARD GREGOR
Union City, Pa.

THE TECHNICIANS' BURDEN

Dear Editor:

I enjoyed Mr. Highstone's article "Voice from the Future," in the January issue. I wholeheartedly agree with his sarcastic innuendoes concerning TV manufacturers' difficult placement of parts. When I began servicing, the physical labor required was not too great. Lately, however, it has become necessary to carry: test equipment such as a tube tester, a vtvm and a tool box weighing 25 pounds and containing all types of socket and screw drivers, 20 or more types of fuses, solder and a gun, two types of cheater cords, corona dope, a syringe, a painters' brush, bits of wire, assorted components, a huge variety of tube sockets, various ion trap magnets, a supply of open-end wrenches, alignment tools, a pair of scissors, a penknife, cutters and pliers (long and short nosed), a variety of knobs, springs, glue, files, long and short tweezers, various extension leads for the yoke, picture tube and high voltage, a neon light, etc.

Add to this a rejuvenator, a huge supply of 300-, 450- and 600-ma tubes, lead-in, etc., and it adds up to a heavy load. And much of this is due to manufacturer's placement of parts and chassis construction.

NATHAN SHAPIRO
Downsview, Ont.

A TV OWNER COMMENTS

Dear Editor:

I have read several letters by H. M. Layden (and others in the same vein) about TV service, criticizing TV owners and part-time service technicians, whom some of the writers seem to think of as scabs.

There are some very nice, capable, reasonable, likeable fellows in the full-time service business. We TV owners appreciate them and pay gladly for their dependable service. But there are far too many of the other kind!

My TV needed some attention, so I called a local shop. When their so-called TV expert stepped into my home, his first crack was: "You surely don't like the way that TV is operating, do you?" and proceeded along the same lines. He pulled the chassis, kept it about a week and returned it with a $20 charge. Hooked it up, turned it on and left after telling off some of those "scabs."

I could not see that the set was working any better than when he took it away, so after a few nights I called one of those part-time guys with a

(*Continued on page* 22)

GET IN ON THE TV BOOM!

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

TRAIN FOR A TOP-PAY JOB AS A TELEVISION TECHNICIAN

NO PREVIOUS EXPERIENCE NEEDED — study AT HOME in your SPARE TIME

Next to the atom and hydrogen bombs, the biggest noise being made today is by the booming radio-television-electronics industry.

Now, while the boom is on in full force, is the time for you to think about how you can share in the high pay and good job security that this ever-expanding field offers to trained technicians.

Just figure it out for yourself. There are more than 490 television broadcasting stations operating right now and hundreds more to be built; more than 40 million sets in the country and sales increasing daily. Soon moderately priced color television sets will be on the market and the color stampede will be on.

All these facts mean that good jobs will be looking for good men. You can be one of those men if you take advantage of my training *now* — the same training that has already prepared hundreds of men for successful careers in the radio-television-electronics field.

No experience necessary! You learn by practicing with professional equipment I send you. Many of my graduates who now hold down good paying technician jobs started with only grammar school training.

RADIO-FM-TV TECHNICIAN TRAINING

If you have previous Armed Forces or civilian radio experience you can finish your training several months earlier by taking my FM-TV Technician Course. Train at home with kits of parts, plus equipment to build YOUR OWN TV RECEIVER. ALL FURNISHED AT NO EXTRA COST!

FM-TV TECHNICIAN TRAINING

After you finish your home study training in the Radio-FM-TV Technician Course or the FM-TV Technician Course you get two weeks, 50 hours, of intensive Laboratory work on modern electronic equipment at our associate school in New York City, Pierce School of Radio & Television. NO EXTRA COST.

EXTRA LABORATORY TRAINING IN NEW YORK CITY AT NO EXTRA COST!

With our TV Studio Technician Course (Advanced training for men with previous radio or TV training or experience) I train you at home for an exciting top-pay job as the man behind the TV camera. Work in the TV studios or "on location" at remote pick-ups! Optional N.Y.C. additional training.

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LEARN BY DOING—As part of your training I give you the equipment you need to set up your own home service shop and prepare for a BETTER-PAY JOB. You build and keep a Television Receiver designed to take any size picture tube up to 21-inch, (10-inch tube furnished. Slight extra cost for larger sizes.) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

EARN WHILE YOU LEARN—Almost from the very start you can earn extra money while learning by repairing radio-TV sets for friends and neighbors. Many of my students earn enough from spare time earnings to pay for their entire training . . . start their own profitable service business.

FCC COACHING COURSE—Qualifies you for Higher Pay! Given to all my students AT NO EXTRA COST. Helps you qualify for the TOP JOBS in Radio-TV that demand an FCC license! Full training and preparation at home for your FCC license.

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My School fully approved to train Veterans under new Korean G.I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on Postage-Free card below.

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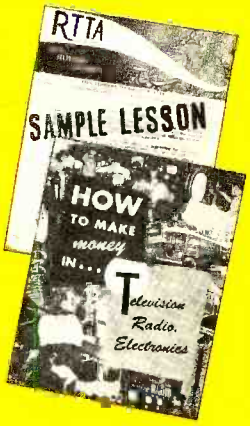

Dear Mr. Lane: Send me your NEW FREE BOOK and FREE SAMPLE LESSON that will show me how I can make TOP MONEY in TELEVISION. I understand I am under no obligation.

(PLEASE PRINT PLAINLY)

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City _____ Zone _____ State _____

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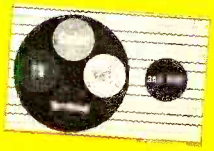
- ☐ FM-TV Technician Course
- ☐ TV Studio Technician Course
- ☐ Color-TV Course (send me Color-TV Brochure only)

VETERANS!
Write discharge date



Radio-Television Training Association

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There's a "POT of GOLD" waiting for YOU — at the end of this COLOR-TV servicing rainbow!

Introducing

RTTA's COLOR-TV TECHNICIAN COURSE

(advanced training for men who have had radio and TV experience)

Color television receivers will demand installation, set-up, adjustment and servicing by highly trained specialists—training and skill which you can acquire in your spare time, at home through RTTA's up-to-the-minute COLOR TELEVISION TECHNICIAN COURSE. All of the latest information and methods for the servicing and maintenance of all color TV receivers and equipment. Trains you thoroughly, accurately and reliably. You will be on a par with the best, anywhere! ***To qualify for this specialized training it is necessary to have had previous radio, television training or experience.***

The step-by-step approach found so successful in teaching our Radio-FM-TV Course, FM-TV Technician Course and TV Studio Technician Course is used in this new, up-to-the-minute COLOR TELEVISION TECHNICIAN COURSE. With the RTTA way, you set your own pace for learning—as rapidly or as moderately as suits your own personal convenience. Lessons are written in easy-to-understand language that everyone can follow. They are illustrated throughout enabling you to grasp the full meaning of concepts immediately.

The course begins with an introduction to the Laws of Color and defines the differences between the transmission and reception of black-and-white and of color television. Starting at the transmitter you are guided through the development of, and transmission of, the composite Color TV signal. With an over-all view of how the receiver functions each circuit is then analyzed. A knowledge of how Color TV circuits work, both as individual and as cooperative units in the receiver, prepares you for all future developments in the field of Color TV. You also receive thorough instruction on test instruments, alignment, as well as servicing. The RTTA Color TV Course features all of the latest information.

For a complete description of the course, send today for your FREE copy of the RTTA COLOR TV Course Brochure.

SLYVANIA SELECTS RTTA's COLOR TELEVISION COURSE FOR ITS EDUCATIONAL PROGRAM

Service dealers throughout the U.S. will soon be able to learn Color Television from the best available information.

The selection of RTTA's COLOR TELEVISION COURSE by Sylvania Tube Division, one of the nation's top manufacturers of receiving tubes and picture tubes is an added assurance to you of the tremendous value of this course. We are proud of this endorsement by Sylvania. It indicates the outstanding merit of the RTTA course. We know that a company such as Sylvania which has earned its fine reputation over the years through the high standard of its products and through leadership, would extend such recognition only after careful cooperation and examination by its staff of experts and engineers. They concluded that the RTTA course offers the best opportunity of studying Color Television on a practical basis—to learn the subject thoroughly.

The Color Television Technician Course is being made available to authorized Sylvania Dealers throughout the 48 states who are interested in expanding their knowledge and experience in Color TV servicing.

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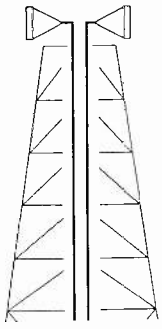
14 THOROUGH LESSONS

1 AN INTRODUCTION TO COLOR
2 FORMATION OF THE COLOR SIGNALS
3 THE CHROMA SIGNALS
4 GENERAL OPERATION OF THE COLOR TELEVISION RECEIVER
5 PICTURE TUBES FOR COLOR TELEVISION RECEIVERS — PART I
6 PICTURE TUBES FOR COLOR TELEVISION RECEIVERS — PART II
7 DETAILED OPERATION OF THE COLOR TELEVISION RECEIVER
8 THE CHROMINANCE CHANNEL
9 COLOR TELEVISION CIRCUITS — PART I
10 COLOR TELEVISION CIRCUITS — PART II
11 ADJUSTING THE COLOR TV RECEIVER
12 COLOR TV TEST EQUIPMENT
13 TROUBLESHOOTING THE COLOR TV RECEIVER
14 SERVICING PROCEDURE

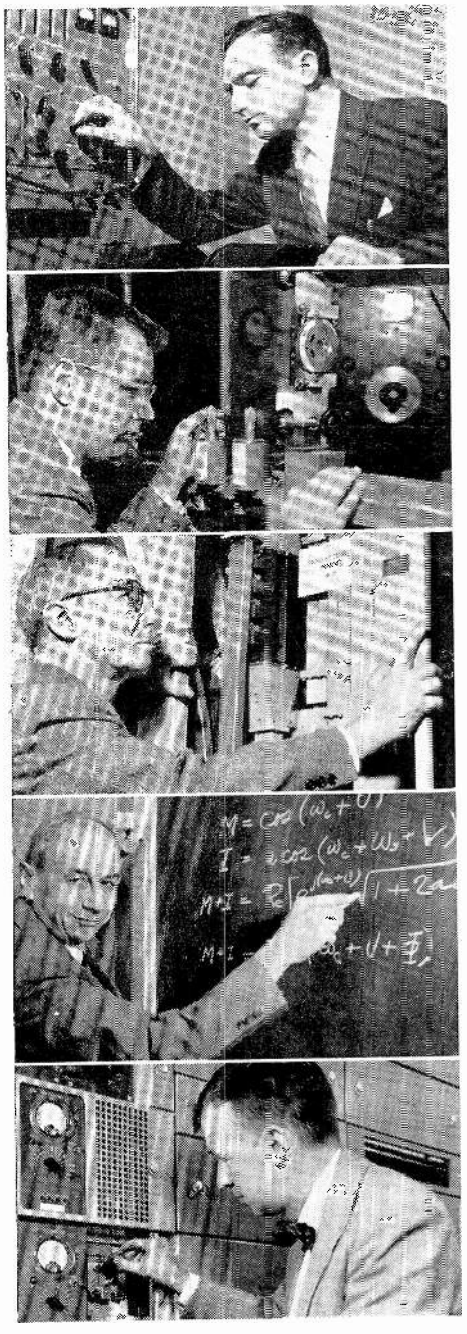
SEND FOR YOUR ENROLLMENT APPLICATION TODAY!

What kind of men develop microwave highways?



The great microwave systems that relay telephone conversations along with television programs from coast to coast will have to work harder than ever to meet growing demands for service. But at Bell Laboratories scientists have been making important advances in the art of microwave communication. These advances are being applied in the development of a new and more efficient system in which single beams of microwaves will carry simultaneously many more telephone conversations and television programs than is now possible.

The development of the new system demands the varied skills of men in many fields of science and engineering. Just a few of the specialists necessary are . . .



PHYSICISTS like J. A. Weiss, Ph.D. in Physics. Ohio State, to harness the properties of ferrites in new ways for better control of the transmission of microwaves.

MICROWAVE ENGINEERS like P. R. Wickliffe, M.S. in E.E., M.I.T., to design new circuitry. Microwaves must be conducted, controlled and amplified through waveguides which resemble pipes.

MECHANICAL ENGINEERS like W. O. Fullerton, B.S. in E.E., Iowa State, to embody new principles in designing the many structures and devices used in microwave telephony—with all parts feasible to manufacture, practical to install and easy to maintain.

SYSTEMS ANALYSTS like J. P. Kinzer, M.E., Stevens Institute, for over-all system planning and prediction. Mr. Kinzer works with numerical quantities and characteristics to predict on paper the performance of an operating system. What will it do? How must it perform to meet the needs?

ELECTRONIC ENGINEERS like B. C. Bellows, B.E. in Engineering, Cornell, for the development of "watch-dog" equipment to protect against failure. Protective devices must operate automatically in split seconds to maintain uninterrupted service.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

CORRESPONDENCE *(Continued from p. 18)*

regular job. He checked the chassis thoroughly here on the floor, replaced resistors and tubes and left the set in such good condition that I gave him a $5 bonus over his charge (which with the bonus was still less than the $20 the smart-aleck "professional" had charged me).

I would suggest that Mr. Layden contact a few such part-timers and get them to give a few lessons in diplomacy in the home to these smart brow-beating men they send out to service people's sets. We TV owners are tired of this criticism of part-time (and ourselves) because we are frustrated with the bum service we have received from professional dubs who often know little more about servicing TV than we owners do and whose real trade seems to be driving customers away by their high-handed methods.

How about a few more letters from owners? Am I the only one who feels this way?

A. H. STEWART
Bloomington, Ill.

GROUNDED OUTLET BOXES

Dear Editor:

I was interested to note C. L. Van Liew's and your comments regarding three-wire line plugs on page 12 of the February issue. You both have good points.

However, Mr. Van Liew states, ". . . the great majority of residences and many other buildings are wired with either open wiring or nonmetallic cable. With these types of wiring you will find that the outlet box is merely grounded to dry wall and nothing more."

On the contrary, there are many nonmetallic cable installations in which the system is grounded, the cable including a separate ground conductor for connection to boxes and other units, thus bonding the whole system.

MAURICE PEACOCK, JR.
Radnor, Va.

LICENSING THE FIRST STEP

Dear Editor:

Bill Mattingly's letter in the January issue highlights a situation that has long been with us but which now has become acute. I mean the crying need for a strong, united front of working techs to safeguard their valid interests and to speak with one voice in presenting their views. Many of us, for this reason, have day in and day out stressed the need for licensing as the first step in forming an organization truly representative of competent and ethical technicians. Perhaps this latest threat, manufacturer's service, will be the spark to ignite the flame of cohesion so lacking in our field. I sincerely hope so. But, first things first. Licensing is the logical first step, which can and will lead to higher ones.

HARRY M. LAYDEN
New York, N.Y.

END

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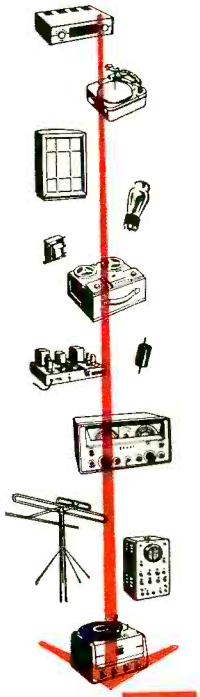

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World's largest selection of quality Hi-Fi components and complete music systems. MORE PEOPLE BUY THEIR HI-FI FROM ALLIED THAN ANYWHERE ELSE IN THE WORLD!

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* simple installation

PHOTO BY ALLAN D. CRUICKSHANK

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*** Simple Installation —**

the pre-wired audio cable and the power cord with standard plugs eliminate need for making solder connections. Pre-cut mounting board available.

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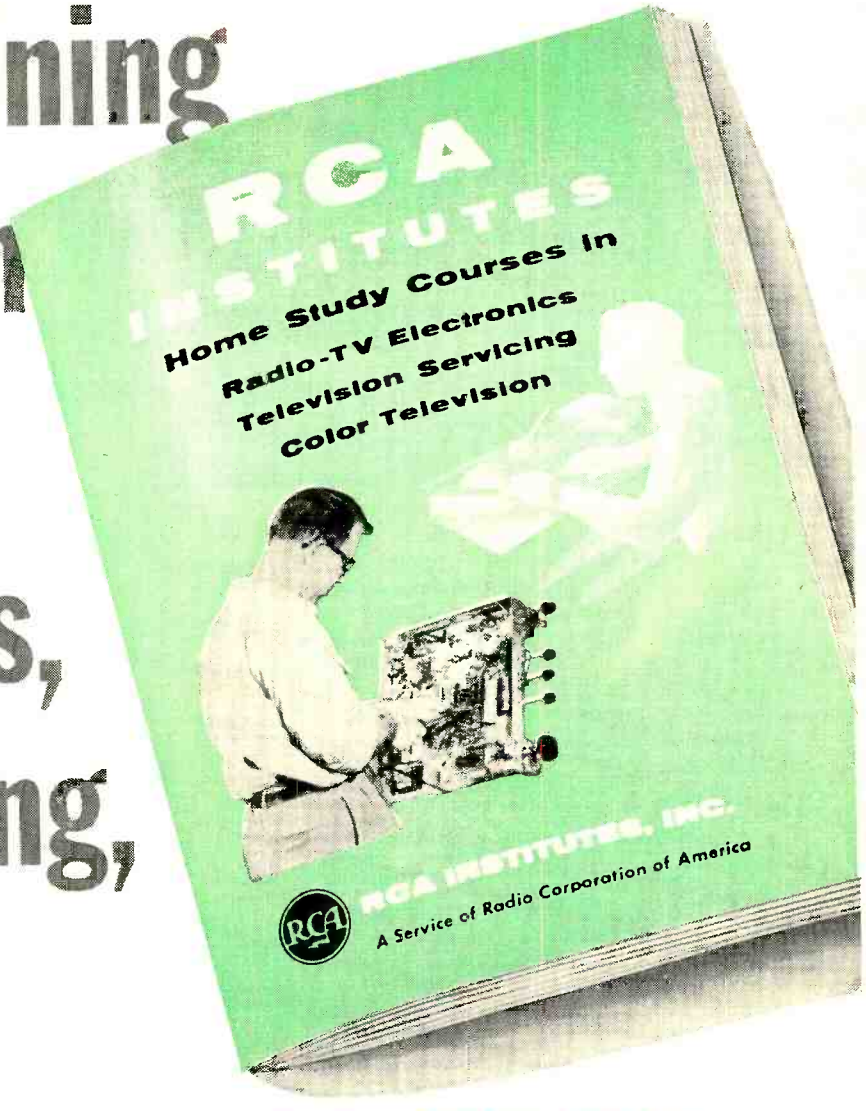
RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV



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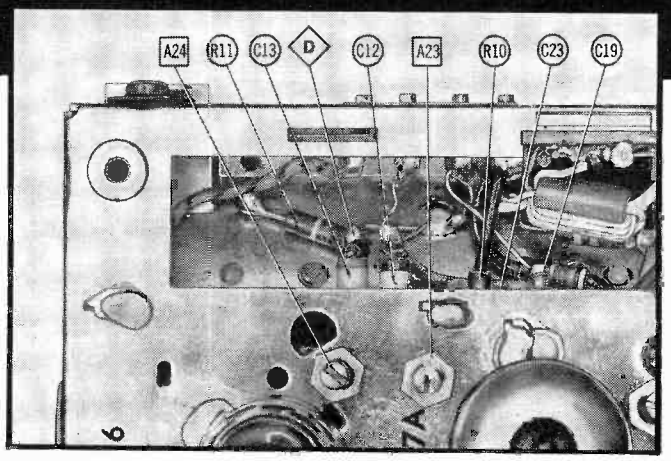
how long would it take you to solve this service problem?

SYMPTOM:
Raster, No Sound,
No Picture,
and No Snow...

PHOTOFACT

helps you lick problems like this in just minutes for only* 2½¢ per model!



(Based on an actual case history taken from the Howard W. Sams book "TV Servicing Guide")

Let's take a look at this problem: A condition such as this can exist only when there is no signal reaching the picture tube or the audio output stage. Using the Tuner Service data (found in every PHOTOFACT TV Folder), first isolate the trouble by connecting an amplitude-modulated signal to the mixer-grid test point "D." The appearance of one or more black bars on the face of the tube would indicate that the trouble is probably in the tuner. So look for the following possible causes:

1. Defective oscillator-mixer tube
2. Defective RF amplifier tube
3. Open plate-load resistor in the oscillator stage
4. Failure of the feedback capacitor in the oscillator stage
5. Open decoupling resistor
6. Dirty or faulty contacts
7. Cold solder joint

Using the applicable PHOTOFACT Folder you can trouble-shoot and solve this problem in minutes. Here's how:

Check the oscillator-mixer and RF amplifier tubes. Tubes okay?—then: Check voltages on the tube pins (they're right on the schematic) for open oscillator plate-load resistor, open RF decoupling resistor, faulty feedback capacitor, dirty switch contacts or cold solder joints.

Every PHOTOFACT Television Folder contains complete detailed information on Tuners, including separate Schematics, separate Keyed Chassis Photographs, Parts Lists, Alignment Points, Test Points, and Field Service Adjustments that will help you quickly locate the proper parts to replace and tell you how to do a touchup or thorough alignment job after making the necessary repairs. These features are a *plus* exclusive in PHOTOFACT.

Whatever your problem or favorite servicing procedure may be—you will always find all of the information you need at your fingertips in PHOTOFACT. For only *2½c per model, PHOTOFACT helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

*Based on the average number of models covered in a single set of PHOTOFACT Folders.

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!

FREE

FOR SERVICE TECHNICIANS ONLY

Fill out and mail coupon today for Free subscription to the Sams Photofact Index—your up-to-date guide to virtually any receiver model ever to come into your shop. Send coupon now.

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My Distributor is:_____

Shop Name_____

Attn:_____

Address:_____

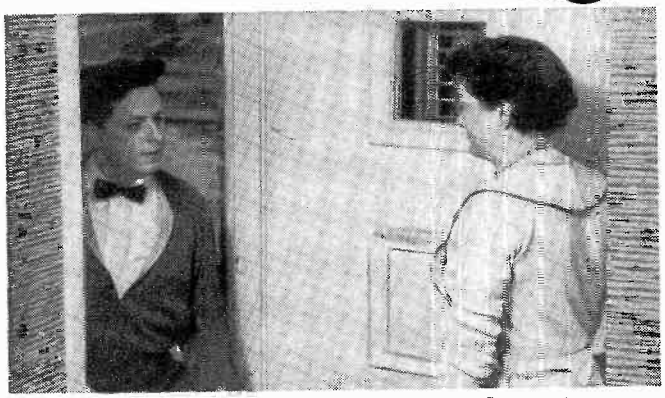
City_____ Zone____ State_____

MR. SERVICE-DEALER:

YOU CAN MAKE $6.40 EXTRA on 7 OUT of 10 TV SERVICE CALLS in INDOOR ANTENNA AREAS

with the JFD Electronics **Magic Genie**®

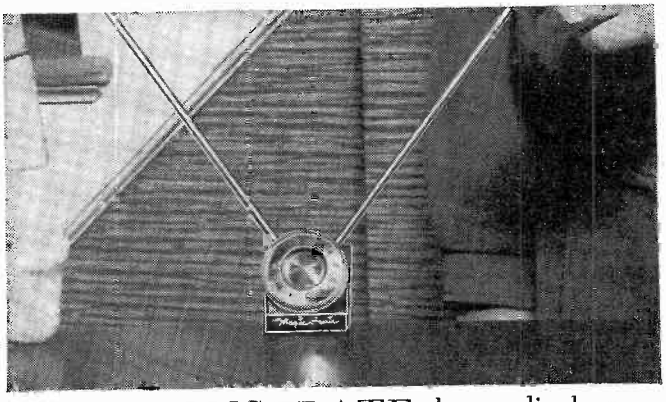
Here's How:



1 TAKE the JFD Magic Genie with you in your tube caddy on your next service call. It's conveniently small and compact.

2 USE the Magic Genie to check the picture after you have serviced the set. Your customer is sure to ask about it.

3 SHOW your customer how much more beautiful the Magic Genie looks than the old ugly indoor antenna sitting on top of her TV set.



4 DEMONSTRATE the way dipoles rotate and adjust in any direction for powerful black and white and color reception.

5 CLINCH the sale by pointing out the Magic Genie unconditional money-back guarantee backed by JFD's 28 years of electronic know-how.

Send Coupon for Free Magic Genie Money-Making Sales Kit and Name of Your Nearest JFD Distributor!

JFD Electronics, Inc.
6102-16th Avenue
Brooklyn 4, New York

Okay!

I want to see how the Magic Genie can make money for me. Send me your free kit and the name of my distributor.

Name.....

Address.....

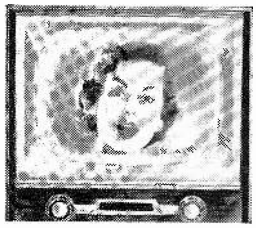
City..... Zone..... State.....

JFD **ELECTRONICS, INC.**
PIONEERS IN ELECTRONICS SINCE 1929

NATIONALLY ADVERTISED AT $17.95 promotionally priced at **$14.95**

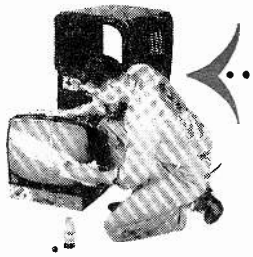
Call your JFD distributor for your Magic Genies and start earning that extra money now. It's so easy.

Have you seen your Independent Service advertising campaign?



PICTURE TUBES DO GET DIRTY! SO CALL YOUR INDEPENDENT SERVICE-DEALER AND...

Have your Picture Tube cleaned today!



Just like windows and mirrors, the inside of the glass front on your TV set gets dirty. And the face of your picture tube — the TV screen — gets even more fogged up with dust and dirt, smoke and fumes. See for yourself. Have your picture tube cleaned today. You can't imagine how much clearer . . . brighter . . . and more enjoyable your TV picture will be!

CALL YOUR INDEPENDENT SERVICE-DEALER FOR HIS SPECIAL "PICTURE TUBE CLEAN-UP."

He is *your* neighbor. He pays taxes in *your* community. His children go to the same schools and churches as *yours*. And he knows his standing and reputation depend upon the care and thoroughness with which he services your community's radio and television sets. What is more, he is trained to service any make of set. So patronize your neighborhood independent radio and television service-dealer.

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

Ask him for CBS tubes. There are no better tubes made . . . and CBS tubes have this seal.

This emblem is one way to identify your independent radio and television service-dealer. Look for it.

Advertisements like this are appearing every month in all local editions of *TV Guide* . . . telling millions of TV set owners why they should call their neighborhood independent service-dealers.

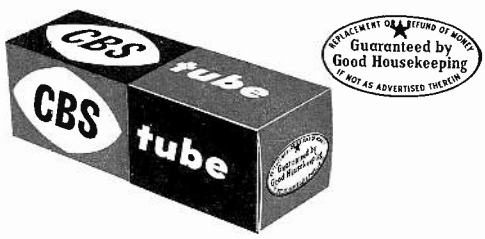
Ask your CBS Tube distributor how you can have *your* name, address and telephone number listed on adjacent pages in your local edition.

Join with other independent service-dealers . . . independent parts distributors . . . and CBS Tubes. Working together, let's build a strong independent service industry.

Identify yourself as an *Independent* Service-Dealer. Arrange for your *TV Guide* listing. Get the tie-in material *and use it*: Independent Service-Dealer decalcomania . . . window display . . . newspaper mats . . . postal cards . . . door knob hanger . . . and consumer booklet.

Tie In Today! Ask your distributor for your *TV Guide* listing . . . your display . . . and other supporting material. And for free, 4-page PA-131 flyer giving complete details on how you can profit by your independent service program.

Remember: Your continuous purchases of CBS tubes make this independent service-dealer campaign possible. So help keep it going. Say, "I want CBS tubes!"



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

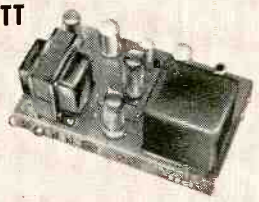
NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12 with Preamplifier, Equalizer & Control Section

KIT $34.95 WIRED $57.95

Compact, beautifully packaged & styled. Provides complete "front-end" facilities and true high fidelity performance. Direct tape head & magnetic phono inputs with NARTB (tape) & RIAA (phono) feedback equalizations. 6-tube circuit, dual triode for variable turnover bass & treble feedback-type tone controls. **Output Power:** 12 w cont., 25 w pk. **IM Dist.** (60 & 6000 cps @ 4:1): 1.5% @ 12 w; 0.55% @ 6 w; 0.3% @ 1 w. **Freq. Resp.:** 1 w: ±0.5 db 12 cps – 50 kc; 12 w: ±0.5 db 25 cps – 20 kc. **Harmonic Dist: 20 cps:** 2% @ 4.2 w; ½% @ 2.5 w; **30 cps:** 2% @ 11 w; ½% @ 6.3 w; **40 cps:** 2% @ 12 w; ½% @ 9.3 w; **2000 cps:** ½% @ 12 w; **10 kc:** 1% @ 10 w; ½% @ 6 w. **Transient Resp:** excellent square wave reproduction (4 usec rise-time); negligible ringing, rapid settling on 10 kc square wave. **Inverse Feedback:** 20 db. **Stability Margin:** 12 db. **Damping Factor:** above 8, 20 cps – 15 kc. **Speaker Connections:** 4, 8, 16 ohms. **Tone Control Range:** @ 10 kc, ±13 db; @ 50 cps, ±16 db. **Tubes:** 2-ECC83/12AX7, 1-ECC82/12AU7, 2-EL84, 1-EZ81. Size: HWD: 5⅝" x 12" x 8¼". 15 lbs.

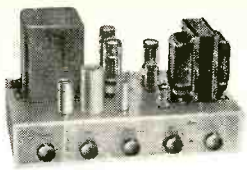
COMING SOON

NEW! 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER



HF50 KIT $57.95 WIRED $87.95

Like the HF60 shown below, the HF50 features **virtually absolute stability, flawless transient response** under either resistive or reactive (speaker) load, & **no hum or flutter** under published conditions. **Extremely high quality output transformer** with extensively interleaved windings, 4, 3, & 16 ohm speaker connections, grain-oriented steel, & fully potted in seamless steel case. Otherwise identical to HF60. **Output Power:** 50 w cont., 100 w pk. **IM Distortion** (60 & 6000 cps @ 4:1): below 1% at 50 w; 0.5% @ 45 w. **Harmonic Dist.** below 0.5% between 20 cps & 20 kc within 1 db of rated power. **Freq. Resp.** at 1 w: ±0.5 db 6 cps – 60 kc; ±0.1 db 15 cps – 30 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **All other specs identical to HF60 below.** Matching cover **Model E-2. $4.50**



NEW! 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52 with Preamplifier, Equalizer & Control Section

KIT $69.95 WIRED $109.95

Combines a power amplifier section **essentially identical** to the **HF50 power amplifier** with a **preamp-equalizer control section similar to HF20 below.** Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output). Matching cover **Model E-1, $4.50.**

The specs are the proof... 7 NEW BEST BUYS by EICO®

NEW

HIGH FIDELITY PREAMPLIFIER

#HF61A KIT $24.95, WIRED $37.95

With Power Supply: #HF51 KIT $29.95, WIRED $44.95

Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel steel cabinet for lasting attractive appearance. **Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization:** 5 most common recording curves for LPs & 78s including RIAA. **Low-distortion feedback tone controls:** provide large boost or cut in bass or treble with mid-freqs & volume unaffected. **Centralab printed-circuit Senior "Compentrol" loudness control with concentric level control. 4 hi-level switched inputs** (tuner, tv, tape, aux.) & **3 low-level inputs** (separate **front panel low-level input selector** permits concurrent use of changer & turntable). **Proper pick-up loading & atenuation** provided for all quality cartridges. **Hum bal. control.** DC superimposed on filament supply. 4 convenience outlets. **Extremely flat wideband freq. resp.:** ±1 db 8-100,000 cps; ±0.3 db 12-50,000 cps. **Extremely sensitive. Negligible** hum, noise, harmonic or IM distortion. Size: 4-7/8" x 12-5/16" x 4-7/8". 8 lbs.

NEW

60-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER #HF60 with ACRO TO-330 OUTPUT TRANSFORMER

KIT $72.95 WIRED $99.95

Superlative performance, obtained through finest components & circuitry. EF86 low-noise voltage amplifier direct-coupled to 6SN7GTB cathode coupled phase inverter driving a pair of Ultra-Linear connected push-pull EL34 output tubes operated with fixed bias. **Rated power output:** 60 w (130 w peak). **IM Distortion** (60 & 6000 cps at 4:1): less than 1% at 60 w; less than 0.5% at 50 w. **Harmonic Distortion:** less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. **Sinusoidal Freq. Resp.:** at 1 w: ±0.5 db 5 cps – 100 kc; ±0.1 db. 15 cps to 35 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **Square Wave Resp.:** excellent from 20 cps to 25 kc, 3 usec rise-time. **Sensitivity:** 0.55 v for 60 w. **Damping Factor:** 17. **Inverse Feedback:** 21 db. **Stability Margin:** 16 db. **Hum:** 90 db below rated output. **ACRO TO-330 Output Transformer** (fully potted). **Speaker Taps:** 4, 8, 16 ohms. **GZ34 extra-rugged rectifier** (indirectly-heated cathode eliminates high starting voltage on electrolytics & delays B+ until amplifier tubes warm up). **Input level control.** Panel mount fuse holder. Both **bias** and **DC — balance** adjustments. Std octal socket provided for pre-amplifier power take-off. Size: 7" x 14" x 8". 30 lbs. Matching cover **Model E-2 $4.50.**

NEW

COMPLETE with Preamplifier, Equalizer & Control Section 20-WATT Ultra-Linear Williamson-Type HIGH FIDELITY AMPLIFIER #HF-20

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. **Rated Power Output:** 20 w (34 w peak). **IM Distortion (60 & 6000 cps/4:1) at rated power:** 1.3%. **Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power:** approx. 1%. **Mid-band Harmonic Distortion at rated power:** 0.3%. **Power Response (20 w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Freq. Resp.** (¼ w): ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps. **5 feedback equalizations** for LPs & 78s. **Low-distortion feedback tone controls:** large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. **4 hi-level switched inputs:** tuner, tv, tape, aux; **2 low-level inputs** for proper loading with all cartridges. **Hum bal. control.** DC superimposed on filament supply. **Extremely fine** output transformer: interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8½" x 15" x 10". 24 lbs.

Matching cover **Model E-1, $4.50**

NEW COMPLETE with FACTORY-BUILT CABINET— 2-WAY HI-FI SPEAKER SYSTEM #HFS1 $39.95

Genuine 2-way book-shelf size speaker system. **Jensen** heavy duty 8" woofer (6.8 oz. magnet) & matching **Jensen** compression-driver exponential horn tweeter with level control. Smooth clean bass & crisp extended highs free of coloration or artificial brilliance. **Factory-built** tuned bass reflex birch hardwood cabinet (**not** a kit) constructed to high quality standards. Neutral acoustical grille cloth framed by a smooth-sanded solid birch molding. **Freq. Resp.** measured 2 ft. away on principal axis in anechoic chamber with 1 watt input — **Woofer:** ±4 db 80-1800 cps; **Tweeter:** ±2 db 2800-10,000 cps; **Crossover Region:** 1800-2800 cps, shift in level over this region depends on tweeter level control setting. Power-handling capacity: 25 watts. Size: 23" x 11" x 9". 25 lbs. **Wiring Time:** 15 min.

See the "BEST BUYS" NOW IN STOCK at your nearest distributor. Fill out coupon on other side for FREE CATALOG.

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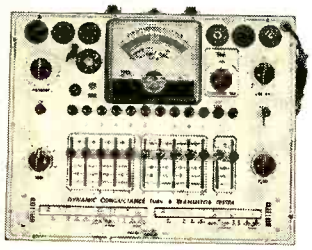
the specs are the test that tells who's best!

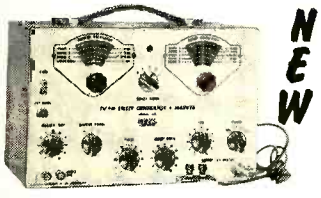


for COLOR & Monochrome TV servicing

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 2-75 mc in 3 FUND. BANDS plus a calibrated harmonic band (60-225 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.

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FREE 1957 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 COLOR & Monochrome DC-5 MC LAB & TV 5" OSCILLOSCOPE #460
KIT $79.95
WIRED $129.50

5" PUSH-PULL OSCILLOSCOPE #425
KIT $44.95
Wired $79.95
•
7" PUSH-PULL OSCILLOSCOPE #470
KIT $79.95
Wired $129.50

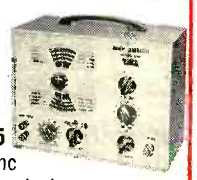
VACUUM TUBE VOLTMETER #221
KIT $25.95
Wired $39.95
•
DELUXE VTVM #214 (7½" METER)
KIT $34.95
Wired $54.95

RF SIGNAL GENERATOR #320
KIT $19.95
Wired $29.95
150 kc-34 mc, calibrated harmonics to 102 mc. Pure or mod. RF, & Colpitts osc. 400 cps sine outputs.

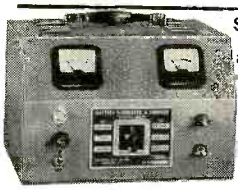
NEW!
REDI-TESTER #540
KIT $12.95
Wired $15.95
Multi-range ac/dc voltmeter, ammeter, ohmmeter, wattmeter, leakage checker for home & auto repairs.

#944 FLYBACK TRANSFORMER & YOKE TESTER
KIT $23.95
Wired $34.95
• fast check all flybacks & yokes in or out of set.
• spots even 1 shorted turn!

RF SIGNAL GENERATOR #324
KIT $26.95
WIRED $39.95
150 kc—435 mc with ONE generator!



1% accuracy on all 7 ranges. Range 75 kc—150 mc. Volt reg.
KIT $39.95
Wired $59.95
DELUXE RF SIGNAL GENERATOR #315



Sep. voltmeter & ammeter
KIT $29.95
Wired $38.95
6V & 12V BATTERY ELIMINATOR & CHARGER #1050

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
KIT $24.95
Wired $39.95
DELUXE MULTI-SIGNAL TRACER #147

Reads 0.5 ohms—500 megs, 10 mmfd—5000 mfd, power factor.
KIT $19.95
Wired $29.95
R-C BRIDGE & R-C-L COMPARATOR #950B

PEAK-to-PEAK VTVM #232 & UNI-PROBE
(pat. pend.)
KIT $29.95
WIRED $49.95

20,000 Ohms/Volt MULTIMETER #565
KIT $24.95
Wired $29.95

1000 Ohms/Volt MULTIMETER # 536
KIT $12.90
Wired $14.90

VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2		$4.95
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

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Radio-Electronics
Hugo Gernsback, Editor

FANTASTIC ELECTRONICS

. . . Electronics' Greatest Developments Are Ahead . . .

THOSE of us who were privileged to help usher in the Age of Electronics at the turn of the century, 50-odd years ago, may be pardoned if, looking backward over half a century, we are emboldened in looking forward and reading the future for the next 50 years to come.

In the past half century—particularly during the last 25 years—electronics has revolutionized the world to a far greater degree than any other endeavor or industry since our civilization began. Even the railroad and the automobile were more or less one-sided, but electronics has affected practically all industries and nearly every human activity. Without electronics even our railroads could not function as they do today. Automobiles could not be mass-produced as at present without electronics and automation—the latter art relying mostly on electronics, too!

Our talking motion pictures, the dial and long-distance telephone, most other types of communication, nearly every industry you can think of, transportation, even banking cannot function efficiently today without electronics.

Your country's security, modern war and peace itself, all rest squarely on electronics. No one who knows the facts will deny that much of World War II was won by electronics—radar alone was one of the chief means to victory, as were radio and other electronic communication. The atom electronic? Certainly! The world's first discovery of fission—an atomic explosion in the laboratory—was witnessed on an oscilloscope screen by Liese Meitner and others in 1939. And, neither A- nor H-bombs could be manufactured without elaborate electronic instrumentation.

Why continue the long triumphal recital of electronics when it is so obvious to all who can see and observe? Yet we who are immersed in its daily progress never cease to wonder how fast it really does grow. Thus, the present writer made what was considered at the time a daring forecast in his editorial of November, 1951, when he predicted that by 1960 the U. S. electronics industry would reach a turnover of $10 billion a year. Yet in 1956—four years ahead of the prediction—we already had reached a total of $11.5 billion! By 1960, as forecast recently by the Radio-Electronics-Television Manufacturers Association, it will top $15 billion. Right now the electronics industry is among the four or five top ones in the U. S. Are we too bold if we suggest now that long before the next 50 years electronics will be *the* largest industry in the country?

From past experience we have seen our most fantastic electronic predictions become commonplace in a few short years. And the ones we did not predict for fear of ridicule—the ones that were considered completely impossible—they, too, are now commonplace. Would anyone in his right senses 10 years ago have dared to predict a complete electronic hearing aid the size of your thumbnail with loudspeaker, electronic amplifier, battery and other parts, all that would fit *inside* your ear? As we write we are looking at a newspaper photograph announcing just such a device, which by the time you read this will be for sale all over the U. S.

What is ahead for the next 50 years? One thing we can almost guarantee—electronic progress will be close to 100 times as great as it was from 1900 to 1950. In *number* of inventions it will be *far* greater, for the simple reason that the art of electronics is still in its infancy. Obviously we cannot in this space list all the advances, not even all the important ones:

● **Peace via electronics.** Nuclear (atomic) wars are on the way out. Electronic interception of all weapons, whether by planes, rockets or guided missiles, is becoming more nearly perfected daily. Soon electronic interceptors will make *all* enemy attacks impractical—even intercontinental ballistic weapons will be exploded or destroyed long before they can reach their targets. Local wars perhaps will be with us for some time, but not atomic wars on a large scale.

● **Conquest of gravitation** is now definitely on the *must* agenda of many of our great scientists. It is a foregone conclusion that when the problem is solved, electronics will hold the key position for the reason that gravitation itself is almost certainly linked with the electron or the electron family. We can let our imaginations run wild in every direction when we contemplate man's immense benefits from the suppression of weight at reasonable cost. All transportation will be revolutionized, most of man's hard bodily labor will be a thing of the past. Skyscrapers and houses can be assembled at distant construction centers, then floated by air to their permanent locations. Freed from their present-day impractical weight, space ships will finally become commonplace when gravitation has yielded its secrets to man.

● **Cosmic energy,** possibly the greatest power in the universe, is beginning to give up its secrets. We already know that the electron is part and parcel of cosmic radiation, hence the future man-made *cosmic generator* must be based on electronic principles. Such a generator will probably far surpass in output and efficiency present day atomic energy for peaceful purposes. Atomic energy, as we have frequently pointed out in the past, is ridiculously wasteful because now we use only its incidental heat, *not* its electromagnetic (electric) energy which is wasted in shielding.

● **Electronoptics and health.** Long before the lapse of the next 50 years man will be able to *see electronically* by electronoptics—the merging of radio waves and light waves. Then the physician will be able actually to see through the living body and watch *all* the internal organs in action. No more guesswork with X-rays which give only vague, often misleading shadows. The entire heart, inside and out, will be in plain view as it beats; the stomach will be watched as it digests; incipient cancer will be spotted—man's inner anatomy will at last be laid bare, just as are the insides of a watch under the watchmaker's eyeglass. Thus will electronics end a great deal of man's illness and suffering. The physician will no longer be blind and guesswork will be a thing of the past.

—*H.G.*

Front view: right, amplifier; left, the power supply.

Bookshelf Audio Amplifier

Unique construction makes a compact self-ventilating amplifier

By G. FRANKLIN MONTGOMERY

IF you roll your own audio equipment and have sometimes wished that the electronic part of your system could be more outwardly attractive without being hidden in a cabinet, this amplifier may be your answer. Built into a pair of standard 4 x 6 x 3-inch chassis, with tubes and connections on the rear chassis walls, the amplifier and its power supply are specifically designed to sit on a bookshelf where they will be convenient and yet unobtrusive. A coat of enamel on each unit blends it with the surroundings.

The amplifier has sufficient gain to operate from most tuner outputs or from a tape recorder, and a phonograph preamplifier is included for operation with a G-E magnetic pickup. Front-panel controls are treble, bass, volume and the phono–tuner and power switches. The equipment consumes little power; this feature means little generated heat, and the components that generate most of it—the vacuum tubes —are horizontal and outside the chassis where air convection can do the most good.

Most of us have discovered by this time that pleasing, satisfactory audio performance can be provided in the average livingroom by an amplifier of modest power output if the amplifier is properly designed. For ear-shattering volume, 10 watts or more may be required, if the loudspeaker can deal with such power adequately (many do not). Experience has shown,* however, that for practically all listening purposes a maximum power of 1 or 2 watts is sufficient. The amplifier described in this article delivers a power output of 3 watts in the middle-frequency range before clipping.

The circuit

The amplifier proper (Fig. 1) consists of a 6BH6 (or 6AU6) driving a single class-A 6V6-GT output stage. The combination of two pentode stages provides relatively large voltage gain at moderate phase shift over the audio-frequency range so that 16 db of feedback can be applied to the driver cathode from the secondary of an inexpensive output transformer with good stability. A modified form of one of the popular tone-control circuits precedes the 6BH6 driver and volume control; the circuit constants have been chosen to allow either boost or attenuation of about 10 db at 50 and 10,000 cycles.

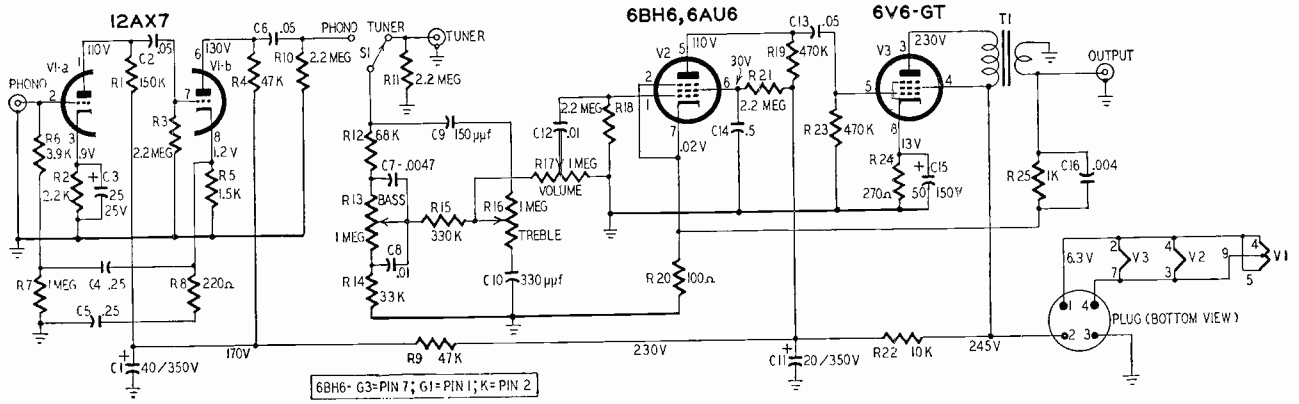
A 12AX7 is used as the phonograph preamplifier. This circuit has been designed particularly for use with the G-E series of magnetic pickups and, when used with these cartridges, provides the standard RIAA–NARTB–New Ortho frequency compensation. If a pickup with an impedance radically different from the G-E is to be used, the compensating network should be modified as will be explained in a later article. An advantage of the circuit is that the connecting cable from pickup to preamplifier input may be several hundred feet long without introducing high-frequency attenuation.

The power supply (Fig. 2) is built in a separate chassis of the same size as that of the amplifier. Years of struggle to eliminate hum induced in low-level amplifier circuits by the power transformer have forced the conclusion that a separate power chassis is superior to heroic hum-reduction methods. The supply circuit is conventional. It includes the usual hum-balancing potentiometer (R26). Adjustment of this potentiometer is usually critical only in phono operation and need be changed only when the 12AX7 is replaced.

Construction

Most of the construction details can be seen in the photographs. The power transformer is mounted in its chassis with only the top shell projecting above the chassis surface. The rectifier socket, supply-cable socket and filter capacitor are mounted on the rear wall in the usual way.

To make construction easy, the amplifier tube sockets, bypass capacitor and input and output jacks are mounted on an aluminum subpanel that is bolted to the rear wall of the chassis. The rear wall has been cut out to make a rectangular hole with dimensions about ¼ inch smaller than those of the subpanel. The subpanel is bolted to the chassis on the inside. Nearly all the fixed circuit components are held by a phenolic board which can be seen mounted on the underside of the chassis top. Resistor and capacitor leads pass through 1/16-inch holes in the board and are twisted together on the rear at circuit junctions and soldered. Excess lead lengths are snipped off after soldering. Wire connections from appropriate junctions pass back through a



R1—150,000 ohms
R2—2,200 ohms
R3—2.2 megohms
R4—47,000 ohms
R5—1,500 ohms
R6—3,900 ohms
R7—1 megohm
R8—220 ohms
R9—47,000 ohms
R10—2.2 megohms
R11—2.2 megohms
R12—68,000 ohms
R13—1-megohm pot, audio taper
R14—33,000 ohms
R15—330,000 ohms
R16—1-megohm pot, audio taper
R17—1-megohm pot, audio taper
R18—2.2 megohms
R19—470,000 ohms
R20—100 ohms
R21—2.2 megohms
R22—10,000 ohms
R23—470,000 ohms
R24—270 ohms
R25—1,000 ohms
R26—500-ohm potentiometer
All resistors ½ watt
C1, C3, C11, C15—40/25/20/50 µf at 350/25/350/150 volts (Mallory FP 419.64 or equivalent)
C2—.05 µf
C4—0.25 µf
C5—0.25 µf
C6—.05 µf
C7—.0047 µf, disc ceramic
C8—.01 µf, disc ceramic
C9—150 µµf, disc ceramic
C10—330 µµf, disc ceramic
C12—.01 µf, disc ceramic
C13—.05 µf
C14—0.5 µf
C16—.004 µf, disc ceramic (see text)
C17—80 µf, 450 volts (Mallory FP 149 or equivalent)
All capacitors 600 volts, unless otherwise specified
V1—12AX7
V2—6BH6
V3—6V6-GT
V4—5Y3-GT
Pilot lamp—No. 47
T1—output transformer, 5,000 ohms single plate to 3.5 ohms voice coil, 8 watts (Merit A-3019 or equivalent)
T2—power transformer, 680 volts ct @ 70 ma; 6.3 volts @ 2.5 amp; 5 volts @ 2 amp; (Stancor PM-8408 or equivalent)
L—filter choke, 16 henries, 50 ma (Merit C-2987 or equivalent)
S1—spdt slide switch
S2—spst toggle switch
PLUG—cable connector, 4 pins
SOCKET—4 pins
Aluminum chassis (2), 4 x 6 x 3 inches (Bud AC-430 or equivalent)
Miniature socket, 7 pins
Miniature socket, 9 pins
Octal socket
Phono jacks (3), RCA type
Pilot-lamp assembly
Length of 4-conductor power cable
Line cord and plug
Shields for 12AX7 and 6BH6
Knobs (3)
Phenolic component board, 3 x 4¾ inches

Fig. 1—The bookshelf amplifier uses only three tubes; delivers ample volume for family listening.

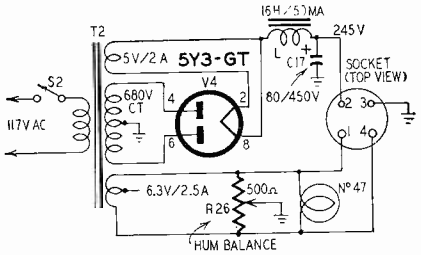


Fig. 2—The amplifier power supply.

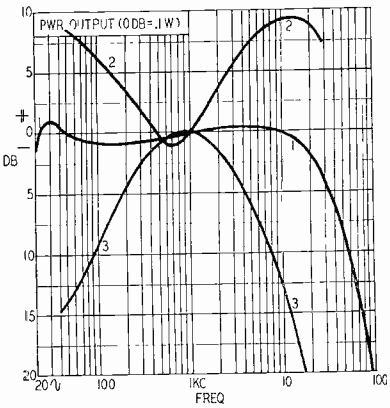
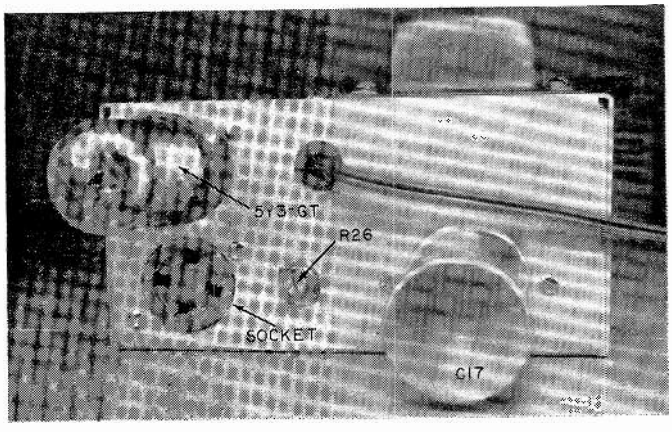


Fig. 3—Frequency response for constant tuner input.

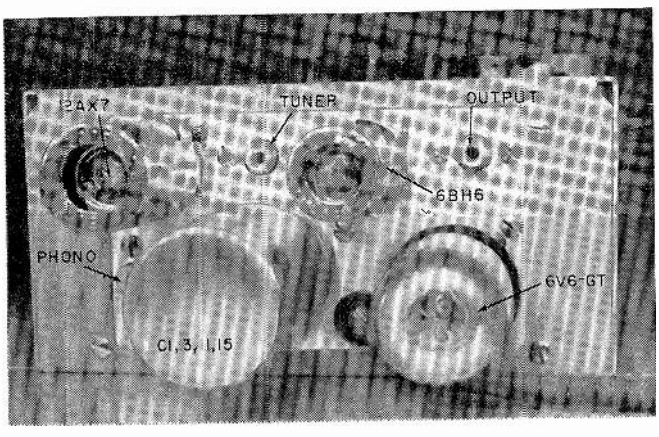
row of ⅛-inch holes at the rear edge of the board and connect to the tube-socket terminals. Wire leads to the potentiometers and phono–tuner switch pass through similar holes at the front edge of the board. The resulting assembly is an unprinted "printed-circuit" kind of construction which allows the amplifier to be completely wired before bolting it into the chassis. The output transformer is mounted on the end of the chassis nearest the 6V6.

Sample frequency-response curves for a constant voltage at the tuner input and a 3.3-ohm resistive load at the output are shown in Fig. 3. Curve 1 is the response with the tone controls in the flat position, curve 2 for both treble and bass controls full clockwise and curve 3 for both controls full counter-clockwise.

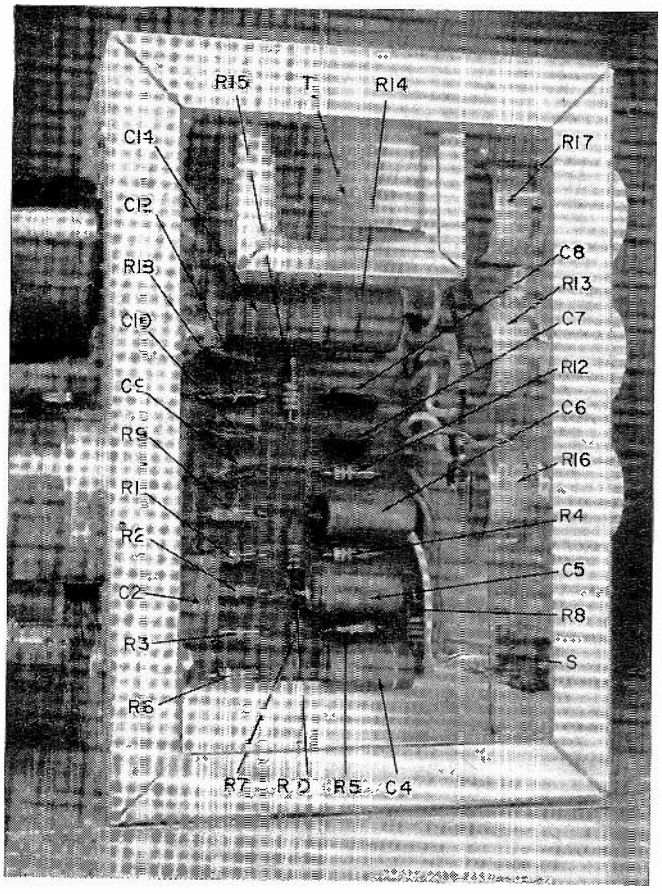
As has been mentioned earlier, the phonograph preamplifier has its RIAA frequency compensation built in so that the tone controls can be used in the normal manner on record playback. Total harmonic distortion *vs* power



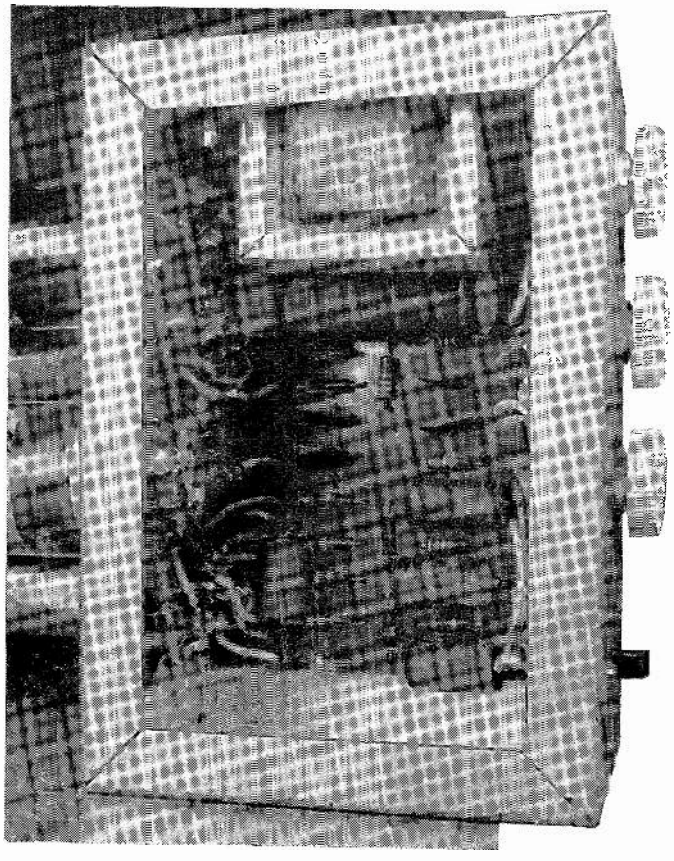
Rear view, power-supply chassis.



Rear view, amplifier chassis.



Under-chassis view of the amplifier.



Another look at the underchassis.

output for a 1,000-cycle sinusoidal input is shown in Fig. 4. With zero input, the total hum and noise output (mostly 120-cycle hum) into a 3.3-ohm load is 68 db below 3 watts.

With tone controls in the flat position, volume full on, and a 3.3-ohm load, 3 watts is obtained at 1,000 cycles with a tuner input of 1.5 volts rms. With the same control settings, 3 watts is obtained at 1,000 cycles with a phono input of 17 millivolts rms in series with 3,000 ohms. The total power delivered by the supply to the amplifier is 18 watts, including power consumed by the tube heaters. Line power consumption should be in the order of 40 watts.

There should be no difficulty in duplicating this performance if the parts used are reasonably equivalent to those given in the parts list. If the output transformer differs from that specified, compensating capacitor C16 will probably have to be adjusted: Connect the output of an audio oscillator directly to the arm of treble

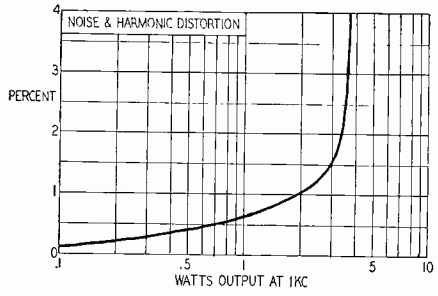


Fig. 4—Harmonic distortion characteristic at 1,000 cycles.

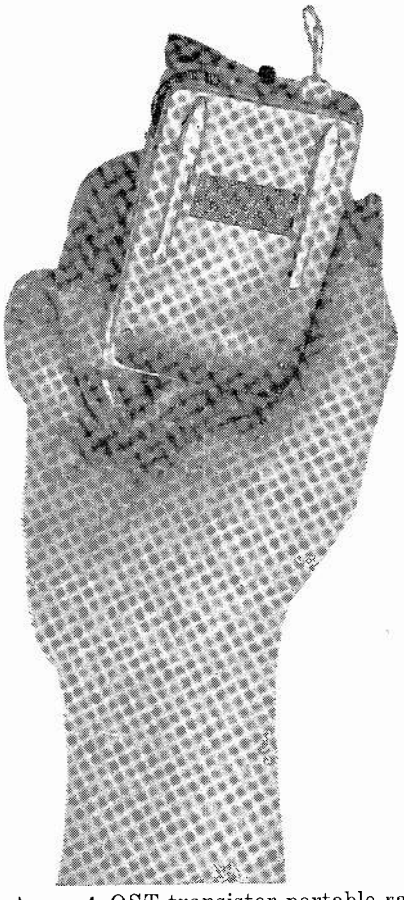
control R16 and ground. Observe the amplifier output across an appropriate load resistor with an output meter or scope. With the input voltage at a level low enough so that the amplifier does not overload, explore the response in the range from about 20 to 100 kc. For small values of C16, a pronounced peak in the response will be found, usually within this frequency range. (With C16 equal to zero, the amplifier may even oscillate at high frequency, depending upon the transformer characteristics. With the specified transformer and C16 equal to zero, a 10-db peak occurs at about 55 kc.) Now increase C16 until there is no peak and the response rolls off smoothly in its vicinity. The value of C16 so found is the proper one to use.

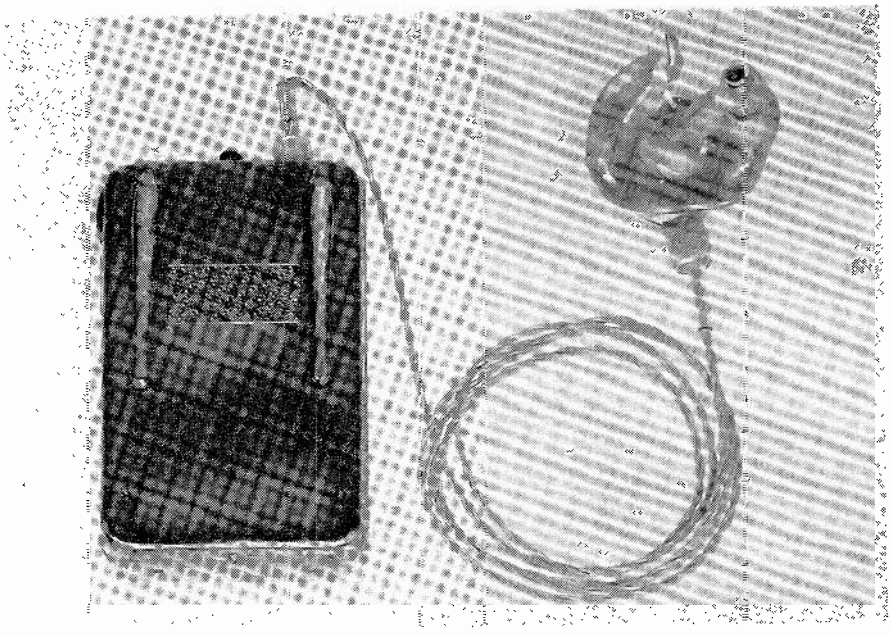
Correct polarity of the output transformer secondary must be found by experiment, of course; a large-amplitude low-frequency oscillation indicates positive instead of negative feedback, and the secondary connections must be reversed. END

Reference

G. Franklin Montgomery, "A Low-Cost Audio Amplifier," RADIO-ELECTRONICS, Vol. 25, pp. 72–73, August 1954.

A commercial hearing aid using the complementary class-B output circuit.





Class-B hearing aid

"Complementary symmetry" adds to compactness, lightness and clarity of reproduction in this transistorized instrument

By I. Queen
EDITORIAL ASSOCIATE

MOST transistor portable radios use class-B output for high efficiency. The usual arrangement is a pair of matched transistors with tapped input and output transformers. For hearing aids, however, a "complementary" class-B circuit is preferable. This type of amplifier pairs a p-n-p with an n-p-n unit and eliminates both transformers. With proper design and adjustment the stage is highly efficient and far more compact than its transformer-coupled counterpart.

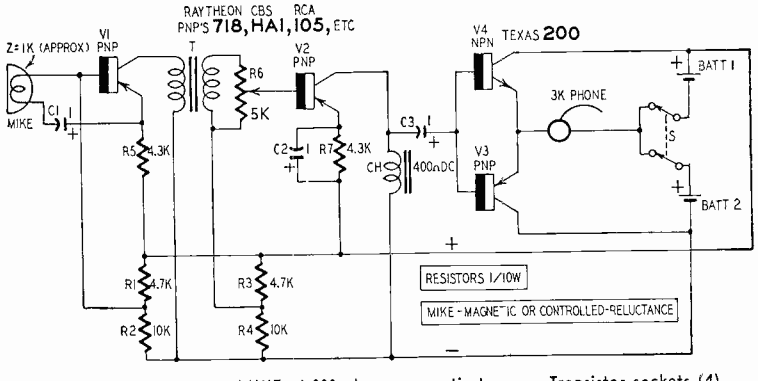
The diagram shows the class-B circuit designed by Victor Laughter, electronic automation engineer and radio pioneer. (He was the first manager of Gernsback's Electro Importing Co., about 1904, and former editor.) It has been tested and found to provide very satisfactory results. The circuit uses four transistors, one interstage transformer, a choke and few other components. Two small mercury cells will operate the hearing aid for a long time. There is ample volume from the earphone, and the tone quality is high.

The first two stages are conventional and use high-gain p-n-p transistors. They may be 2N77's, CK782's, TI208's or equivalent. Each stage depends on its own voltage divider, built up of 1/10-watt resistors, that maintains stability, yet does not consume too much power. All capacitors may be 1 μf or larger. Several hearing-aid microphones are now on the market and are satisfactory in this circuit. Use one with an impedance of approximately 1,000 ohms. Shure and other manufacturers make them as small as 1 inch in diameter. The transformer is a conventional interstage unit. Argonne's AR-104 or the UTC SSO-7 is satisfactory.

A choke is used in the collector circuit of V2. This is not a critical item, but should be tiny to match the other parts. The low side of a 30,000-to-1,200-ohm interstage transformer has been used here. The UTC SO-5 is another possibility.

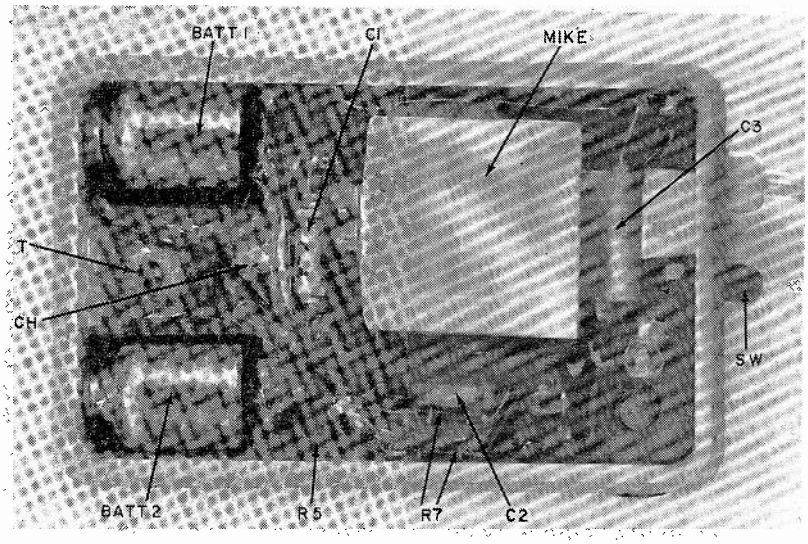
The class-B stage uses transistors of opposite type. The p-n-p may be any of those mentioned above. TI200 (Texas Instruments) has been found satisfactory for the n-p-n to mate it. Experimenters may also try a 2N34–2N35 combination. Absolute matching is not imperative. Although distortion may be slightly higher without a true match, it has not been found objectionable.

This is how the final stage operates: Each transistor receives an identical signal through blocking capacitor C3. This capacitor assures that the bias is zero without signal. Since the transistors are *opposite* types, one will be blocked by the signal, the other will conduct. Reversing signal polarity



R1, 3—4,700 ohms 1/10 watt
R2, 4—10,000 ohms, 1/10 watt
R5, 7—4,300 ohms, 1/10 watt
R6—5,000-ohm pot
C1, 2, 3, 4—1 μf or larger, 6 volts, miniature electrolytic
MIKE—1,000 ohms, magnetic type
PHONE—earphone 1,000–3,000 ohms
T—20,000 to 600 ohms (see text)
V1, 2, 4—p-n-p (see text)
V3—n-p-n (see text)
BATT 1, 2—mercury (1.34 volts)
Transistor sockets (4)
battery holder (optional)
CH—choke (see text)
S—dpst switch
Mounting baseboard

The class-B hearing-aid circuit uses four transistors.



The construction and parts layout are seen in these photographs (taken from both sides) of the class-B hearing aid. All important parts are called out.

simply changes the role of each transistor. Thus we have true class-B operation without the need to split phase with tapped transformers. Consequently we save space and also the power that would be dissipated in the windings.

This particular complementary stage may appear strange because there seems to be no return for the signal. One lead goes to C3, but where is the return path? The return is through the battery leads. It does not matter which—battery resistance is low and so far as ac is concerned is a short-circuit.

Note the dpst battery switch. There are two cells connected in series for V1, V2. Each energizes one of the class-B transistors. A single-pole unit cannot open all the circuits required.

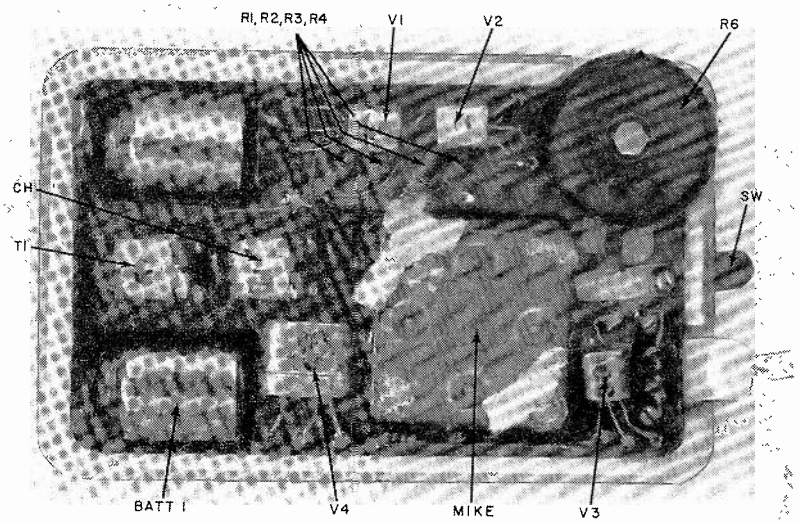
The earpiece is a high-impedance model. Because its output level may be high, it is important that a good seal be maintained between it and the ear, otherwise there may be feedback to the mike.

This high-gain amplifier was found to have low background noise in a breadboard test. Tone quality was very good. With sine-wave input there was little distortion even with the volume control turned all the way up. Maximum output was measured as 0.5 volt. When distortion may be tolerated (as it may to a certain extent in a hearing aid), intelligibility was maintained up to a point where volume became deafening to a person with normal hearing. Conversations 20–30 feet away were picked up clearly.

Total quiescent battery drain is less than 1 ma! This rises to approximately 2 or 3 ma, depending upon input level.

A commercial unit* based on this complementary circuit is now on the market (see photos). Dimensions are 2½ x 1¼ x ⅝ inch and weight is only 2 ounces. It is small enough to be clipped inside a pocket or other inconspicuous spot. The batteries are easily accessible although replacement will be infrequent. END

* Alfa Electronics, Inc., 1626 Exchange Bldg., Memphis 3, Tenn.



modern phonograph cartridges

By JULIAN D. HIRSCH

Part I—Types of pickups; the variable-reluctance cartridge; General Electric RPX-052; Audax DL-6 and Hi-Q7

LITERALLY dozens of different phono cartridges are currently being manufactured. All may be classified into one of two basic groups: amplitude-responding and velocity-responding types.

Amplitude-responding cartridges include all crystal and ceramic models as well as the FM capacitance pickup. Also in this category, but no longer being manufactured, were the Pfanstiehl strain-gauge pickup and the older Zenith Cobra pickups.

Velocity-responding cartridges include all magnetic types, which may be broadly subdivided into moving-iron and moving-coil cartridges. The popular "variable-reluctance" cartridges are of the moving-iron type.

The names of the two basic cartridge types are descriptive of their characteristics. Amplitude-responding cartridges deliver an output proportional to the *distance* the stylus is moved from side to side by the record groove, while velocity-responding cartridges deliver an output proportional to the *speed* of the stylus as it follows the groove modulation.

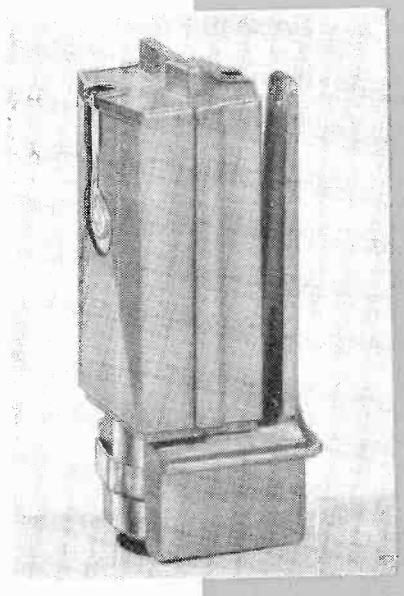
In this series of articles, we will describe a number of modern cartridges of both basic types and show how they differ from each other in details of construction and principles of operation.

Magnetic cartridges

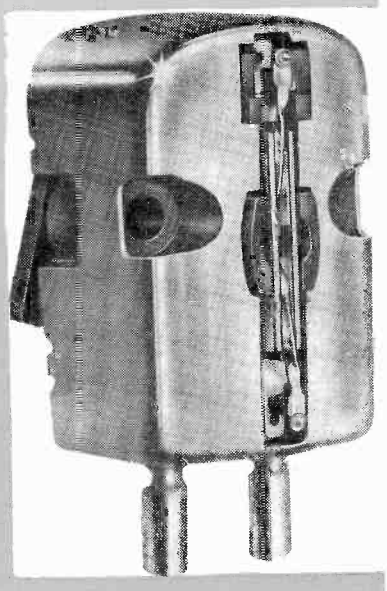
All magnetic cartridges are based on the fact that a voltage is induced in a coil of wire when it is moved in a magnetic field or when it is stationary in a magnetic field of changing strength. The magnitude of this voltage is proportional to the number of turns in the coil, the strength of the magnetic field and the *rate* at which the coil and field move relative to each other. This field motion may be a physical motion of the coil or merely a change in the number of magnetic flux lines linking the coil.

In moving-iron cartridges, the coil is fixed and the magnetic field varied. This is usually done by moving a small piece of iron in an air gap to vary the *reluctance* of the magnetic circuit (hence the name "variable reluctance"). Reluctance is the magnetic counterpart of resistance. Iron has a low reluctance, while that of air or any other nonmagnetic material is very high. When an iron path connects the N and S poles of a magnet, a large number of magnetic lines of force ("flux") pass through the magnetic circuit. Introducing even a very small air gap into this magnetic circuit greatly reduces the amount of flux, due to the high reluctance of the gap, which is directly proportional to its length. So by varying the size of the air gap one can easily control the amount of flux in the magnetic circuit. This is the basis of operation of all variable-reluctance cartridges.

The same effect can be achieved by causing the magnet itself to move rela-



Audax Hi-Q-7 pickup cartridge.



The G-E variable-reluctance cartridge.

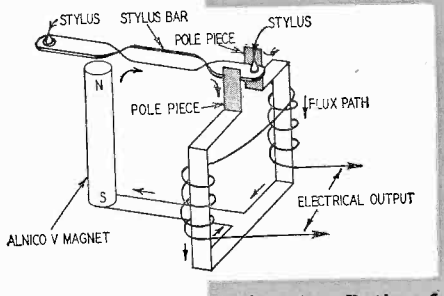
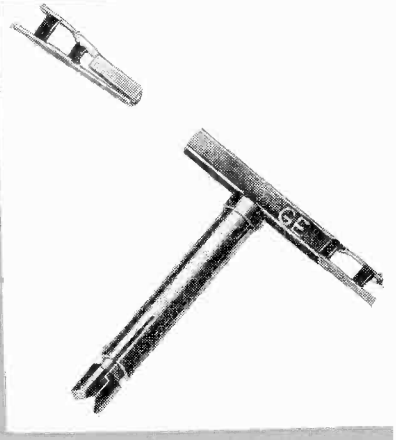


Fig. 1 — Path of magnetic flux in G-E variable-reluctance cartridge.



Stylus assembly of the G-E RPX-052.

tive to a coil which is located in its field. This, however, results in a high moving mass, which is undesirable in a phono cartridge. No modern cartridge employs a moving magnet.

GE RPX-052

The first variable-reluctance cartridge to be widely marketed in this country was manufactured by General Electric. Their current line includes many models, some with single stylus of either 1-mil (thousandth of an inch) or 3-mil tip radius and others with a turn-around structure mounting two styli. This allows both microgroove and older 78-rpm records to be played with a single cartridge. Various combinations of sapphire and diamond styli are available. The most popular model is the RPX-052, which contains a 1-mil diamond and a 3-mil sapphire stylus. The entire stylus holder is rotated 180° to place the desired stylus in playing position. Unlike earlier models of this cartridge, the styli may be replaced separately.

The external appearance of the RPX-052 cartridge and the details of the removable stylus clip and its mount may be seen in the photos. Fig. 1 is a sketch of the internal structure of this cartridge, illustrating its principle of operation.

The stylus bar, which is made of a magnetic material, carries the flux from the Alnico V magnet to the pole pieces on either side of the stylus jewel. When the stylus is in its center or neutral position, the flux divides equally between the pole pieces. It passes through the cores of the two coils and returns to the other pole of the magnet.

The reluctance of the magnetic circuit is divided between the fixed air gap separating the magnet and the stylus bar, and the two gaps between the pole pieces and the bar. When the stylus is deflected from its center position, the gap is reduced on one side and increased on the other. This causes more flux to pass through one coil than through the other. The change in flux in both coils induces voltages in them. They are series-connected so that the two voltages add in the output. When the stylus is displaced in the opposite direction, the same action takes place but the polarity of the induced voltage is reversed. Thus the record groove modulation is transformed to an electrical voltage, proportional to the velocity of stylus motion.

The double twist in the stylus bar provides increased compliance to both lateral and vertical motion. High compliance is a desirable quality in a cartridge since it means that less force must be exerted on the stylus by the groove wall (and vice versa) during the tracking process.

Since vertical motion of the stylus does not alter the division of flux between the pole pieces, it produces no output. This is an essential feature of a good cartridge since vertical response will introduce unpleasant second-harmonic distortion as well as increase the likelihood of audible turntable rumble.

The small damping blocks under the stylus bar (see photo of the stylus assembly) serve to reduce the amplitude of mechanical resonances in the stylus system. Without them the response of the cartridge would show a large peak in the region of 10–15 kc. The blocks are made of a rubberlike material.

The G-E cartridge has an output of approximately 10–15 millivolts when playing LP records. Although this was considered a low output when the cartridge was introduced in 1946, it might be termed a medium-output cartridge in today's market.

The cartridge is surrounded by a mu-metal shield which reduces hum pickup from external magnetic fields such as surround phonograph turntable motors and power transformers. In addition, the two coils in the cartridge are connected in a "hum-bucking" arrangement so that hum induced from external sources tends to be cancelled.

The other cartridges discussed in this article differ in many details of construction from the G-E but their principles of operation are identical to its. We have gone into more detail on the G-E than we will on the others, since it is one of the easiest to understand as well as being the most widely used.

Audax DL-6 and Hi-Q7

The Audax cartridges are unique in their physical structure and in their magnetic circuitry but may still be considered as operating on the variable-reluctance principle. The two models are identical in form and performance except that the Hi-Q7 delivers about 24 mv of output compared to 12 mv for the DL-6. This increase is obtained by using a coil with twice as many turns.

The Audax cartridge is a turnover design in which two independent non-interacting and individually replaceable styli are mounted on opposite sides of the cartridge body. Each stylus has its own pole pieces, only the coil and magnet being comon to both of the styli.

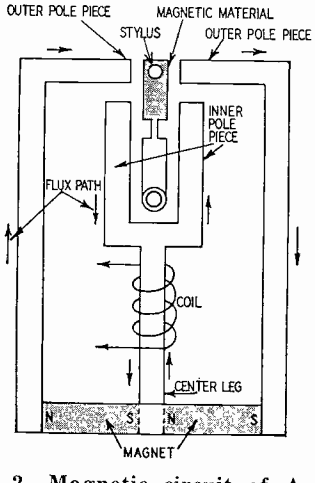


Fig. 2—Magnetic circuit of Audax cartridge. A single coil is used.

Fig. 2 is a sketch of the internal structure of the Audax cartridge, viewed from the bottom. The magnet and single coil are parallel to the record surface. The flux from each pole of the magnet passes up one of the outer strips of magnetic material and across the air gap between the pole piece and the armature. The armature is a small piece of magnetic material attached to the end of the stylus bar. The flux then crosses a second air gap to what might be termed an inner pole piece, and passes through the core of the coil on its way back to the magnet.

Although a single magnet is actually used, it may be drawn as though two magnets were placed end to end, with the center element of the magnetic path returning to their junction. It can be seen that the flux from the north pole of the magnet tends to cancel that from the south pole in the center leg. With the stylus in its neutral position, the air gaps on both sides of the armature are of equal size so equal amounts of flux from the two poles pass through the armature and the center leg. The result is complete cancellation of flux through the coil, with all of it flowing around the outer magnetic circuit between the north and south poles of the magnet.

Any lateral motion of the stylus will allow more flux to pass through the armature from one pole and less from the other. The difference is the unbalance flux which passes through the center leg and the coil on its way back to the magnet. The unbalance flux generates a voltage in the coil. Its polarity depends on the direction of stylus movement and its amplitude is proportional to stylus velocity.

There are several other noteworthy differences between the Audax and G-E cartridges. The Audax 1-mil diamond stylus obtains its high lateral and vertical compliance by means of a very thin cross-section of the stylus bar instead of by twisting the bar. Fig. 3

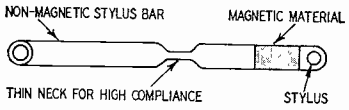


Fig. 3—The Audax stylus.

gives details of this stylus assembly. The bar is nonmagnetic and does not carry any flux except for the tiny armature near its tip.

Since it has only one coil, the Audax does not "buck out" induced hum. It has a mu-metal shield around it, but nevertheless must be carefully positioned relative to the turntable motor to minimize hum pickup.

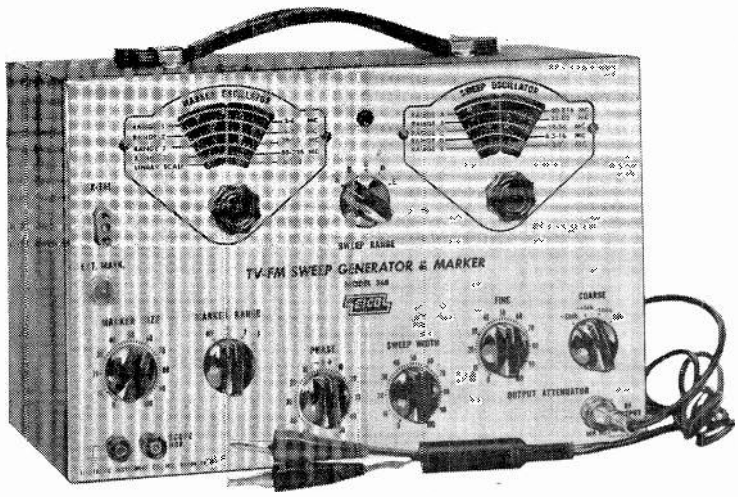
Because of its unusual mechanical design and single-hole mounting, it cannot be used in any but Audax arms, except in special plug-in shells which are available for all the better record changers.

TO BE CONTINUED

The Increductor and its use in the Eico model 368 TV-FM sweep generator

saturable reactor controls sweep generator

By ROBERT F. SCOTT
TECHNICAL EDITOR



THE sweep circuits of a number of TV–FM sweep generators are designed around an Increductor—a special type of high-frequency saturable reactor with a wide inductance range made by C.G.S. Laboratories. The basic Increductor consists of a toroidal magnetic core with signal and control windings. Schematically, the signal winding is often shown in two sections at right angles to the core and control winding to indicate total cancellation of magnetic coupling between the two sets of windings. The inductance of the signal winding is varied by varying the current through the control winding. The signal winding is used as the variable inductor in variable-frequency and sweep oscillators, filters, tuned amplifiers, traps and many other applications.

Fig. 1 shows the basic oscillator circuit using the Increductor. The signal winding forms the tuned circuit of a Colpitts oscillator. The oscillator frequency is determined by the setting of the tuning capacitor and the inductance of the signal winding. When the control-winding current is zero, the inductance of the signal winding is maximum. As current through the control winding increases, the core permeability decreases, thereby reducing the inductance of the signal winding and increasing the oscillator frequency. Thus it can be swept about a center frequency by applying a sawtooth or sine-wave current to the control winding. Increductors may be used in variable heterodyne and beat-frequency oscillators in communications, panoramic and special-purpose receivers. They are also useful in tunable filters and in amplifiers and other devices in which the frequency of an L-C network must be varied from a remote point or tuned rapidly through a given range at a high recurrent rate.

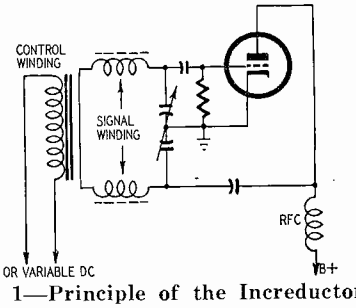


Fig. 1—Principle of the Increductor.

The type 6XBK5 Increductor with four signal windings is used in the Eico 368 TV–FM sweep generator, an excellent example of the use of this unit (Fig. 2). The windings are on ferrite bars bridging the iron yoke or core for the control winding. The core configuration of this unit is shown in the photo.

The 368 circuit

The sweep oscillator V2-b is a Colpitts type using half a 12AV7. Signal windings L6-a through L6-d are connected in series across the tuning capacitor (SWEEP OSCILLATOR control) and a section of the range switch. All coils are used on the lowest (3–6.5-mc) range and are shorted out one at a time on progressively higher ranges until the combined inductance of the switch and connecting leads is used alone on the highest (80–216-mc) range. Here, L6-f is formed by copper straps passing on each side of a ferrite bar and connecting the tuning capacitor to S1-a.

Switch sections S1-a and S1-b are on opposite sides of the same wafer. Contacts 1 on both sides are tied together by a common mounting rivet as are contacts 2. This reduces the inherent inductance of the switch to give adequate coverage on the highest range.

L5 is a special type of rf choke whose inductance and stray capacitance are such that it does not resonate anywhere in the range of the sweep oscillator. Being nonresonate in its operating range, it minimizes suckouts and prevents rf signal voltage from feeding back into the B-plus line.

L6-d, used only on the lowest range, is tapped. The tap is returned to ground through R2 and C2 in series. A tapped coil with the tap at ground potential (signal-wise) is required for best performance from a Colpitts oscillator operating at comparatively low frequencies. This R-C network and the network consisting of R1 and C1 eliminate phase shift that might occur when the inductance of the coils is varied at a 60-cycle rate.

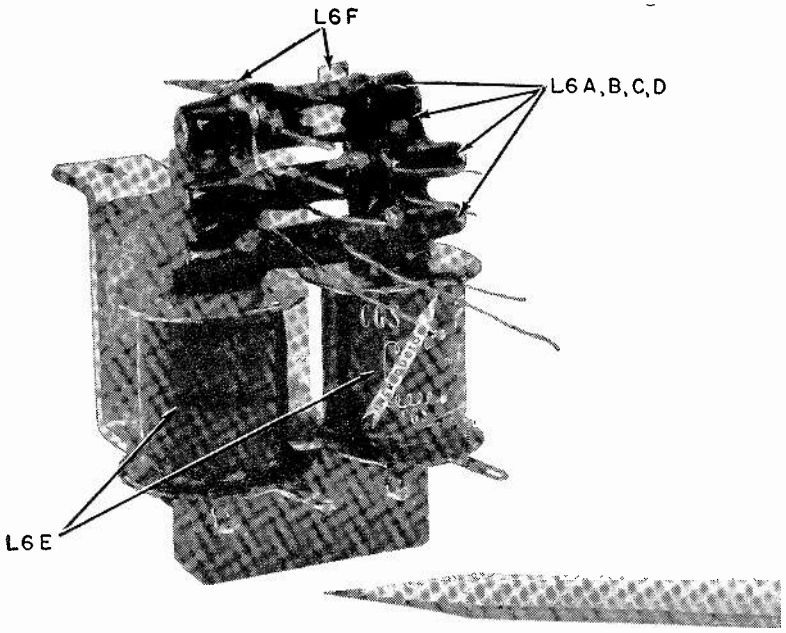
Control winding L6-e is supplied from the 60-cycle ac line and current through it is controlled by the SWEEP WIDTH control. A 6,800-ohm limiting resistor in series with the control prevents excessive current from flowing through the control winding.

A dc bias voltage, obtained by rectifying ac from the power line, is fed through the control winding through R3 and R4. These resistor values are selected so that with zero sweep width, the frequency of the signal winding is midway between the zero-current and saturation points of the inductor. This insures that the sweep will be linear on both sides of the center frequency.

V2-a is a cathode follower fed by capacitance coupling from the grid of V2-b. The input impedance of the cathode follower is high enough to minimize loading on the oscillator and its output impedance is low enough to match the 50-ohm attenuator network and the output impedance of the instrument.

Blanking and agc

The swept rf output of the 368 is blanked out on the return trace to prevent double images and provide a



The Model 6XBK5 Increductor.

base line for the response curve being observed on a scope. This is done by connecting the grid of V2-b to the plate of a diode-connected blanking tube (V3-a) through a 10,000-ohm isolating resistor. The cathode of V3-a is connected to one side of the high-voltage winding on the power transformer through a voltage divider consisting of 22,000- and 47,000-ohm resistors. When the cathode is positive with respect to the plate, the diode is cut off. The oscillator bias is supplied solely by its 4,700-ohm grid resistor.

When the voltage on V3-a's cathode swings negative, the diode conduets and plate current flows through V2-b's grid resistor. The voltage drop across this resistor is negative with respect to ground and is high enough to drive V2-b to cutoff. The ac voltage applied to the cathode of the diode is phased so the oscillator cuts off on the return trace.

The negative pulse voltage at the plate of diode V3-a is applied to the grid of the first agc amplifier (V3-b), thus developing a positive pulse at its plate. This positive pulse is amplified to produce a large negative pulse at the plate of V4.

V5 is a series regulator tube supplying B-plus voltage to the plate of the sweep oscillator. The grid of V5 is direct-coupled to the plate of V4. The negative pulse delivered to its grid drives V5 to cutoff and removes plate voltage from the oscillator. Thus, the sweep oscillator is cut off during the retrace interval both by the high negative voltage applied to its grid and by removal of its plate voltage.

The output of the sweep oscillator is maintained constant by an agc circuit whose operation is based on the fact that the negative grid bias of an oscillator increases as the output increases. If the output of V2-b rises, its grid goes more negative, producing a negative pulse that is amplified by V3-b and V4 to produce a negative pulse of much greater amplitude on the grid of V5. The internal resistance of V5 increases and drops the B-plus voltage to the oscillator to the point where the output drops to a predetermined level.

Conversely, if the output of the sweep oscillator fails, its grid becomes less negative, thus producing a positive pulse that is amplified and fed to the series regulator tube. The internal

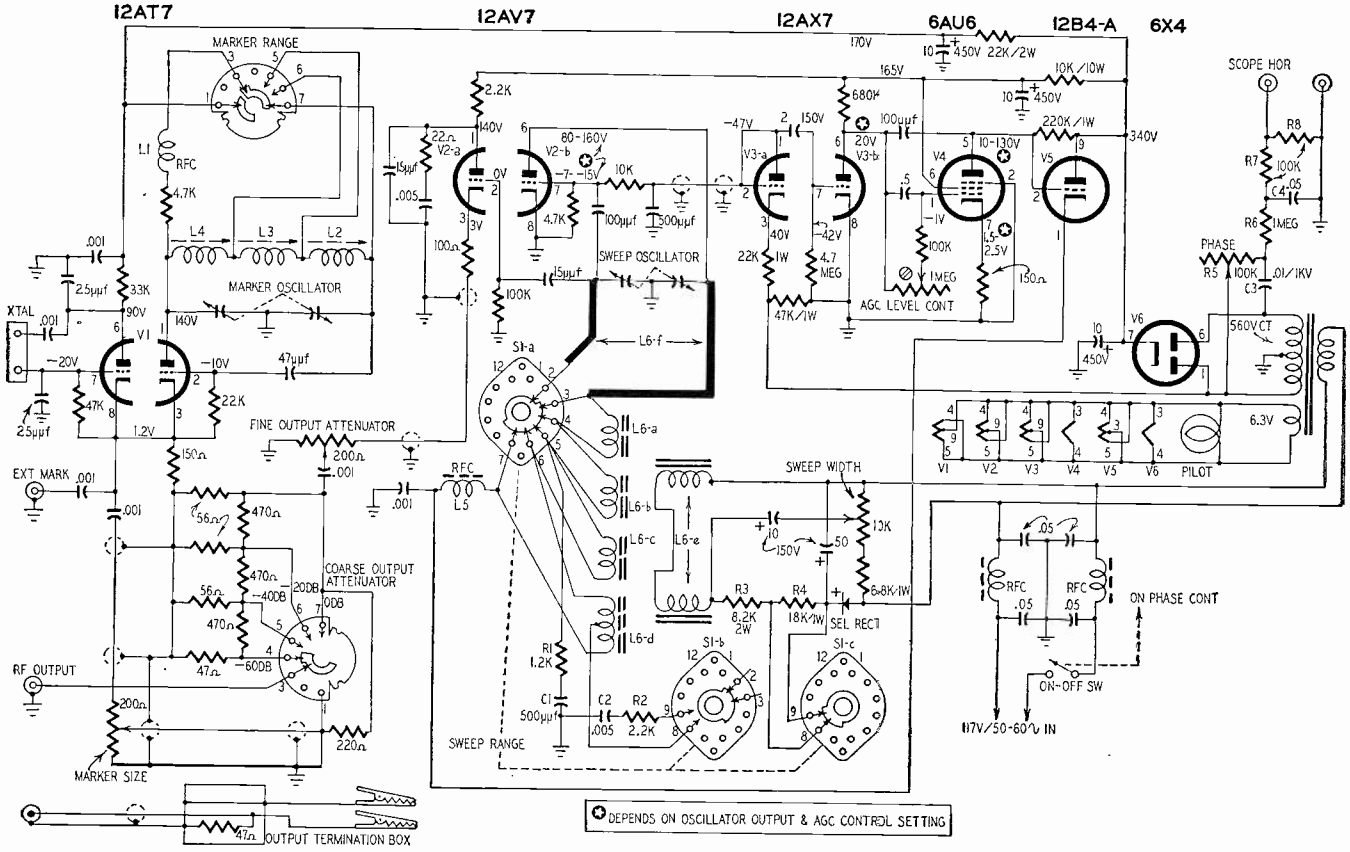


Fig. 2—The Eico model 368 TV-FM sweep generator, a typical example of Increductor use.

resistance of V5 drops and raises the plate voltage on the oscillator so its output rises to a predetermined amplitude. The AGC LEVEL control is adjusted for minimum variation in the amplitude of the rf response curve as observed on a scope as the SWEEP OSCILLATOR control is rotated through its range on each band.

The phasing circuit

The 60-cycle sweep signal applied to the scope must be a pure sine wave exactly in phase with that used to frequency-modulate the sweep oscillator. Oscillator sweep voltage is taken from the primary side of the power transformer and the sweep voltage for the horizontal deflection circuits of the scope is taken from across the high-voltage secondary through a phase-shift network consisting of R5, R6, R7, R8, C3 and C4. Potentiometer R5 varies the phase of the scope sweep signal with respect to the FM sweep signal to compensate for unwanted phase shifts in the transformer, Increductor control winding and other circuit elements.

Generating markers

The marker oscillators use the two sections of a 12AT7. V1-a is a Pierce type crystal oscillator and V1-b is a variable-frequency Colpitts oscillator covering from 2 to 75 mc in three fundamental ranges and from 60 to 225 mc on the third harmonic of the 20–75-mc fundamental range. The variable-frequency oscillator may be turned off with the MARKER RANGE switch. The crystal oscillator is started and stopped by inserting and removing the crystal from the socket on the front panel.

A 4.5-mc marker crystal is supplied with the instrument but fundamental type crystals suitable for use in a Pierce oscillator may be used to supply additional marker frequencies. The signals developed by the two oscillators are mixed in the common cathode circuit. In this way, markers are obtained at frequencies equal to the fundamentals of each oscillator, at their harmonics and at the sum and difference frequencies of the fundamentals and harmonics. Marker signals from an external generator may be fed to the common cathode circuit through an external marker terminal on the front panel.

Marker signals are taken from across the 150-ohm cathode resistor and applied to the MARKER SIZE control. They are taken from the arm of this control and fed to the COARSE OUTPUT ATTENUATOR along with the swept rf output from the arm of the FINE OUTPUT ATTENUATOR. By feeding the marker and sweep signals into the coarse attenuator, it is possible to vary the composite output of the generator in 20-db steps while maintaining a constant amplitude relationship between the marker and frequency-modulated signals. END

CONTACT POTENTIAL For Loadless Metering

By THOMAS L. BARTHOLOMEW

WHEN the cathode of a vacuum tube is heated, negative electrons are repelled to the next adjoining element. If the cathode is brought up to normal heat, a reading of 0.5 to 1 volt may be noted between the cathode and adjoining element in most tubes. A voltage so derived is known as contact potential. Enough power can be taken from this source to operate meters.

Now if we have a four-element tube, (Fig. 1) and the cathode (filament) is

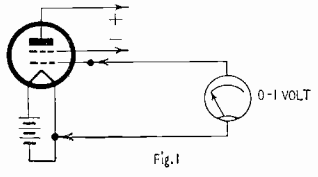


Fig. 1

operating at normal temperature, the meter will indicate a voltage. If a voltage is applied across the screen grid and plate, polarity observed as shown, there will be a definite reduction in the contact potential. The negative potential on the screen grid will repel the negative electrons that have formed on the control grid and the contact potential will be reduced. By noting how much the contact potential has been reduced we can determine the voltage applied to the screen and plate. Since there is no current flow between screen and plate under these conditions, we will now have loadless metering, often highly desirable.

Fig. 2 shows the contact potential generated by some tubes and the effect on the contact potential by a negative charge on the screen grid. The positive lead was connected to the suppressor grid of the 6AB7 and the 6J7, and the negative lead was connected to the screen grid. With the 1R5, grids 2 and 4 (connected internally) were negative and grid 3 was positive. The voltmeter used to make the readings was 100,000 ohms per volt and was set on the 1-volt range.

The following are the current readings of the contact potential of various tubes tested.

6J7	(0–100-μa meter)	30 μa
6AB7	(0–1-ma meter)	1 ma
1R5	(0–1-ma meter)	500 μa

If a milliammeter or microammeter is placed between the control grid and the cathode, the voltage is dropped considerably due to the load created. Lowering the contact potential voltage also lowers the negative voltage required on the screen grid, thus allowing the tube to operate over a lower voltage range. Ac voltages can also be measured in this manner, but the scale will not be the same as for direct currents. With alternating currents there will appear to be a current drain, due to the capacitance of the elements within the tube. Tubes like the 6K6 will not work in this type of circuit since the suppressor grid is connected to the cathode internally. When a voltage is applied to the screen grid and plate, some conduction takes place.

Since contact potential is not the same in all tubes, even in twin-section units, a tube must be selected and a scale hand-drawn to meet its characteristics. Static charges greatly affect the

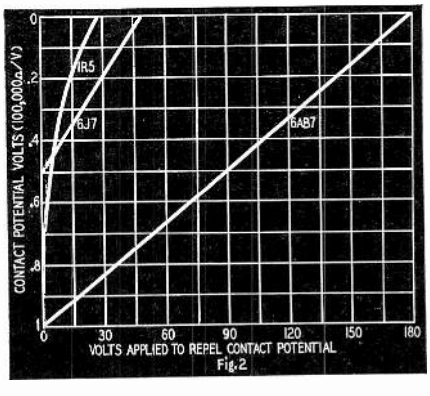
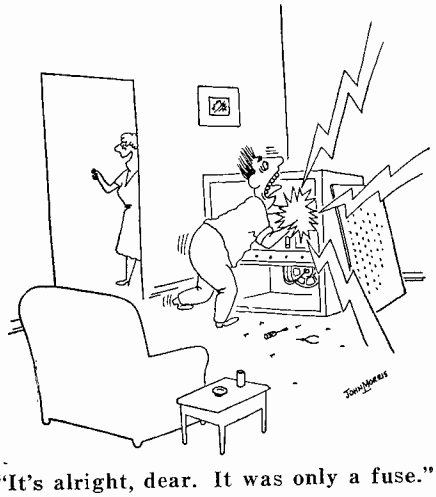
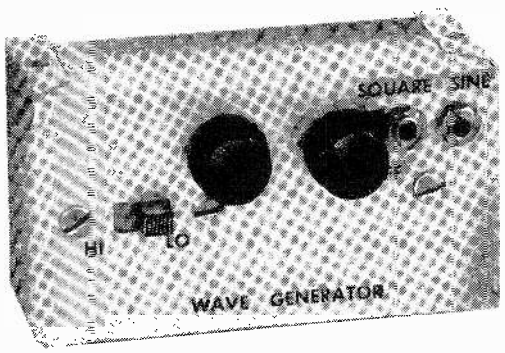


Fig. 2

readings so care must be taken that they are eliminated. The filament supply and the circuit under test cannot come from the same source due to the capacitance effect that would give false readings. END



"It's alright, dear. It was only a fuse."

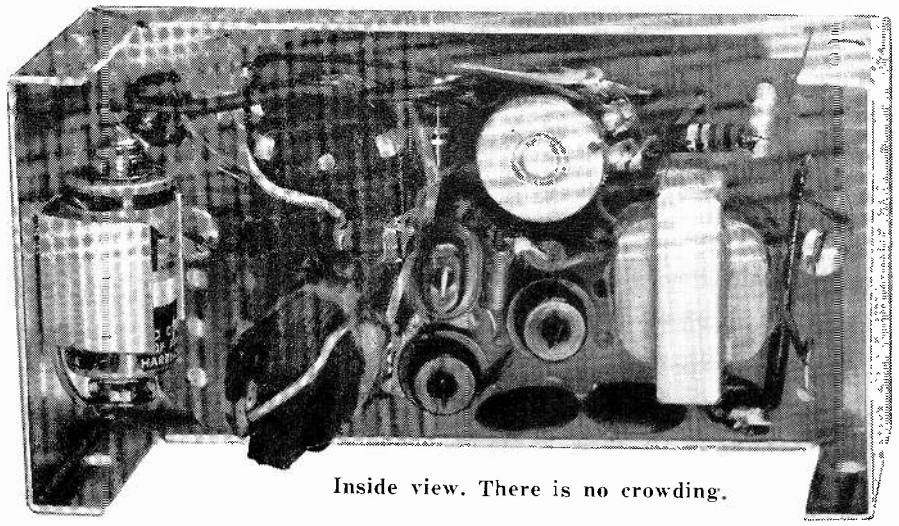


Instrument is only 4 inches long and 2 inches high.

By I. QUEEN
EDITORIAL ASSOCIATE

Sine/Square-Wave Generator

This transistorized little package produces waves as good as from many a bigger and more expensive instrument



Inside view. There is no crowding.

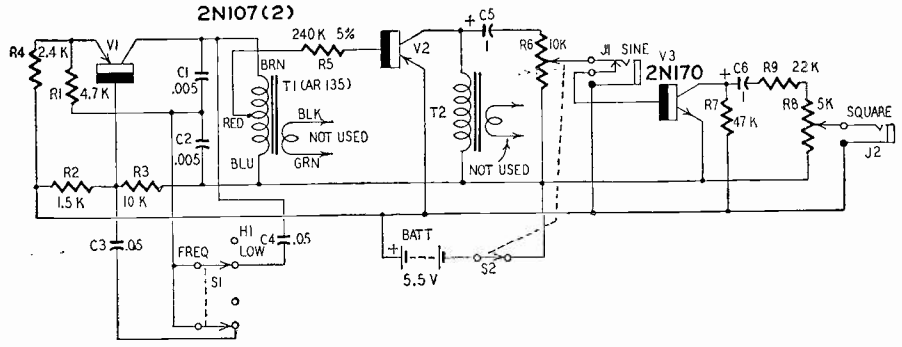
VOLTAGES that vary and repeat themselves at regular intervals are often needed in electronics. Sine, square, sawtooth and pulse are among the recurrent waveforms most useful. Of these, the first two are especially important for testing audio amplifiers and networks. This compact transistorized unit generates both sine and square waves. Furthermore, there is a choice of frequency—420 or 2,100 cycles. The instrument has three transistors and a 5½-volt battery supply. It measures 4 x 2 x 1½ inches and weighs 7 ounces. The battery is contained in the unit.

It is not practical to use a conventional variable Wien-bridge oscillator with transistors due to their low impedance. Therefore many previous transistor generators have been limited to a single fixed audio frequency. Here, by including a choice of *two* (widely separated) frequencies, the device becomes far more practical for testing, calibration and repair work.

The generator provides a sine wave in the first stage, V1 (see diagram). This voltage is amplified by V2 which makes the sine signal available at a subminiature jack. A third stage (V3) amplifies the voltage still more and (due to overloading) flattens the signal and converts it to a square wave. As in tube circuits, this method cannot yield a perfect square wave but, with sufficient gain and clipping, the ideal is approached closely.

V1 is connected as a Colpitts audio oscillator. A tapped capacitance shunts T1, which is the primary of a subminiature transformer. Its secondary is not used. Feedback is controlled by R1, a fixed 4,700-ohm resistor. For stability, the transistor base is biased from voltage divider R2–R3. With .005-μf capacitors, the output frequency is relatively high. This is lowered when the .05-μf capacitors C3 and C4 are switched in. The ratio of the higher to the lower frequency is 5 to 1. For convenience, the lower frequency may be chosen to be an *exact* multiple of the line frequency. In this particular instrument, I obtained a value of 420 cycles, which I can use as a *standard* frequency. It can be checked periodically (with the aid of a scope) by comparing with the 60-cycle line source. The circuit has been found to have high frequency stability, so the 420 cycles may be used for calibrating audio oscillators and other networks.

Due to differences in transistors, transformers and other parts, your low frequency may not come out to exactly 420 cycles as mine did. If you like the feature of an *exact* multiple of the line frequency, note these pointers: If the frequency is too high, it may be lowered slightly by adding a shunt capacitor across the primary of T1. As a starter, try a variable mica trimmer of about 580 $\mu\mu$f maximum. On the other hand, if your frequency is lower than the desired value, use less



R1—4,700 ohms
R2—1,500 ohms
R3—10,000 ohms
R4—2,400 ohms
R5—240,000 ohms, 5%
R6—10,000 ohms, pot with switch (Lafayette VC-28)
R7—47,000 ohms
R8—5,000 ohms, pot (Lafayette VC-33)
R9—22,000 ohms
All resistors ½ watt
C1, C2—.005 µf disc
C3, C4—.05 µf, disc or tiny tubular
C5, C6—1 µf, 6-volt electrolytic
BATT—(VS310), holder and terminal contacts

T1—primary 4,000 ohms center-tapped, secondary 3.2 ohms (AR-135)
T2—primary of output transformer approximately 30,000 ohms to speaker (TR-46)
S1—dpdt or dpst slide type switch
S2—spst switch ganged to R6
V1, V2—2N107 (p-n-p)
V3—2N170 (n-p-n)
Sockets for above (3)
J1—subminiature jack (Lafayette MS-282)
J2—may be above type with one unused contact
Perforated board (Lafayette MS-304) cut as required
Metal box, 4 x 2⅛ x 1⅝ inches
Knobs (2) for controls
Screws and separators (see text)

The sine-square wave generator uses three transistors.

capacitance for C1 and C2. Ceramic discs are available in such sizes as .0047, .0043, .004, etc. Since the second transistor stage may produce changes in the oscillator frequency, it is better to complete at least the first two stages before making a final frequency measurement.

The sine output of T1 is coupled through resistor R5 to the next transistor. If R5 is too small, the oscillations may cease or become unstable. If too high, output from V2 will be low. The resistance shown was found correct.

T2, the load for V2, is the primary of any small output transformer. C5 keeps dc out of the "sine" jack J1 while passing the af. R6 controls the output voltage from a maximum of about 0.8 volt peak to peak down to zero. The sine waveform is excellent at both frequencies and amplitude is nearly the same.

When a subminiature plug is inserted into J1 for sine output, the final stage is automatically disconnected. This prevents loading the second stage.

V3, the final transistor, is an n-p-n type that is unbiased. It overloads easily, thus providing the required square wave. Maximum output is about 0.3 volt peak to peak, with excellent waveform at both frequencies of 420 and 2,100 cycles. The waveform is maintained even when relatively low resistors are shunted across the output leads. R6 must be left at maximum setting for good square waveform.

For convenience, this generator is first mounted on a perforated board. When completed, the board is screwed down to a metal box measuring 4 x 2⅛ x 1⅝ inches. Tapped metal separators keep the board ⅜ inch away from the metal box so there is plenty of space for wiring and parts. The mercury battery is mounted at one end.

Applications

A sine wave is the only voltage waveform that is unchanged (as to shape) when it is passed through ordinary resistors, capacitors and coils. The wave may, however, be deformed by a nonlinear resistor, overloaded or incorrectly biased tube, saturable coil or other nonlinear element. Thus a sine wave is an ideal test signal. When fed into a hi-fi amplifier, its output will be a sine wave also. Only the amplitude will change, not the general shape. If the wave comes out flattened, peaked or otherwise deformed, there is a defect of some sort in the amplifier or it is not a hi-fi design. Distortion is the introduction of harmonics—multiple frequencies of the original sine wave. The strength of these spurious frequencies indicates the degree of distortion.

Another important application of sine voltages is bridge measurement. If the signal is not a pure sine (single frequency), the bridge detector may not show the desired minimum or sharp null.

A square-wave voltage is a combination of many sine voltages, including a fundamental frequency and very many odd harmonics. Because the square wave is so rich in harmonics, it is an ideal signal for indicating frequency response over a very wide band.

A good hi-fi amplifier should reproduce a 2-kc square-wave signal with little if any deformation. * If it is passed with but little or no change in shape, we may assume that the amplifier has flat response out to 20 kc or more. If it passes a 450-cycle square wave with little distortion, it can be taken to mean flat response down to approximately 40 cycles. With experience, the technician will be able to estimate the amount of amplifier distortion from square-wave tests made with the low- and high-frequency outputs from this square-wave generator.

The techniques of using square waves for audio tests and measurements are discussed beginning on page 209 of Marshall's aforementioned book. END

* Joseph Marshall, *Maintaining Hi-Fi Equipment*, page 13 (Gernsback Library).

CURRENT TESTER

By GEORGE P. PEARCE

IT is often necessary to find the current flow in a radio-electronic device, as well as small fans or other household appliances, etc. This easy hookup enables me to take a current reading in a few seconds. No wiring other than a simple plugging-in is required.

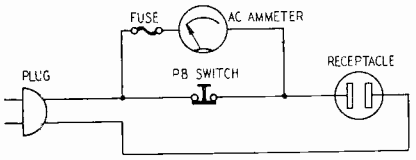


Fig. 1—The simple current tester.

The diagram is shown in Fig. 1. The ammeter is shorted out when the appliance under test is plugged in, thus the meter is completely protected against any high initial current flow as frequently occurs in inductive circuits. After the surge has settled down, pressing the push button of the normally closed switch passes the current through the meter without any break in the flow. When the button is released

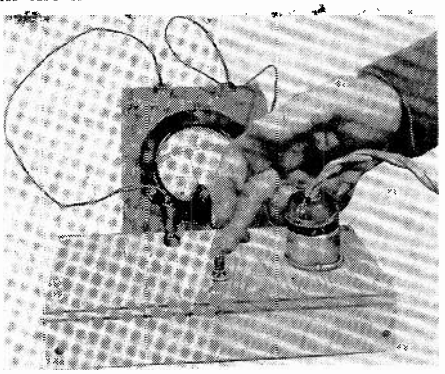


Fig. 2—Pushbutton actuates meter.

the current once more flows through the switch.

The device to be tested is simply plugged into the receptacle on the tester. Then the proper ammeter is plugged into the two jacks, and the tester cord is plugged into the wall receptacle. When a reading is wanted, just press the push button. Releasing the button switches the current back through the switch and unloads the meter. Fig. 2 shows the current tester in use. The fuse protects the meter against overload. Fig. 3 shows the wiring underneath where it is fully protected by wood sides so that nothing can roll against it and cause a short. It can be further protected by fastening a plywood bottom to it. END

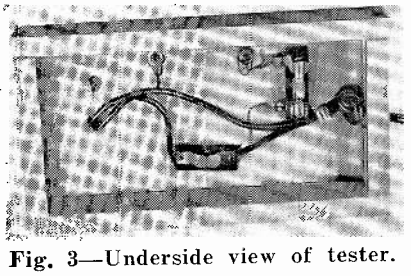


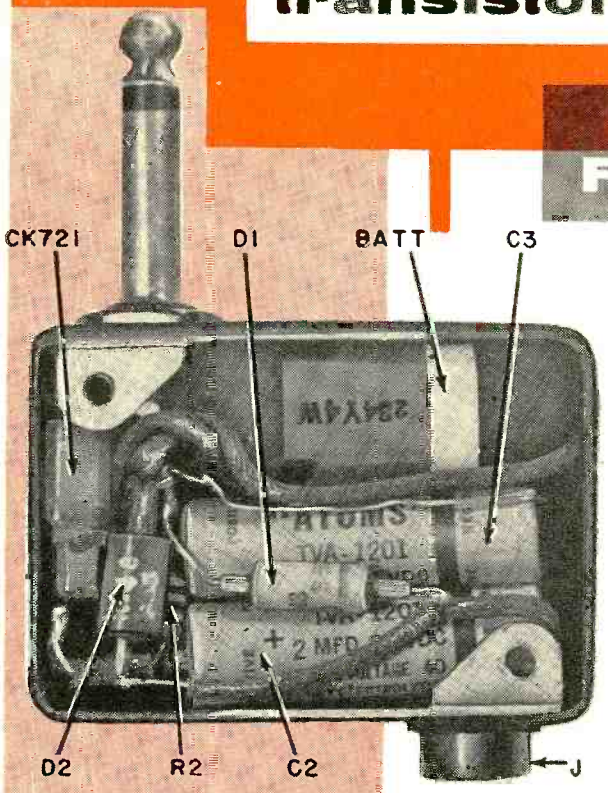
Fig. 3—Underside view of tester.

transistor PREAMP for VTVM's

Self-powered device provides voltage multiplication of 100 with good response from 25 cycles to 15 kc

By ELLIOTT A. McCREADY

THE lowest full-scale ac range on the average vacuum-tube voltmeter is in the neighborhood of 1.5 to 3 volts. With this range, readings of as low as 100 to 200 mv are possible, but not too practical. What is needed is an ac vacuum-tube voltmeter with a full-scale range of 100 mv (or less!) or some sort of preamp that can be used with a conventional vtvm to boost its sensitivity. Of the two, the preamp is considerably less expensive.

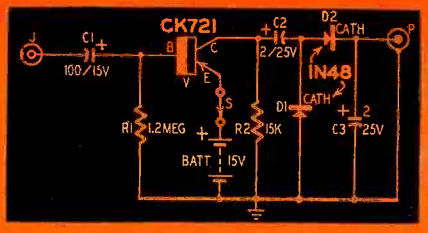


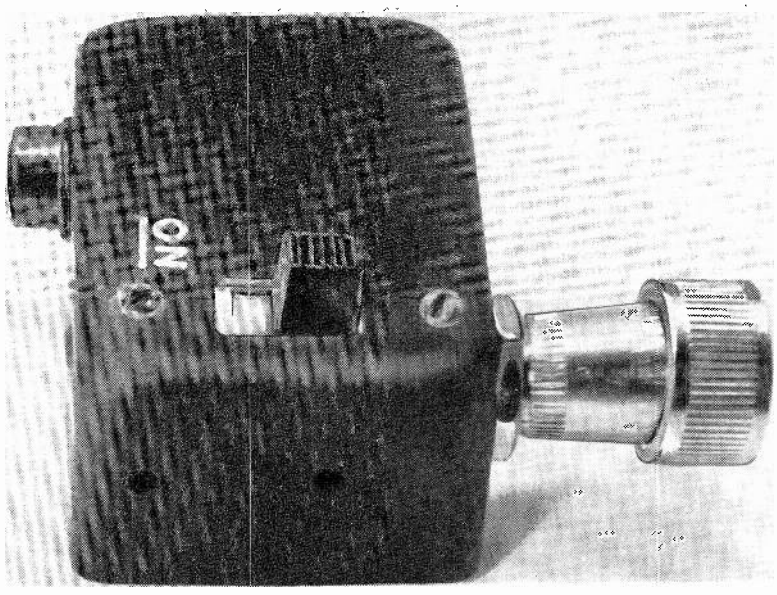
Internal construction of the preamp.

Phone plug adapts the preamp for use with most kit type meters.

Fig. 1—Schematic diagram of the transistorized preamplifier for vtvm's.

R1—1.2 megohms, ½ watt
R2—15,000 ohms, ½ watt
C1—100 µf, 15 volts, electrolytic (Sprague Atom TVA-1160 or equivalent)
C2, 3—2 µf, 25 volts, electrolytic (Sprague Atom TVA-1201 or equivalent)
S—spst switch
D1, 2—1N48 crystal diode
V—CK721
BATT—15-volt hearing aid battery (RCA VSO83 or equivalent)
J—banana or tip jack
P—phone plug or female microphone connector (see text)
5-prong hearing aid socket (Cinch-Jones)
Headset adapter case, surplus, type MC-385-A (or any small metal box)





The female mike connector permits using the preamp with most commercial vtvm's.

An instrument preamplifier using a single 12AX7 tube was described in RADIO - ELECTRONICS, December, 1955 ("Milvamp" by Forrest Franz, Sr.) This preamp is entirely self-contained and self-powered, plugs into a conventional vtvm and boasts a gain of 100, an output in excess of 5 volts and a frequency response sufficiently flat for most applications. The only fly in the ointment is its rather low input impedance, a characteristic of the junction transistor in a grounded-emitter circuit. This low input impedance is not the drawback that it might seem at first glance. Much of the extremely low-voltage work is done in connection with low-impedance devices such as magnetic phono pickups or dynamic microphones, and there is a definite advantage in being able to use long, unshielded leads.

The preamp (Fig. 1) is designed around a Raytheon CK721 junction transistor. It has a gain of around 50 and an undistorted output of about 2.5 volts. The voltage doubler at the output of the preamp doubles both the gain of the amplifier stage and the voltage output. Large electrolytic capacitors insure good low-frequency response and all parts are chosen for minimum size. The total current drain from the 15-volt hearing aid battery is approximately 500 microamps, which makes for long battery life.

Construction

The entire preamp is housed in a surplus headset adapter case. The type of output connector will depend on the make of vtvm with which the preamp will be used. The standard phone plug used on the headset adapter fits most of the kit type instruments. The female microphone connector shown in the photo adapts the preamp to most other types of vtvm's. To prepare the mike connector for mounting, file the taper off the first ½ inch or so and thread with a 7/16 by 20 die. Then use two flat control nuts to hold the connector to the headset adapter case.

Replace the phone jack on the headset adapter with a banana jack (or tip jack), insulated from the metal case. Cut or file the threaded portion of this jack so that as little as possible projects inside the metal preamp case.

Mount slide switch S directly behind the output connector. Then clip the switch terminals to within ⅛ inch of the switch, leaving just enough of the terminal projecting to solder a wire to.

The battery leads and input capacitor C1 are wired first. C1 is directly behind the input jack and under C2 and C3. The remainder of the components can be seen in the photo. The polarity of C2 is opposite to that normally used in a voltage doubler. Its polarity was necessarily reversed to agree with the polarity of the dc voltage on the collector.

Using the specified capacitors and battery, the components fit very nicely, although somewhat tightly, into the metal case. Take care during the construction of the preamp to avoid shorts and use fine spaghetti on most of the leads which are not at ground potential. Some space can be saved by using a newer type crystal diode and eliminating the transistor socket. I prefer using a socket for the transistor, however, as heat from the soldering iron can quickly ruin a transistor. Incidentally, an Ungar iron with a No. 535 tip is very useful on this job.

After all wiring is completed and checked, solder the battery to its leads and insert it as shown. Then insulate the inside of the metal lid with plastic electrical tape or anticorona lacquer and screw in place. It will probably be necessary to shorten one or both of the screws that hold the lid in place to prevent them from shorting to some of the components when they have been tightened.

Connect the preamp to the vtvm and switch both units on. It is a good idea to set the vtvm to one of the higher ranges initially to prevent pegging the meter when the preamp is switched on. Insert the test leads (the vtvm ground lead and the lead from J) and connect them to an audio oscillator or other signal source through a suitable attenuator. With an input of 10 mv the vacuum-tube voltmeter should read approximately 1 volt.

As maximum gain was desired from the preamp no attempt was made to attain linearity. A calibration card will enable the user to make precise measurements of small voltages. The frequency response of the preamp is within 1 db from 25 cycles to 15 kc, dropping to −1½ db at 20 cycles and −2 db at 20 kc. Above 20 kc the tapering off is very gradual, and the unit still shows a gain of 10 at 1,000 kilocycles.

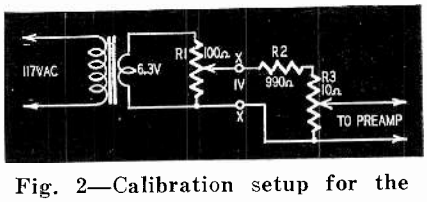
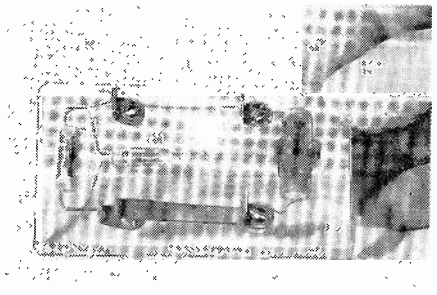
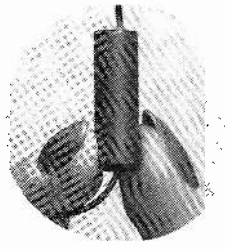


Fig. 2—Calibration setup for the preamp.

The following procedure (Fig. 2) may be used to calibrate the preamp: Connect resistors R1, R2 and R3 to a 6.3-volt filament transformer. Set R1 for 1 volt across points X–X. The voltage across R3 will then be very close to 10 mv. By calibrating R3 in 1-ohm divisions with an ohmmeter, the preamp can be calibrated in 1-mv steps to 10 mv. This setup won't be within 1%, but should be accurate enough for all practical purposes. If the overall gain of the preamp is greater than 100 or than desired, insert a resistor of around 100 ohms or so in series with the emitter and battery or try a lower battery voltage. END

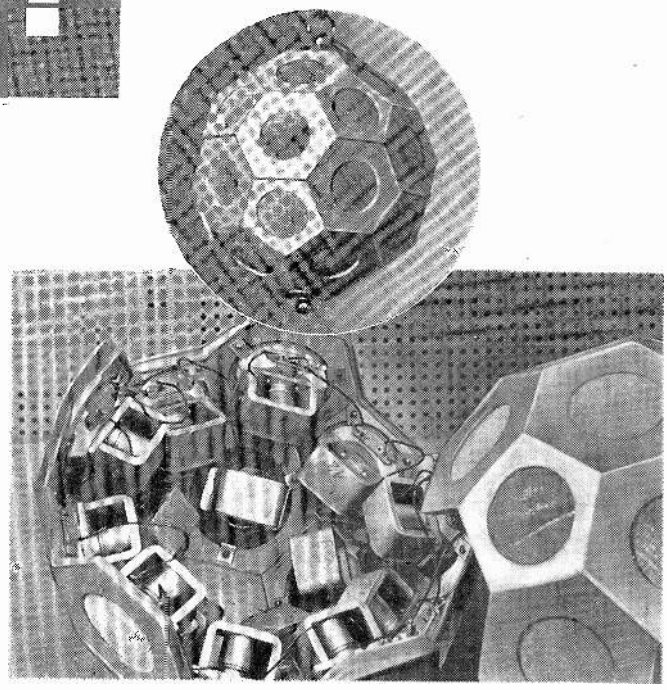
what's new?



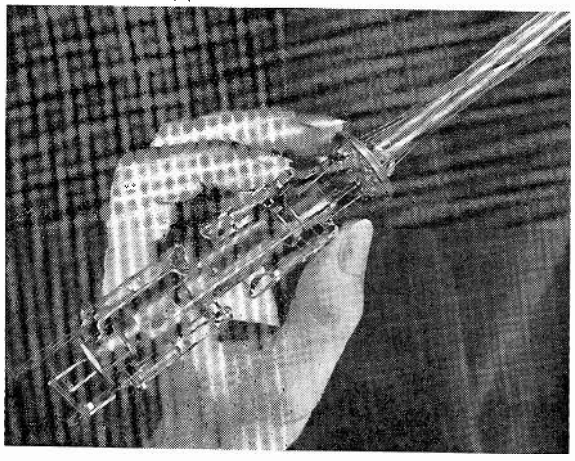


SMALLER AND BETTER BATTERIES are announced from two separate sources this month. One is made by the National Carbon Co.; the other by General Electric. Alike in many respects, they are fundamentally different: the G-E battery (left, near fingers) has a silver anode, silver bromide electrolyte and a cupric bromide and carbon cathode; while the National Carbon Co. battery (right) is made primarily of silver, silver iodide and vanadium pentoxide. Both are truly "dry batteries with a solid electrolyte, are rated at 95 volts and have an indefinite shelf life, G-E suggests that their battery's life is "over 20 years" and National Carbon says "the solid electrolyte battery should give up to several decades" continuous service in suitable applications, such as maintaining a charge on capacitors in electric circuits." Open-circuit applications are not the only suitable ones, and the batteries can be used for low-current or intermittent applications, with currents up to 10 μa. They are especially adapted to applications which may require intermittent bursts, with long idle periods, such as in alarm circuits, where reliability demands a battery that can remain in excellent condition over long "shelf" periods.

Both batteries are 1 inch long and about ⅛ inch in diameter. The G-E battery contains 127 disc-shaped cell units, and the National Carbon 200 cells.

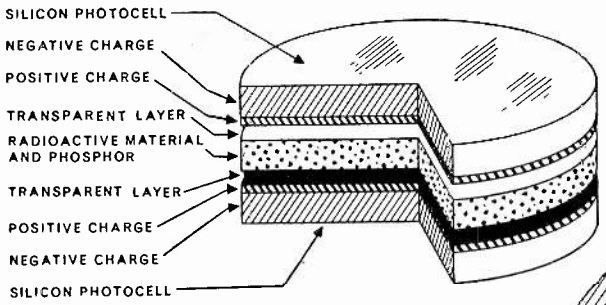


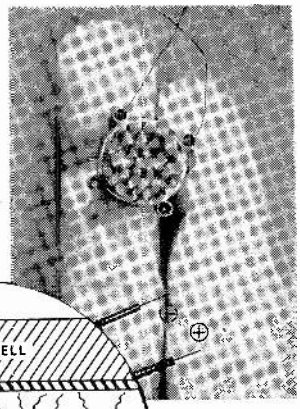
THE SPHERICAL SPEAKER, dream of many an audiophile, is realized in appearance at least, by this "treble ball," as its manufacturers call it. It contains 30 small speakers and radiates through a spherical angle of 360°. The speaker is made by the firm of ***Tonographie*** of Wuppertal-Barmen, Germany, and was described in the German electronic magazine Funkschau, in an article which covered several types of spherical or near-spherical loudspeakers.

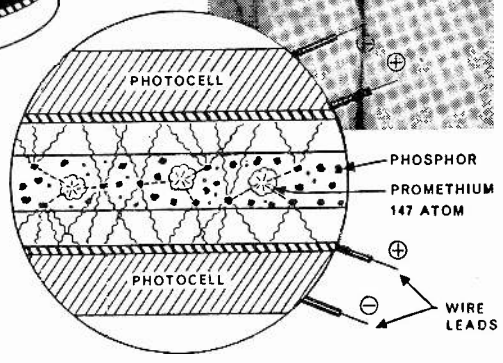


MORE CONTRAST in portable TV receivers is offered with this new electron-gun assembly which is designed to work with low voltages (115 or so) on grid 2. Chief design changes are closer spacing between cathode, Grids 1 and 2, and a larger aperture in grid 1. Besides the low grid-2 voltage—very important in portable receivers—the contrast is also greater for a given amount of video drive. Although designed for portables, the fact that the tube can replace older types with no other change than reduction of grid-2 voltage makes it possible that this type of tube may be used universally in a short time. Tubes using the new gun have already passed portable dimensions, and are being manufactured by Westinghouse in 17- and 21-inch sizes.

ELGIN-KIDDE NUCLEAR BATTERY — HOW IT WORKS





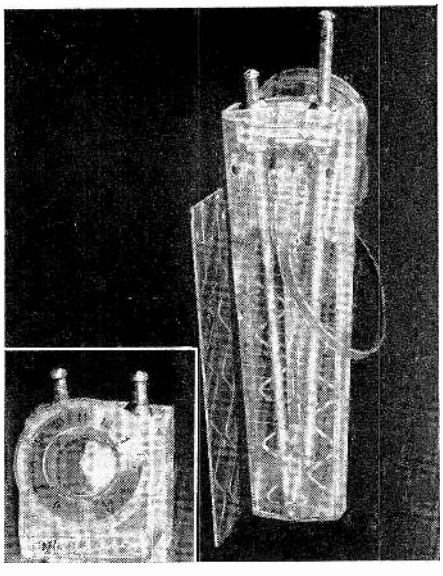


ATOMIC POWER may some day operate your wrist watch. This atomic battery, less than ¼ inch thick and about a ½ inch in diameter, was produced by the joint efforts of Elgin Watch Co. and Walter Kidde Nuclear Laboratories with just such an ultimate objective in mind. Using plutonium 147 as its power source, it is still far too expensive to be practical. But the Atomic Energy Commission believes the element will soon be available in large enough quantities to bring its price down to 50c a curie or so. (Plutonium 147 costs about $500 a curie now.)

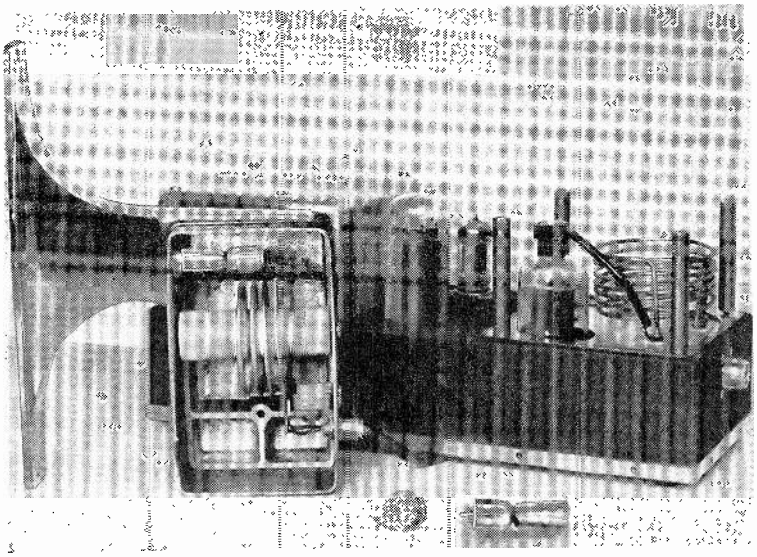
The atomic battery is a complex device, in which energy is first turned to light, then back again to energy. The plutonium 147 is the layer in the middle of the layer-cakelike assembly. Mixed with it are phosphors which give out light as they are bombarded by beta rays from the plutonium. The light rays are converted into electricity by the silicon photocells which form the outside layers of the battery.

Present experimental models produce as much as 20 μa at 0.25 volt. Voltage may be doubled by connecting the photocells in series instead of parallel, and quadrupled by sawing each photocell disc into two semi-discs and connecting them all in series. Higher currents can be produced with larger cells and probably also by improvements due to research now under way. The useful life of the cell is expected to be a little over 2 years of continuous duty, at which time its output will be halved, the half-life of plutonium being 2½ years. (Unlike the 95-volt batteries described in this section, the atomic battery can operate at full current output without shortening its life.) With its metal shield, the battery radiates less than a radium-dial wristwatch and will be entirely safe for such personal uses as watches and hearing aids.

HEARING-AID MINIATURIZATION approaches the ultimate with this "all-in-the-ear" 3-transistor aid developed by Sonotone. The instrument is about the size of a nickel and is worn in the ear with no external wires, clips or other attachments. A 32-cent battery considerably smaller than a dime powers the aid for 50 hours. A companion piece, with a clip for attaching to a spectacle bow, is made for those who wear glasses. Sound from it is piped into the ear with an inconspicuous plastic tube.



PRINTED CIRCUITS are now appearing in antennas. The pair of wavy lines seen through the plastic of this back-of-set antenna—and more clearly on the detached piece alongside—is actually a shorted stub, which is switched across or in series with the rabbit-ear type of antenna in various combinations, to match local reception, interference and ghosting conditions. The antenna, made by JFD of Brooklyn, N. Y., attaches to the back of the set with a contact-sensitive adhesive surface, with only the dial visible when the antenna rods are not extended. This, incidentally, is the second time printed circuits have appeared in antennas. The earlier types—attempted in connection with outdoor vhf–uhf antennas—were affected by weather and have been abandoned.



IONOVAC, improved form of the Ionophone (RADIO-ELECTRONICS, November and December 1951) is a speaker with no moving parts. The "unit" is the small quartz tube in the foreground. A small stylus is inserted into the narrow part of the tube and 20-mc rf current applied between its point and a collar around the tube's neck, ionizing the air around the point. By modulating the rf with audio frequency sound waves are produced as the ionization of the air varies. Demonstrated as a hi-fi tweeter, its manufacturers, DuKane Corp., St. Charles, Ill. believe it will have wider applications as an ultrasonic generator.

A digest of interesting circuitry and news from French technical publications

FIFTY MILLION FRENCHMEN....

By A. V. J. MARTIN*

■ TV tuning indicator

A CLEVER tuning indicator is used by Siemens on their 5653 de luxe television receiver. In radio receivers, the usual tuning indicator is a small cathode-ray tube ("magic eye"). For their television receiver, however, Siemens conceived the idea of using the picture tube itself as an indicator.

All television standards now in service utilize the single-side band system though a few old stations (notably London) vary from it. In this system the maximum definition is obtained when the tuning is such that the picture carrier falls exactly on the −6-db point of the response curve. It is not easy when tuning in a program to adjust the receiver to this point for best picture detail.

A simplified diagram to illustrate the principle of the Siemens circuit is given in Fig. 1. A highly selective tuned

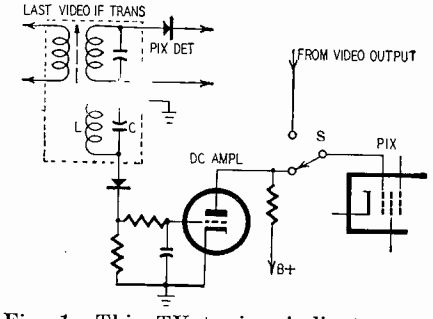


Fig. 1—This TV tuning indicator uses the picture tube as indicating device.

L-C circuit is loosely coupled to the last if transformer. This circuit is tuned to the exact frequency of the correct picture carrier and feeds a diode detector. After filtering, the rectified voltage is amplified by a triode and applied to the grid of the picture tube, while the video modulating signal is suppressed. The tuning is correct when the screen is darkest.

The two-way switch S could be combined with the fine-tuning control so that when pushing in the knob one is on "tune" position, and pulling back the knob would then restore the picture.

* Professor, Carnegie Institute of Technology, Pittsburgh. Formerly editor of *Television* (Paris, France).

■ Three-tube af amplifier

THIS three-tube af amplifier was described in *Radio Constructeur*, November, 1956. It was originally designed to fit in a standard portable record player. Its dimensions and performance are good.

The complete circuit is given in Fig. 2.

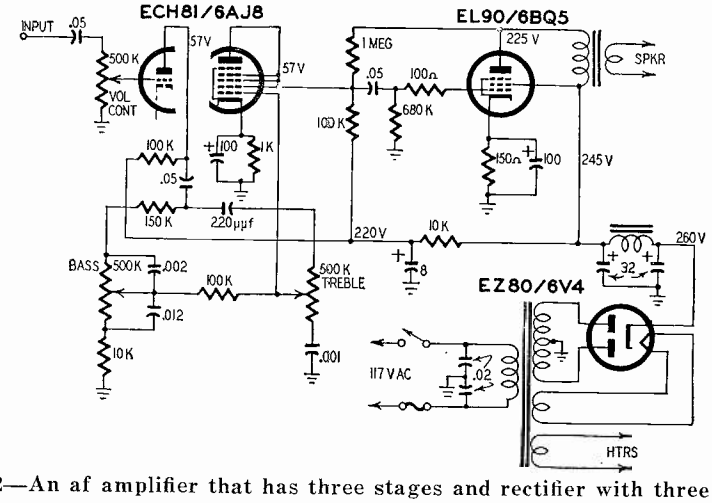


Fig. 2—An af amplifier that has three stages and rectifier with three tubes.

It uses a 6AJ8 converter as a two-stage preamplifier, a 6BQ5 power output tube and a 6V4 rectifier for the ac power supply.

The 6AJ8 is used as a double triode, the heptode part having grids 2, 3 and 4 tied to the plate.

Between the two elements of the 6AJ8 will be found a simple and convenient tone control, using two 500,000-ohm potentiometers for separate control of bass and treble.

The measured efficiency of these controls is −12 to +15 db at 80 and −5 to +18 db at 5,000 cycles.

The power output stage uses a 6BQ5, and a plate-to-plate feedback to the second preamplifier stage is provided by a 1-megohm resistor. The feedback percentage is in the order of 10%.

The output power is about 4 watts at 800 cycles for an input voltage of 0.4. The loudspeaker is a 9-inch flat type.

The power supply uses a 6V4 and is conventional. It provides 250 volts, 65 ma, approximately.

[The tubes in this circuit have RETMA type numbers but are not readily available in this country at this time. Experimenters wishing to try this circuit without modifying it for available American type tubes can purchase the European equivalents (shown in parenthesis) from distributors or service agencies handling European radios and amplifiers.—*Editor*]

■ Unique power supply cancels hum

THE af output stage and power supply of a French radio receiver, Ducretet L325, appears in Fig. 3. This is an ac model with ac–dc noval tubes and a small transformer with only one secondary winding. The full secondary voltage is rectified to obtain the 160-volts B-plus. A tap on the secondary gives the correct voltage to apply to the series-fed heaters.

The plate of the power tube is fed with rough, rectified, nonfiltered current, and a simple R–C smoothing circuit is used for the rest of the receiver.

Three resistors in series between B minus and ground provide two values of negative grid bias. One is −1.2 volts and feeds the avc line and the first af amplifier. The other is −7.5 volts and

feeds the output tube. To cancel the hum in this tube, the bias voltage is not filtered and hence contains a small ac component at hum frequency. A phasing circuit R–C adjusts the phase of this hum component, applied to the grid, for best cancellation and minimum hum in the output.

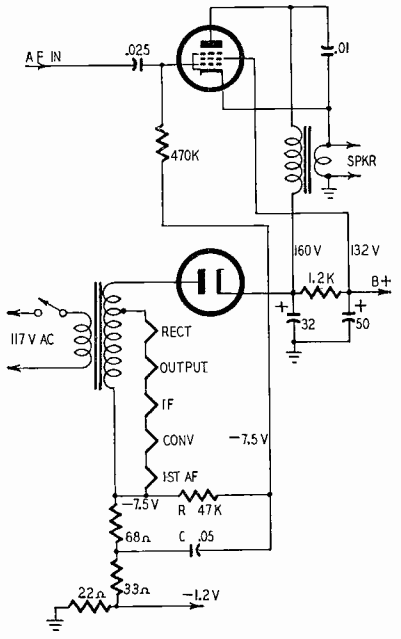


Fig. 3—Hum-cancelling power supply.

Note also the simple and efficient negative feedback obtained by grounding the output tube cathode through the output transformer secondary.

■ Two-tube frequency changer

BATTERY-FED receivers usually employ a 1R5 miniature tube for frequency changing. While this is satisfactory for the broadcast band, the sensitivity is low for shortwave listening. Communication receivers using 6.3- or 12.6-volt tubes normally employ two tubes in the frequency-changing circuit.

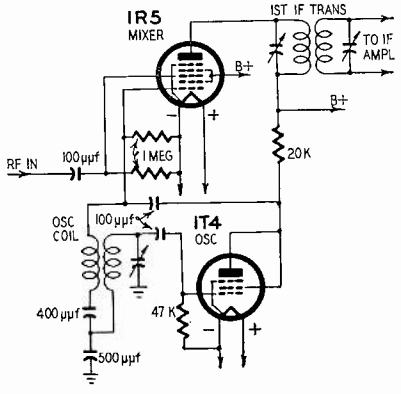


Fig. 4—Dry-cell receiver uses separate mixer and oscillator.

A French battery receiver, the Pizon Skymaster, which features several shortwave bands, also embodies a two-tube frequency changer (see Fig. 4). A 1T4, triode-connected, is used as a separate local oscillator and feeds the first grid of a 1R5. The rf signals from the rf amplifier tube are applied to the third grid of the 1R5, which then works as a conventional mixer tube.

■ Just an idea

A GREAT deal of test and measuring equipment is battery-operated. Frequently the power is turned on for a few minutes and then turned off. At least, it should be . . . But in how many cases does the user simply forget to turn the equipment off, with the result that the battery will run down or at least be unnecessarily and uneconomically on duty.

A very simple and efficient way to protect battery life is to use one of the cheap timers used, for example, in photography. When one wants to use the equipment, he has to wind the timer, thus switching on the battery. After a few minutes, the timer will come to rest to its zero position and automatically switch off the equipment. This device is simple, cheap and foolproof. Its effectiveness will be particularly appreciated in schools or in any laboratory where several people use common equipment. The photograph shows how a timer has been added to a battery-operated bridge. The idea could be extended to line-operated equipment.

■ "Sync-trigger" relay

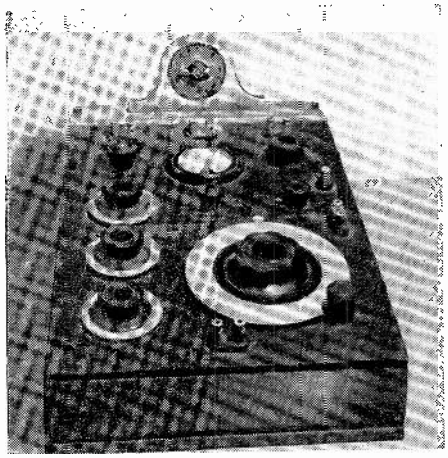
THIS thyratron relay, called the "sync trigger," was described by P. Sufdery in the November–December, 1956, issue of our French contemporary *Electronique Industrielle*.

It is an electronic relay, able to switch on or off a relatively large amount of electrical power and controlled by a very small signal which can be produced by a very high resistance contact (up to 3 megohms).

The controlled power can be practically unlimited, if only by cascading electromechanical relays.

A number of uses immediately suggest themselves. A typical one is in temperature-controlled environments where a mercury-contact thermometer can provide only a very weak controlling current but where the controlled current to the heaters may well be in the order of 10 amperes. Other immediate applications are liquid level control—even if the liquid is a poor conductor — cracking-collector control and sorting or counting. An entire field is opened up by the fact that the sync trigger can be directly controlled by a photoresistant electric cell.

Fig. 5 shows that a single miniature 2D21 thyratron is used. Note that there



Timer prevents test instrument being left on overnight.

is no rectifier for the anode voltage, the 2D21 being supplied ac voltage by one half of the high-voltage winding. The rectifier heater winding on the transformer (a standard 80-ma model) provides grid bias through a full-wave bridge rectifier. Although the original transformer had a 6.3-volt rectifier heater winding, a 5-volt winding would probably do just as well.

A 60-ma relay is placed in series with the anode connection of the thyratron. It may have any contact arrangement. The one shown has two one-circuit two-way contacts. One is used to light "on" or "off" pilot lamps. The other one is the working contact, and the binding posts allow the user to choose a "make" or "break" contact when the relay closes.

The circuit is very simple. The −8 volts negative bias applied to the grid through the 5-megohm resistor maintains the thyratron beyond cutoff. When the EXTERNAL SYNC circuit is closed by the controlling mechanism, or when one actuates the MANUAL SYNC pushbutton, the grid is practically grounded through the 100,000-ohm resistor and the thyratron fires and works as a rectifier for the applied ac voltage.

The anode current flows through a rough smoothing circuit—1,000 ohms and 8 microfarads—and then through the relay, which closes. END

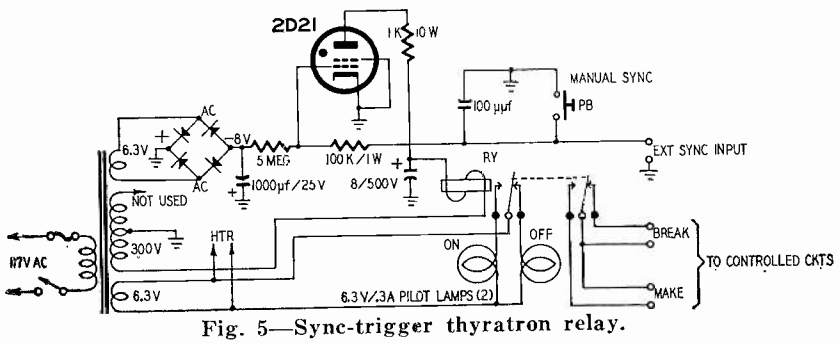


Fig. 5—Sync-trigger thyratron relay.

the SWEEP TUBE ...TV's workhorse

Some of those old sets may work better with newer type horizontal output tubes—how to compare and substitute them

By W. O. HAMLIN*

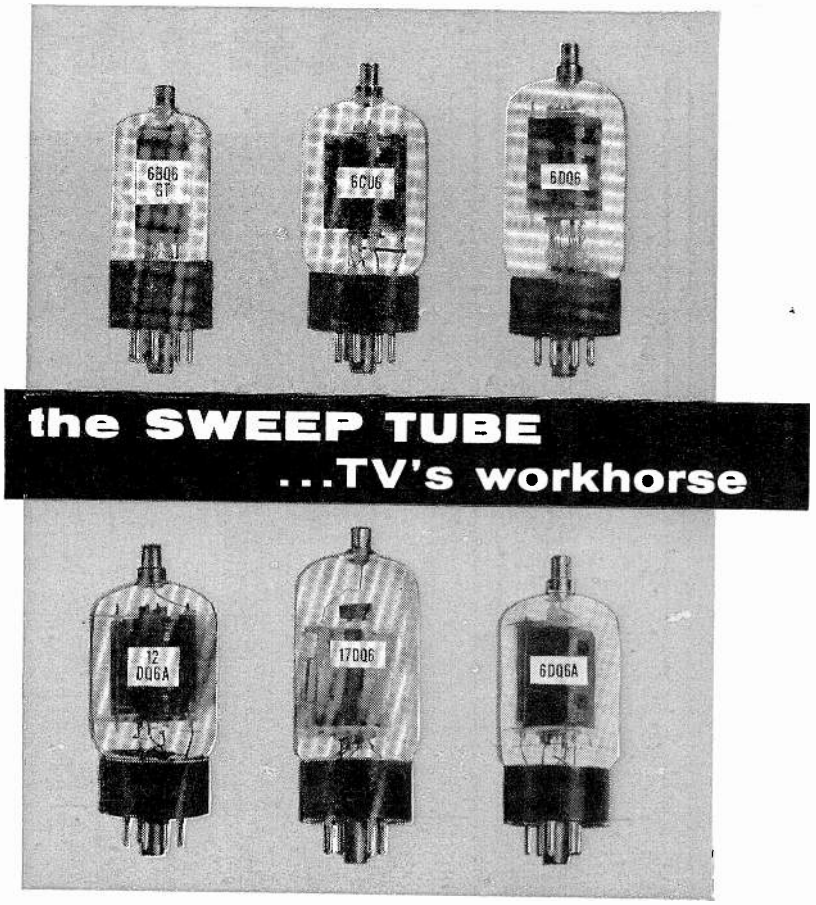


Fig. 1—A wide variety of horizontal output tubes is now available.

THE number of horizontal output tubes is forever increasing. This not only adds to inventories, but the wide assortment sometimes makes selection of substitutes by crystal-ball techniques appear attractive. As there is no universal substitute tube, the lowdown on horizontal output tube features and characteristics may clear the air a little and give the service technician an edge over swami methods.

The television horizontal output tube is in many respects like a medium-power transmitting tube, such as the 807, which has grown like Topsy into a mass of related but not identical types (Fig. 1). It has high efficiency, high current-handling capability, and is able to withstand high peak plate voltages. Some of the earliest television sets actually did use the 807 but, since it was not specifically designed for the one-eyed monster, its home-style cousin, the 6BG6-G, was developed in 1946 specifically for TV.

However, TV sets do not have elaborate high-voltage supplies nor are the operating conditions the same as for transmitters. A small, efficient, low-voltage tube was required that would furnish the high currents needed for magnetic deflection coils. A tube developed in 1949 specifically to fill this need was the 6BQ6-GT, the granddaddy of most of the later horizontal output tubes.

The 6BQ6-GT did a swell job of sweeping the then-popular 10- and 12-inch picture tubes with a 52° deflection angle. In addition, it would without strain supply several hundred volts of dc boost voltage and 8 to 12 kilovolts for the picture-tube anode.

TV people were content for a while with the little powerhouse but picture tubes became larger and deflection angles increased from 52 to 72 and then up to 90°. This required not only more sweep power but more kilovolts for the anode. And the monkey wrench was thrown in by economic pressure. Prices went down, transformers went out of some sets and the B-plus supply voltages suffered. This meant that the output tube must supply higher current at a lower plate supply voltage.

New tube types were designed to fill the more stringent requirements. The heater-voltage variations for series-string television receivers complicated matters further. As a result, today there are over 30 types of horizontal output tubes.

What it has to do

The horizontal output workhorse has a tough job. Its principal duty is to supply a very high square-wave pulse to generate a sawtooth current for the horizontal deflection coils at a rate of 15,750 times per second. This requires quite a few watts of average power. In addition, it supplies dc boost and picture-tube second-anode voltage.

Because of the power demand it is vital for long tube life to have a highly

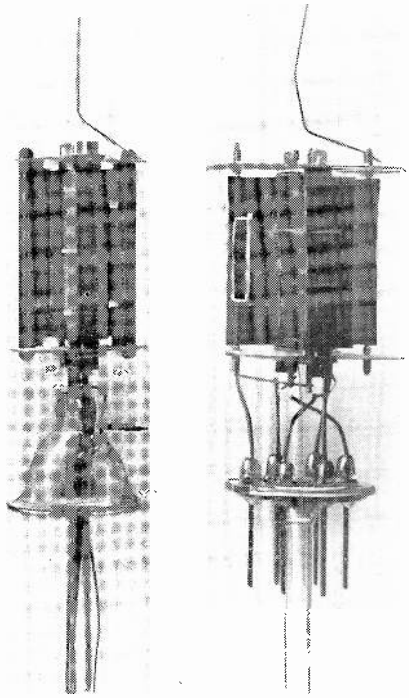


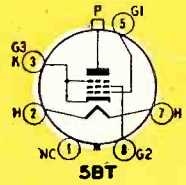
Fig. 2—Old and new mount construction, comparing press-stem construction of 6BG6-G at left with button-stem 6DQ6A at right.

* Supervisor, Technical Information Service, CBS-Hytron, Danvers, Mass.

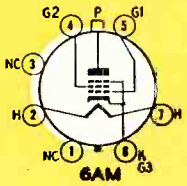
COMMON SWEEP TUBES, WITH SUBSTITUTION INFORMATION

Type	Substitution	Evaluation				Heater			Mechanical		Maximum Ratings					Characteristics									
		0-Bias Plate Current at E_b=60 Volts	Plate Dissipation, max. W	Screen Dissipation, max. W	Plate Voltage Peak Positive, max.	Heater Voltage	Heater Current Amps.	Warmup	Basing	Bulb Style	Plate Supply Volts Boost + Dc Supply	Plate Voltage Peak Negative	Cathode Current Average	Cathode Current Peak	Bulb Temperature at Hottest Point, °C	Plate Voltage	Screen Voltage	Control Grid Voltage	Plate Resistance Kilohms	Transconductance μmhos	Plate Current	Grid 2 Current	Control Grid Volts for Near Cutoff	Approx. Retail Cost
6AU5-GT	A1	210	10	2.5	5,500	6.3	1.25	–	6CK	T-9	550	1,250	110	400	210	115 60	175 175	–20 0	6	5,600	60 210	6.8 25	–45	$3.50
6AV5-GT	A2†	225	11	2.5	5,500	6.3	1.2	–	6CK	T-9	550	1,250	110	400	210	250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.50
6AV5-GA	A3‡	260	11	2.5	5,500	6.3	1.2	–	6CK	T11,12	550	1,250	110	400	210	250 60	150 150	–22.5 0	14.5	5,900	57 260	2.1 26	–43	$3.50
6BG6-G 6BG6-GA	B1 B2‡	180	20	3.2	6,600	6.3	0.9	–	5BT	ST-16 T-12	700	1,500	110	400	210	{250 60	250 250	–15 0	25	6,000	75 180	4.0 18	–45	$5.30
6BQ6-GT 6BQ6-GTA 6BQ6-GA	C1 C2‡ C3‡	225	11	2.5	5,500 6,000 6,000	6.3	1.2	–	6AM	T-9 T-9 T-11	550 600 600	1,250 1,250 1,250	110 110 110	400 400 400	220 220 190	{250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.80
6BQ6-GTB	C5†	270	11	2.5	6,000	6.3	1.2	–	6AM	T-9	600	1,250	112.5	400	220	250 60	150 150	–22.5 0	18	6,000	65 270	2.1 30	–46	$3.80
6CB5¶ 6CB5-A¶	D1 D2‡	460 at 75V	23	3.6	6,800	6.3	2.5	–	8GD	ST-16 T-12	700	1,500	200	–	210 220	{175 75	175 150	–30 0	5	8,800	90 460	6 42	–60	$6.05
6CD6-G 6CD6-GA	E1 E2‡	230	15 20	3.0	6,600 7,000	6.3	2.5	–	5BT	ST-16 T-12	700	1,500	200	700	210 225	{175 60	175 100	–30 0	7.2	7,700	75 230	5.5 21	–55	$5.05
6CU6	C4†‡	255	11	2.5	6,000	6.3	1.2	–	6AM	T-12	550	1,250	110	400	220	250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.80
6DN6		240 at 50V	15	3.0	6,600	6.3	2.5	–	5BT	T-12	700	1,500	200	700	225	125 50	125 100	–18 0	4	9,000	70 240	6.3 30	–36	$5.05
6DQ6	C6†	300	15	2.5	6,000	6.3	1.2	–	6AM	T-12	550	1,375	120	440	220	250 60	150 150	–22.5 0	20	6,000	75 300	2.4 27	–50	$3.80
6DQ6-A	C7‡	300	15	3.0	6,000	6.3	1.2	–	6AM	T-12	700	1,375	140	440	220	250 60	150 150	–22.5 0	20	6,600	75 300	2.4 27	–46	$3.80
12AV5-GA		225	11	2.5	5,500	12.6	0.6	*	6CK	T-12	550	1,250	110	400		250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.55
12BQ6-GTA 12BQ6-GA	F1 F2‡	225	11	2.5	5,500 6,000	12.6	0.6	*	6AM	T-9 T-11	550 600	1,250	110	400	220 190	{250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.85
12BQ6-GTB	F4†	270	11	2.5	6,000	12.6	0.6	*	6AM	T-9	600	1,250	112.5	400	220	250 60	150 150	–22.5 0	18	6,000	65 270	2.1	–46	$3.80
12CU6	F3†‡	255	11	2.5	6,000	12.6	0.6	*	6AM	T-12	550	1,250	110	400	220	250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.80
12DQ6	F5†	300	15	2.5	6,000	12.6	0.6	*	6AM	T-12	550	1,375	120	440	220	250 60	150 150	–22.5 0	20	6,000	75 300	2.4 27	–50	$3.85
12DQ6-A	F6	300	15	3.0	6,000	12.6	0.6	*	6AM	T-12	700	1,375	140	440	220	250 60	150 150	–22.5 0	20	6,600	75 300	2.4 27	–46	$3.85
17AV5-GA		260	11	2.5	5,500	16.8	0.45	*	6CK	T-12	550	1,250	110	400	210	250 60	150 150	–22.5 0	14.5	5,900	57 260	26	–43	$3.50
17BQ6-GTB	K1	270	11	2.5	6,000	16.8	0.45	*	6AM	T-9	600	1,250	112.5	400	220	250 60	150 150	–22.5 0	18	6,000	65 270	2.1 30	–46	
17DQ6	K2†	300	15	3.0	6,000	16.8	0.45	*	6AM	T-12	550	1,375	120	440	220	250 60	150 150	–22.5 0	20	6,000	75 300	2.4 27	–50	$3.80
17DQ6-A	K3‡	300	15	3.0	6,000	16.8	0.45	*	6AM	T-12	700	1,375	140	440	220	250 60	150 150	–22.5 0	2	6,600	75 300	2.4 27	–46	$3.80
19BG6-G 19BG6-GA	G1 G2‡	180	20	3.2	6,600	18.9	0.3	–	5BT	ST-16 T-12	700	1,500	110	400	210	{250 60	250 250	–15 0	25	6,000	75 180	4.0 180	–45	$6.15
25AV5-GT	L1	260	11	2.5	5,500	25	0.45	–	6CK	T-9	550	1,250	110	400	210	250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.50
25AV5-GA	L2†‡	260	11	2.5	5,500	25	0.45	–	6CK	T-12	550	1,250	110	400	210	250 60	150 150	–22.5 0	14.5	5,900	57 260	2.1 26	–43	$3.50
25BQ6-GT 25BQ6-GA	H1 H2‡	225	11	2.5	5,500 6,000	25	0.3	–	6AM	T-9 T-11	550 600	1,250 1,250	110 110	400 400	220 190	{250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.90
25BQ6-GTB	H4†	270	11	2.5	6,000	25	0.3	–	6AM	T-9	600	1,250	112.5	400	220	250 60	150 150	–22.5 0	18	6,000	65 270	2.1 30	–46	$3.90
25CD6-GA 25CD6-GB	J1 J2	230	20	3.0	7,000	25	0.6	*	5BT	T-12	700	1,500	200	700	225	{175 60	175 100	–30 0	7.2	7,700	75 230	5.5 21	–55	$5.05
25CU6	H3†‡	255	11	2.5	6,000	25	0.3	–	6AM	T-12	550	1,250	110	400	220	250 60	150 150	–22.5 0	20	5,500	55 225	2.1 25	–46	$3.90
25DN6		240 at E_b=50V	15	3.0	6,500	25	0.6	*	5BT	T-12	700	1,500	200	700	225	125 50	125 100	–18 0	4	9,000	70 240	6.3 30	–36	$5.15
25DQ6	H5†	300	15	2.5	6,000	25	0.3	–	6AM	T-12	550	1,375	120	440	220	250 60	150 150	–22.5 0	20	6,000	75 300	2.4 27	–50	$3.90
35CD6-GA		230	20	3.0	7,000	35	0.45	*	5BT	T-12	700	1,500	200	700	225	175 60	175 100	–30 0	7.2	7,700	75 230	5.5 21	–55	

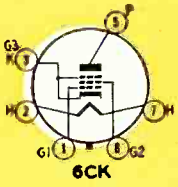
*Warmup-time-controlled heater for series-string heater circuits.
†For more sweep than preceding type.
‡For longer life than preceding type.
¶Color television deflection tube.



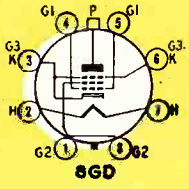
5BT



6AM



6CK



8GD

The chart lists the majority of horizontal output tubes. Method of using it for substitutions is explained in the text.

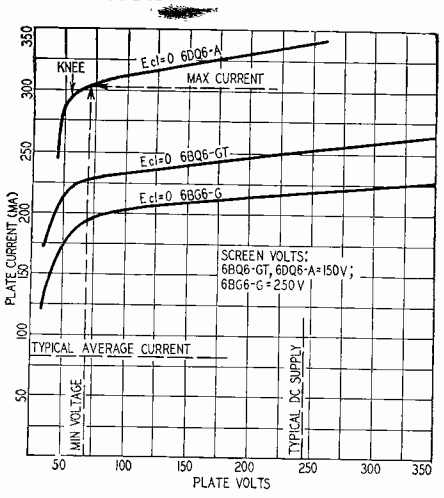


Fig. 3—Typical plate currents for horizontal output tubes, featuring the critical plate-current knee.

efficient circuit. It must supply high power with low plate dissipation in the tube and thus insure that tube ratings are not exceeded. High efficiency is achieved by use of the well known flyback transformer system. It develops the high pulse voltage needed for the picture-tube anode by resonant-frequency flywheel action, stores up a dc charge for boost voltage and at the same time matches the relatively high-impedance plate circuit to the low-impedance deflection coil.

The transformer must have a high Q (high ac and low dc resistance) and in older sets deterioration of the transformer reduces output, thus requiring more drive from the sweep tube.

In the flyback circuit the peak pulse voltage developed at the plate may be 10 times that of the total dc plate supply voltage. This explains why most horizontal output tubes have the plate brought out to the top of the tube. A few tube types have it brought out through one of the base pins, thus requiring special insulation and blank base pins on either side of the plate terminal.

Tube design

Significant for longer tube life was the changeover from the old press-stem construction to the newer button-stem construction. In press-stem construction the base leads enter the tube through the glass stem in a straight line (see Fig. 2). Lead wires are necessarily thin and there is a considerable distance between the base pins and tube mount. In button-stem construction the leads go directly from the base pin through the glass into the tube mount, being arranged in a circle similar to that used in miniature tubes. This type of construction uses heavier and shorter leads, resulting in better heat transfer from inside the tube through the base pins. It also leaves more room between the top of the tube mount and the glass, which results in improved heat radiation.

Other improvements to be found in today's tubes are larger and better grid heat radiators on the top of the tube mount. Keeping the grid cool reduces the possibility of grid emission and runaway conditions. Large plate fins are also included to increase heat radiation from the plate area. Other refinements such as ribbed plates and one-piece beam-plate construction are sometimes added. The overall result is a more efficient tube that operates at low plate supply voltages and gives satisfactory service in sweeping 90°-deflection-angle picture tubes of large screen size.

A few comparisons

By examining the voltage, current and wattage ratings of several popular deflection tubes, the capabilities of the various tubes may be compared. Their important characteristics are given on the chart printed with this article. Types of the same family are pretty much identical but some derivatives have greater stamina against heat and greater resistance to such abuse as misadjustment of the drive control. The zero-bias plate current characteristic is a good yardstick of comparison because most set designs take full advantage of this limiting characteristic for which the value given is just beyond the knee on the plate-current–plate-voltage curves. For most efficient operation the tubes' plate voltage must swing down to the knee, about 40 volts to obtain the maximum plate current (see Fig. 3). The significance of a high zero-bias plate current is fully realized when the plate supply voltage is relatively low and the picture-tube deflection angle large. Therefore the chart lists this characteristic, the zero-bias plate current, in the first column.

The first horizontal deflection tube, the 6BG6-G, could operate with high plate supply voltage up to 700 and a relatively low zero-bias dc plate current of 180 ma. Next came the 6BQ6-GT rated at 550 volts plate supply and a maximum dc current beyond the zero-bias knee of 225 ma. Finally, following other intervening types, there is the new 6DQ6-A with a zero-bias rating of 300 ma and a supply voltage of 600. Of course there are many other types which either upgrade electrical ratings or have mechanical improvements for better heat transfer. Notable in this respect is the 6CU6 which, though rated the same as the 6BQ6-GT, is improved for conservative operation, thus providing longer life. The characteristics chart also gives the approximate retail prices.

Substitution rules

In general, a different type should not be substituted for the original tube used in the set unless the original did not give satisfactory performance or service. For example, if tube life is short or sweep is insufficient, substituting a tube with higher ratings or improved construction may prolong life. Substituting a more efficient tube for one of lesser efficiency may increase sweep width and high voltage.

If a more efficient tube is substituted, be sure to readjust the drive control to protect components and the damper tube and to insure that the picture-tube anode voltage does not go too high. If substitution for a more efficient tube is not called for, the resulting sweep could be too great and be beyond range of adjustment, especially in receivers without a width control.

The following Substitution Rules use the characteristics chart on page 51 as a guide:

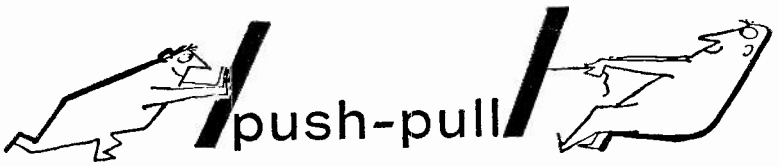
1. If the failure rate of the horizontal output tube is high but sweep is wide enough, substitute a more rugged tube with the same electrical characteristics, such as a 6CU6 for the 6BQ6-GT. In the chart substitution column, *tubes with the same letter but with progressively higher numerals and followed by a ‡ footnote symbol are unilaterally interchnageable with the types below.* A3‡ substituted for A2‡.

2. If the sweep width is not sufficient—probably caused by component aging in the flyback circuit or lower B-plus supply voltage and other conditions in the set—then substitute a more efficient tube with higher zero-bias plate current and transconductance, such as 6DQ6-A for the 6CU6. In the characteristics chart the types *with the same letter but with progressively higher numerals followed by the † footnote symbol* may be substituted unilaterally for types below it (C6† for C4 or C5). If substitution fails to bring back the sweep to normal, it is time to suspect other components, the damper tube, horizontal oscillator, high-voltage rectifier, low-voltage rectifier or flyback transformer.

Substituting a horizontal output tube is a fairly simple problem when the reasons behind a newer type are known. It is hoped that the chart will enable you to select intelligently the best tube for substitution in a television receiver that has trouble in the horizontal output tube section. As new tubes come out in the future, simply note the difference from its prototype; for instance, does it have a larger glass envelop, does it have higher zero-bias plate current or will it handle higher peak plate voltages?

These pieces of information in addition to plate and screen dissipation, will tell you when to use the tube. Intelligent substitution should help the service dealer to reduce the number of callbacks due to horizontal output tube failure. Remember, although a given receiver may have employed certain tubes that were available at the time it was designed, there is no reason why these same tubes should always be replaced in that receiver for the rest of its life. Tube manufacturers have improved the design of sweep tubes considerably over the years, through greater experience in manufacturing these types and the demand of set manufacturers for higher performance tubes.

END



push-pull video amplifier doubles picture signal

By SOL LIBES*

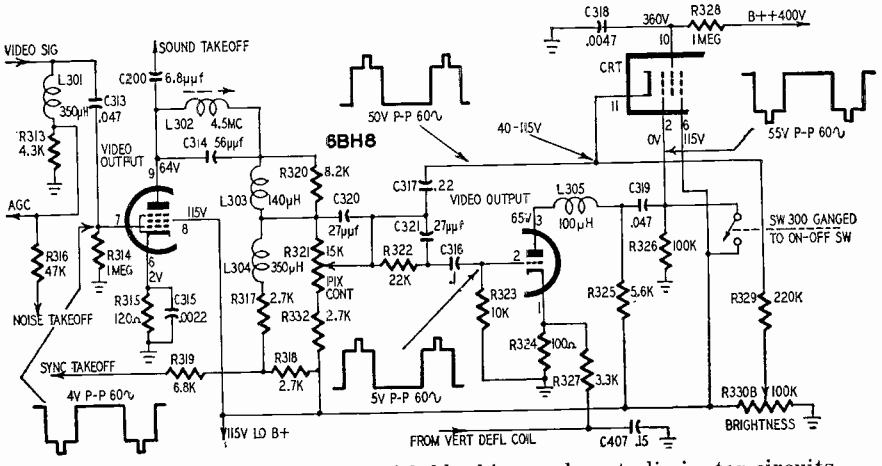
NEW Westinghouse portable television receivers—both the 14- and 17-inch types—employ a novel push-pull video amplifier design. This circuit overcomes the most serious limitations of low-voltage-operated portable TV receivers—inadequate contrast due primarily to low dc supply voltages to the video amplifier stage. This is especially true of television receivers with unamplified automatic gain control, in which the amplitude of the grid driving signal is affected by signal strength rather than remaining at the constant level maintained by a good amplified automatic gain control system.

The push-pull video amplifier circuit that removes these limitations is seen in the figure. Included in this circuit are the sound and sync takeoff, picture control, brightness control, vertical retrace elimination and the "spot eliminator."

Heart of the circuit is the 6BH8 (pentode–triode). Each section functions as a video amplifier, amplifying signals that are 180° out of phase. These out-of-phase signals are simultaneously used to drive the picture-tube cathode and grid with resultant increased contrast. With the picture control set at maximum the cathode has a 50-volt peak-to-peak positive-going video signal. The grid has a 55-volt peak-to-peak negative-going video signal. Hence, this out-of-phase relationship provides video drive of 105 volts peak to peak to the picture tube.

The detected video signals (see schematic) are applied to the pentode control grid and grid resistor R314 through capacitor C313. The pentode stage is biased for linear operation by resistor R315 to gain the additional advantages of minimum distortion of the transmitted portions of sync, video and white level. As a result, the pentode stage may be also used as a sync and 4.5-mc sound amplifier without danger of sync instability or buzz in the sound due to video amplifier overload on strong signals (as occurs on many current receiver designs).

The pentode stage alone is a typical conventional low-voltage video amplifier design utilizing combination series (L303) and shunt (L304) peaking. Adjustable coil L302 and capacitor



The push-pull video amplifier with blanking and spot-eliminator circuits.

C314 are tuned to resonate at 4.5 mc to prevent 4.5-mc beat from appearing in the picture and also to provide a high impedance for sound takeoff through capacitor C200. The pentode load is comprised of resistors R317 and R318. The desired amount of sync is obtained at the junction of these two resistors and coupled to the sync separator through isolating resistor R319.

Contrast control R321, bypassed by capacitor C320 for high-frequency video compensation, is across the pentode load and controls the amount of positive-going video signal applied to the picture-tube cathode and the grid of the triode section. The network consisting of R322, R323, C316 and C321 attenuates the video signal to the proper level for the triode section.

To obtain a high video output, the triode stage is operated beyond the linear portion of the E_p–I_p curve. The resulting compression of the sync signal is of no consequence since the sync is taken off before this stage and the triode is used for video amplification only, the compression thus occurring in the blacker-than-black region.

The negative-going video output of the triode section—developed across L305 (series-peaking coil used for high-frequency compensation) and load resistor R325—is coupled to the picture-tube grid through capacitor C319 and resistor R326. The two opposite-polarity video signal voltages, from the pentode and the triode sections of the 6BH8, are applied to the picture-tube cathode and grid additively. The result is nearly twice the contrast that would be obtained from a single pentode video amplifier operating from low-voltage power supplies.

An additional unique feature of this circuit is the method for obtaining vertical retrace blanking. Negative-going vertical pulses taken from the yoke are developed across resistor R324 and injected into the triode. These negative pulses thus appear in the triode output, phase unchanged, and cut off the picture tube during retrace blanking time.

This push-pull video amplifier circuit is neatly laid out on a printed board and should give little trouble and be very easy to service. The circuit can be checked for proper operation simply by viewing the signal with an oscilloscope at the points where waveforms are shown in the schematic diagram. Check the signals for proper waveshape and amplitude. Set the picture control at maximum (a 50-volt peak-to-peak signal at the C-R-tube cathode) and all other controls for normal picture. The dc voltages should be measured from B minus, with no applied signal, using a vtvm.

Switch SW300, in the spot-eliminator circuit, is ganged to the power on–off switch. When the line switch is opened. SW300 closes, shorting the 115-volt line to the control grid of the picture tube, momentarily placing a high positive bias on the grid. This accelerates the beam, hastening the discharge of the filter capacitors in the B-plus and high-voltage circuits and kills the spot before it damages the screen. END

* Technical editor, Service Dept., Westinghouse Electric Corp., Metuchen, N. J.

TV Service CLINIC

conducted by

JERRY KASS

WHILE most technicians are concerned with obtaining as much signal strength as possible, there are many whose problem is to attenuate an extremely powerful TV signal. Such a signal overloads a receiver and the best of agc systems cannot cope with it. The contrast control can vary the gain of a stage considerably but, being located in the video amplifier cathode circuit of most sets, it cannot prevent overloading of the rf and if circuits.

A powerful signal can cause loss of sync, sound modulation in the picture, cross-modulation buzz, and an overcontrasty and distorted image. The best general solution for this problem is to use an attenuator pad, a resistive network, between the transmission line and the antenna input terminals of the receiver. The resistors used need be no more than ½-watt carbon units. Wirewound resistors are not suitable because of their inductance, and all leads should be kept as short as possible.

A pad of this type can also be used to eliminate reflected signals. A strong direct signal can be attenuated somewhat and still be of acceptable strength. However a relatively weak, reflected signal may disappear entirely as a result of the attenuation.

The first requisite of an attenuator pad is that it properly match the characteristic impedance of the transmission line and the receiver's input. In most cases a balanced pad can be used to match a 300-ohm ribbon line to the 300-ohm input of the TV receiver. In fewer cases an unbalanced attenuator must be used to match a 72-ohm transmission line with the 72-ohm input of a TV receiver. In either case a transmission line must look into its own characteristic impedance, while at the same time the receiver input circuit does so also.

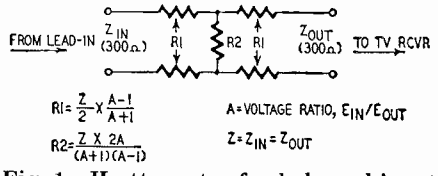


Fig. 1—H attenuator for balanced input and output impedances.

Many network configurations are possible; however, a simple H-pad (Fig. 1) is perfectly suited for attenuating signals between 300-ohm balanced input and output impedances. A T-pad (Fig. 2) can be used for the 72-ohm unbalanced arrangement.

In the balanced pad of Fig. 1 let us assume that we want to attenuate a powerful incoming signal to one-tenth its original value. This represents a reduction in signal strength of 20 db.

Using the simple formula in Fig. 1, attenuation factor A or (E_{in}/E_{out}) is equal to 10 and R1 = 150 × 9/11, or 122.7 ohms. For practical purposes, using preferred values, a resistor of 120 ohms may be used for R1. Solving for R2 follows along the same line. Again using the formula shown in Fig. 1, R2 = 300 × 20 / (11 × 9), or 60.6 ohms.

We can use a resistor of 56 or 68 ohms. However, R1 was made a few ohms less than its theoretical value so R2 must be slightly larger than its ideal value. Hence, a resistor of 68 ohms should be used for R2. The completed balanced pad for 300 ohms input and output, and an attenuation of 20 db or 9 / 10 signal strength is shown in Fig. 3.

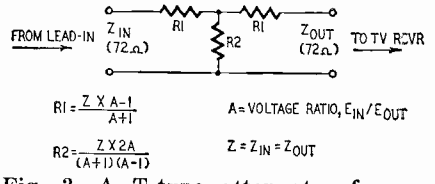


Fig. 2—A T-type attenuator for unbalanced input and output.

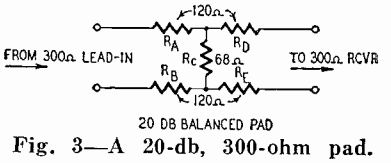


Fig. 3—A 20-db, 300-ohm pad.

We can now check the calculations for impedance match. Looking in from the 300-ohm lead-in, resistors R_A and R_B are in series with R_C which is paralleled by the series circuit of R_D, R_E and the 300-ohm input of the receiver. R_C is thus in parallel with 540 ohms. The 68-ohm R_C and the 540 ohms make up an equivalent resistance of approximately 60 ohms. This, in series with the 240 ohms of R_A plus R_B, provides a 300-ohm input impedance that matches nicely the 300-ohm impedance of the transmission line.

Similarly, the 300-ohm input impedance of the receiver also looks into its own impedance. Thus, besides introducing a signal loss, the attenuator pad prevents transmission-line reflections by maintaining a proper impedance match.

In the same way, a signal loss of any amount can be introduced. Generally, calculations will not have to be made because the attenuation ratios shown in Table I will satisfy almost any condition. Those given are for the more commonly used attenuation factors.

TABLE I
Balanced Pad—300 ohms

R1 (ohms)	R2 (ohms)	Loss (db)	Signal Attenuation
150	5.6	40	100:1
120	68	20	10:1
82	220	10	3:1
47	390	6	2:1
24	910	3	1.4:1

Solving for resistor values in the 72-ohm unbalanced pad of Fig. 2 follows much the same pattern. To introduce a 20-db loss we have:

R1 = 72 × 9 / 11, or 58.9 ohms.

The closest preferred value to this is 56 ohms. To find the value of R2 we have:

R2 = 72 × 20 / (11 × 9), or 14.5 ohms.

This is extremely close to the preferred value of 15 ohms and should be used. Fig. 4 shows the 20-db unbalanced attenuator pad.

Here the transmission line looks into R_A in series with the parallel combination of R_B and R_C and the 72-ohm input impedance of the receiver. Thus the 56-ohm R_A is in series with an equivalent resistance of approximately 14 ohms, and the 72-ohm lead-in looks into an impedance of about 70 ohms. This slight difference is not important and will usually occur unless the precise calculated resistance can be obtained. However, since the attenuator pad introduces signal losses over a wide range of frequencies, the closest preferred value resistance will usually suffice.

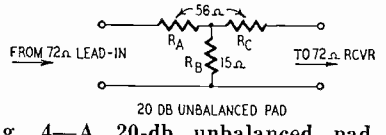


Fig. 4—A 20-db unbalanced pad to match 72-ohm coax to set's antenna input impedance.

TABLE II
Unbalanced Pad—72 ohms

R1 (ohms)	R2 (ohms)	Loss (db)	Signal Attenuation
75	1.5	40	100:1
56	15	20	10:1
33	51	10	3:1
22	100	6	2:1
12	220	3	1.4:1

Table II gives resistance values for commonly used attenuation ratios.

In some areas a strong signal may occur on one channel only, and it will be desirable to remove the attenuator pad when tuned to a normal or weak channel. When such is the case, a simple switching circuit using a dpdt switch can be used. The attenuator pad should be mounted on the rear of the TV cabinet, close to the antenna input terminals.

When time is important, as is often the case with the busy service technician, and when the desired amount of attenuation is not known, we recommend one of the commercially available pads. Variable types such as the IRC QJ-3, Centralab PCH-4 and Taco type 835 are ideal when different levels of attenuation are needed for various channels. The QJ-3 is a potentiometer type; the PCH-4 is a switch type providing attenuation of 10–40 db in four steps and the 835 provides 0-, 15- and 30-db attenuation. In cases where the desired signal loss is known, fixed pads in the Centralab PCH printed-circuit series can be used. All attenuators mentioned here are for 300-ohm circuits.

Arcing in audio socket

I recently had a Trav-ler model 1710 portable in the shop with a complaint of picture smear. While servicing I heard intermittent arcing which gradually grew louder. Finally, I noticed part of the audio output socket was burned away. I replaced the socket and the arcing stopped. I now have a similar model in the shop which also began to arc and the socket burned. I would like to know why, and what can be done to eliminate this trouble. Once the set is delivered to the customer's house there is no complaint about arcing. Could the trouble be the higher line voltage in the shop? Some technicians have complained of this, others said they did not have this trouble.—B. R., Chicago, Ill.

The trouble you describe is widespread on this and similar models. The arcing takes place between plate and screen (pins 8 and 9) on the 6AW8 audio output tube socket. It is caused by removing the cabinet top to get at the underside of the chassis. This opencircuits the secondary of the audio output transformer and unloads it. As a result, signals that reach the grid of the output tube cause excessive peak voltages in the plate circuit. Frequently, the resulting arcing between pins 8 and 9 may damage the socket. Sometimes the arcing cannot be heard but flashes appear on the screen.

Thus, when the cabinet top is removed, connect the secondary of the audio output transformer to an external speaker or a 2-watt 4.7-ohm resistor, or be sure the volume control is set at its minimum position. The technicians that did not notice any arcing may have been checking for sound defects and thus had a loudspeaker connected.

Loss of vertical sweep and raster size

I have what I believe to be an unusual case in which there is no vertical sweep and a short wavy horizontal line on the screen. The set is a Crosley chassis 466 and the symptoms point to a defect in the low-voltage power supply or in the boost circuit. My schematic calls for a boost voltage of 550 and I get about 375. Also, the grid of the vertical output tube reads −90 volts when it should read about 60.

From checking, I cannot be sure whether the trouble is in the vertical circuit, boost circuit or low-voltage power supply. I have replaced the selenium rectifiers and the filter capacitors in the power supply, and the output is a normal 260 volts. All tubes in the vertical, horizontal and damper circuits have been replaced. The main trouble here is that these circuits are so interconnected that the defect can't even be localized. I have replaced the vertical output transformer and tried a new deflection yoke, but these did not help.—T. R., Gary, Ind.

You did not mention it but one check should have been to disconnect the vertical circuit from the boost line and observe if the boost returned to its normal voltage. However, your symptoms of loss of vertical sweep, reduction in the width of the horizontal line and the negative voltage on the grid of the 6S4 output tube point almost positively to a defective cathode capacitor in the vertical output stage (Fig. 5).

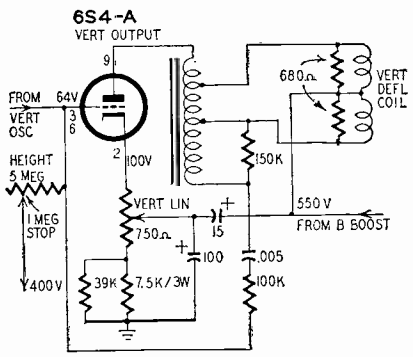


Fig. 5—Vertical output circuit in the Crosley 466 TV chassis.

Where the capacitance of this unit drops considerably there will be a reduction in width. This is due to the fact that while it bypasses the cathode circuit it is also used as a filter in the boost circuit. Thus, an open or high-impedance capacitor affects the amount of boost voltage developed. The combination of reduced plate voltage and cathode degeneration in the vertical output stage prevent vertical deflection.

Crystal bias in uhf tuner

Motorola receiver using a WTT-81 uhf tuner has a very weak output. I have tried a few 6AF4 oscillator tubes and have replaced the crystal. In some cases I get what appears to be a strong picture but it is accompanied by a great deal of noise. There is an oscillator tab that has some effect when it is moved, but it does not permit me to get a good picture. I am in a fairly strong signal area.—B. V., Elmira, N. Y.

It appears that you are having trouble getting the correct crystal bias, so very important to the proper operation of this tuner. The crystal bias consists of a combination of a small positive voltage from B plus and the negative

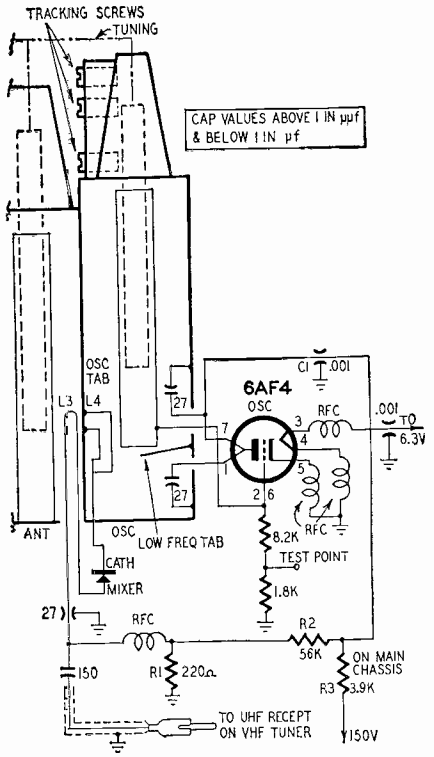


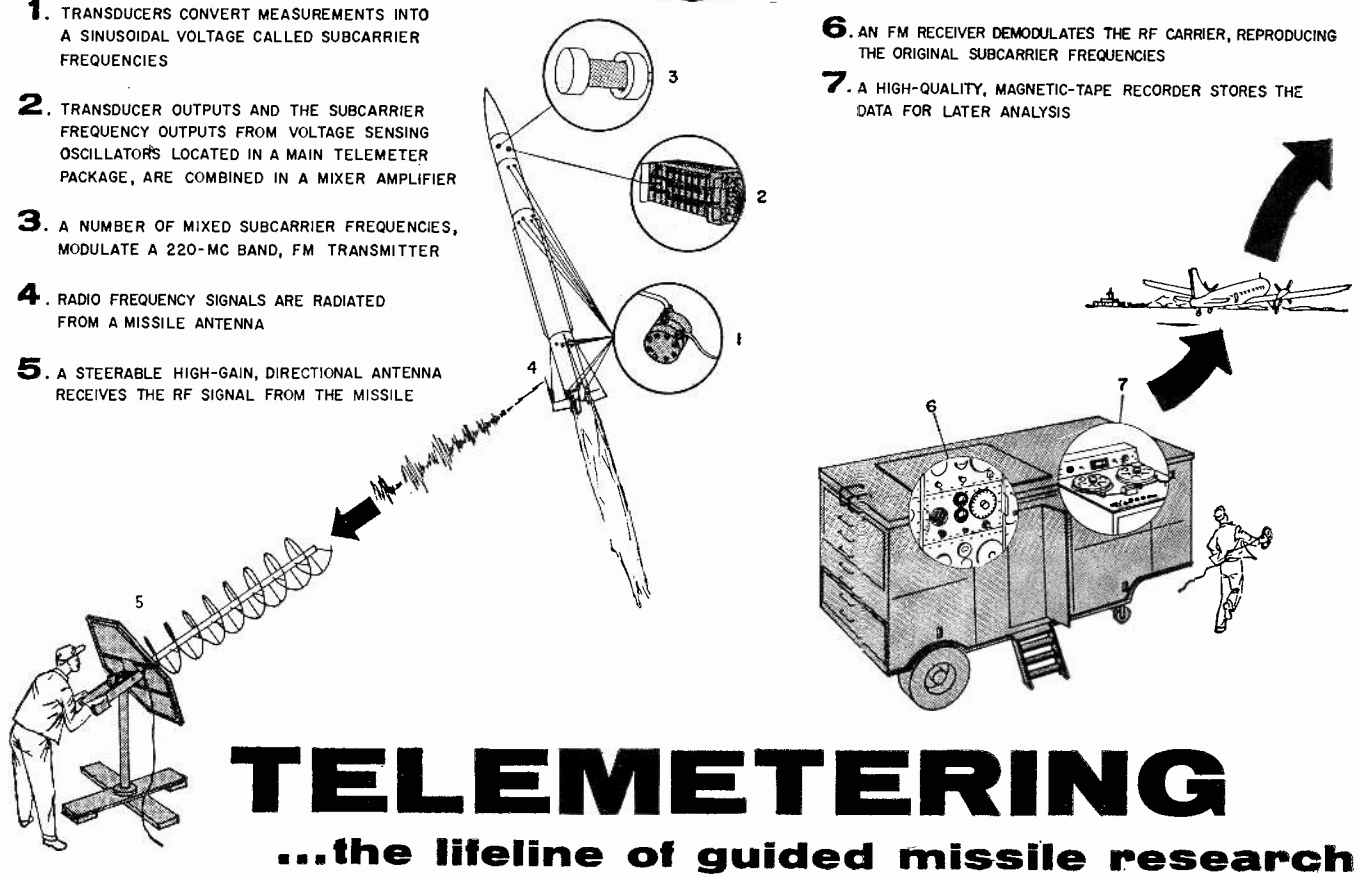
Fig. 6—Partial circuit of the Motorola coaxial-line uhf tuner.

rectified oscillator output, developed across R1 (Fig. 6). This can be used as an indication of the oscillator injection voltage. With the tuner operating normally, this voltage should be no more positive than 0.1 volt and no less negative than 0.15 volt, throughout the entire tuning range.

A negative voltage indicates that the oscillator signal is greater than the applied B voltage. Thus, an increased negative reading indicates greater oscillator injection; a decreased reading reduced oscillator injection. The voltage on the oscillator plate (junction of R2 and R3) should be almost exactly 80. The positive crystal-biasing voltage across R1 should be between 0.15 and 0.35 volt, the result of a dc drop, and must be made with the oscillator injection removed.

First measure the oscillator plate voltage. Then disable the oscillator by disconnecting its plate lead at C1. Finally, place a 5,000-ohm 5-watt rheostat from the junction of R2 and R3 to ground, and adjust it to obtain a voltage at this junction equal to the original plate voltage. Then measure crystal bias across R1. If voltage is off, check value of all resistors carefully. Be sure to adjust the proximity tabs on the oscillator line. END

COVER FEATURE



TELEMETERING

...the lifeline of guided missile research

By JOSEPH KOUKOL

THE development of the *Corporal* weapons system, at the Jet Propulsion Laboratory of the California Institute of Technology,[1] was made possible by radio telemetering, a form of remote instrumentation in which a large number of measurements may be transmitted simultaneously by radio to the ground, where they are recorded on magnetic tape for later analysis. An important part of the telemetering system is the steerable, high-gain, helix, telemetering receiving antenna shown in the cover illustration. This antenna has a gain of 11 db over a dipole for a circularly polarized wave. It has a narrow beamwidth for maximum rejection of interfering signals and to obtain the greatest possible signal level. The operator tracks the missile manually by three methods: visually with post type sights, until it is out of sight because of distance or clouds; with the signal-strength meter shown mounted on the antenna pedestal and by moving the antenna in azimuth and elevation according to preflight-calculated positions, as a function of time. The rest of the ground-located telemetering gear, consisting of missile telemetering-checkout, data-recording and data-analysis equipment, is housed in a portable van connected to the antenna by a short coaxial cable.

Just how the telemetering system employed during the Corporal missile system development can measure dozens of functions simultaneously, transmit these signals over a hundred miles or more and finally reproduce the original data with accuracies comparable to good-quality laboratory instruments is shown in Fig. 1.

The subcarrier method of making a number of continuous measurements on one carrier is called frequency multiplexing. As shown in Fig. 2. 18 bands with center frequencies ranging from 400 cycles to 70 kc have been standardized for telemetering use.[2] Each nonoverlapping subcarrier channel has a bandwidth of ±7½% of the center frequency with a nominal data-frequency response of 1/10 of the channel bandwidth. Frequently as many as 70 measurements have been made on one 16-band system, by time-multiplexing a number of measurements on one or more subcarrier channels with a 20-segment mechanical commutator rotating at 1 revolution per second. Only data with a relatively slow variance have been handled by this technique but as many as 20 separate measurements have been made on one subcarrier frequency.

The airborne telemetering equipment used for much of the Corporal development program is shown in Fig. 3. The plug-in modules contain circuitry which may be connected together in a number of ways by the "patch-panel" arrangement seen on the front of the large chassis. For instance, it may be necessary to amplify a dc signal of a few millivolts to the 5-volt level necessary to modulate a standard subcarrier oscillator. Thus, two separate modules are connected to make one measurement. The second chassis contains a nickel-cadmium battery pack which is the primary power supply for the airborne telemeter and which contains switching circuits and a dynamotor to supply 28 and 150 volts dc for the transmitter and the subcarrier oscillator plate supplies.

Important design objectives of the airborne telemetering components are:

1. Reliability—The equipment must operate continuously and reliably when subject to the high-level vibration environment and wide temperature variations found in guided missiles.

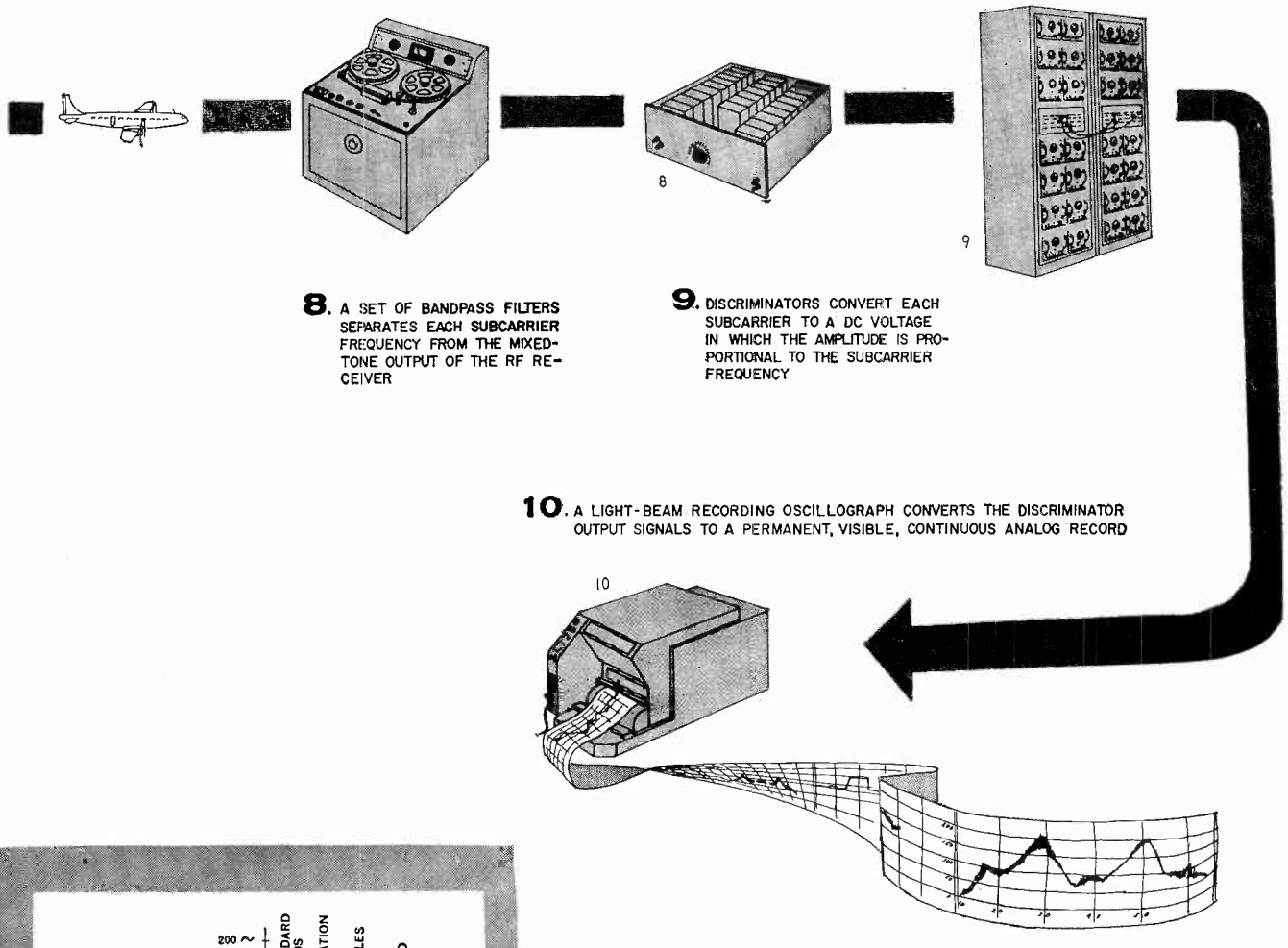
2. Accuracy—Measurements must be made with accuracies which frequently are 2% of full scale or better.

3. Flexibility—The system must be capable of making a large number of measurements of different types, with a minimum of wiring changes or complex adjustments.

4. Small size and weight—It is important that flight equipment be small and light because in a typical missile only a very small space and weight allocation is available for instruments.

[1] This paper presents the results of one phase of research carried out at the Jet Propulsion Laboratory, California Institute of Technology, under Contract No. DA-04-495-Ord 18, sponsored by the Department of the Army, Ordnance Corps.

[2] Bendix Aviation Corp., *The Theory and Application of FM/FM Telemetry*. Bendix Aviation Corp., Pacific Division, North Hollywood, Calif.



8. A SET OF BANDPASS FILTERS SEPARATES EACH SUBCARRIER FREQUENCY FROM THE MIXED-TONE OUTPUT OF THE RF RECEIVER

9. DISCRIMINATORS CONVERT EACH SUBCARRIER TO A DC VOLTAGE IN WHICH THE AMPLITUDE IS PROPORTIONAL TO THE SUBCARRIER FREQUENCY

10. A LIGHT-BEAM RECORDING OSCILLOGRAPH CONVERTS THE DISCRIMINATOR OUTPUT SIGNALS TO A PERMANENT, VISIBLE, CONTINUOUS ANALOG RECORD

Fig. 1—Flow of information, from instruments in the missile to ink records on a continuous graph, and the forms in which the information appears at various points in the flow.

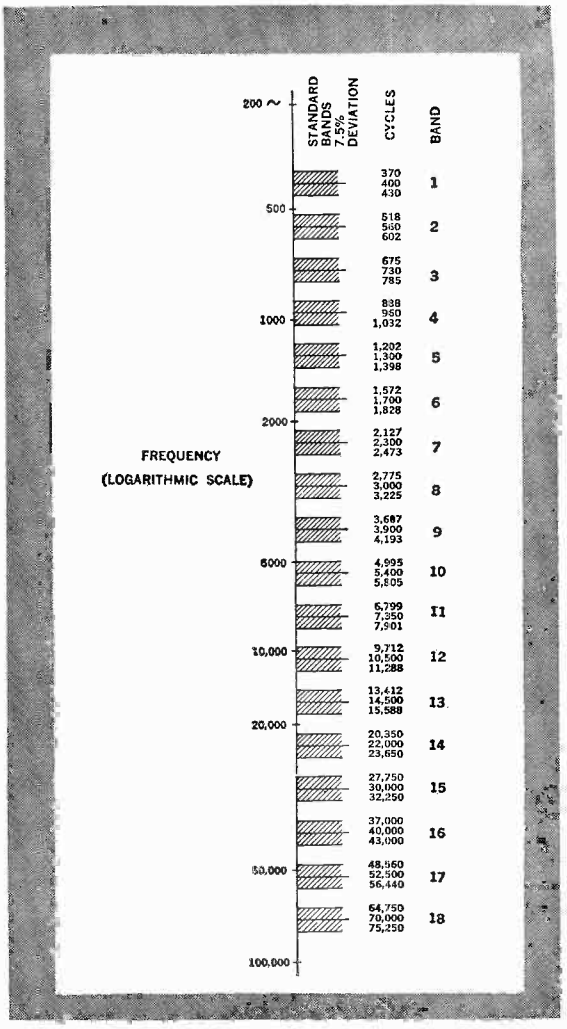
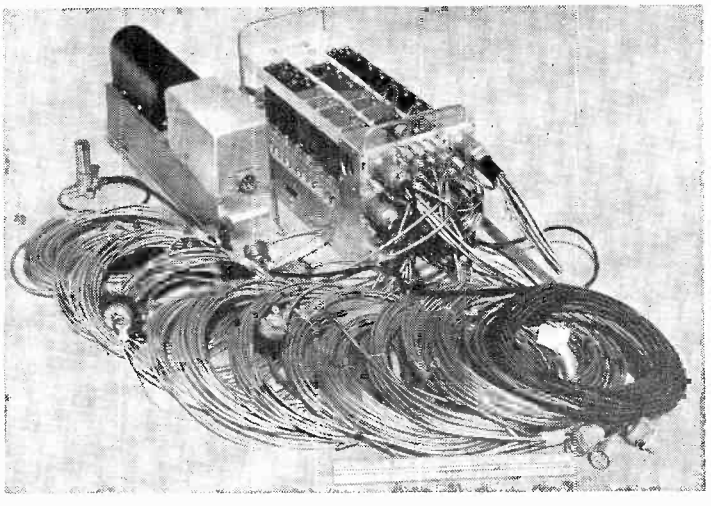


Fig. 2—Telemetering carrier frequencies. Bands are logarithmic so that signal-handling capability and interference rejection are proportional on all. Frequency is in *cycles*.

Fig. 3—Airborne equipment and cabling.



Following the research and development phase of the Corporal, when the missile first began to be used by troops in the field for training purposes, the need arose for a simple, reliable telemetering system capable of making about six measurements. These measurements were selected for monitoring certain key functions which through previous experience were found to be the most valuable in assessing missile performance. In the design of this system even greater emphasis was placed on reliability. All audio circuits used transistors in place of the more conventional vacuum tubes.

The packaging techniques raised the mechanical resonant frequency of electronic component mountings and supports to several thousand cycles per second or higher so that even when vibration excitation forces of up to 15 times the force of gravity over a frequency range of 20 to 2,000 cycles were applied for long periods of testing time during the development program, the motion of leads, wiring and supports due to amplification at mechanical resonance did not cause components to fail or parts to break loose.

To show the necessity of designing packaging to have as high a mechanical resonance frequency as possible, the peak-to-peak displacement of an object subjected to 15-g peak sinusoidal forces is about .0003 inch at 2,000 cycles. At 100 cycles when subjected to the same force, the peak-to-peak motion is about .03 inch, or 100 times greater. Movement of this amplitude may very easily exceed the elastic limit of a support, material or component lead and result in an operational failure. The rugged appearance of this unit may be noted in Fig. 4.

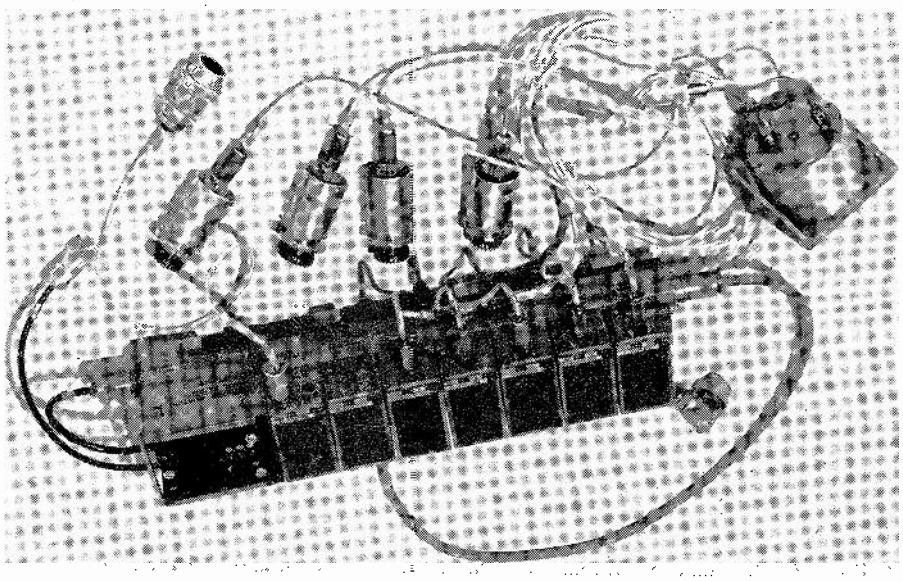


Fig. 4—This equipment is designed to withstand shocks and vibration that would wreck ordinary "ruggedized" apparatus almost immediately.

The successful development of the Corporal has in large measure been dependent on continual improvements in telemetering techniques and equipment. The use of transistors and continual circuit improvements have greatly improved the reliability of both airborne and ground components, bringing the state of the art one step closer to the ultimate objective, an instrumentation system with an infinite life and perfect reliability. END

INDUSTRIAL ELECTRONIC QUIZ

By ED BUKSTEIN*

THE following quiz is designed to test your knowledge of industrial electronic techniques and instruments. A score of 18 or more correct is *excellent* and indicates a close acquaintance with current practice. A score of 15 to 18 correct is *good*, 12 to 15 correct *fair*, less than 12 correct *poor*.

1. The photoelectric pyrometer is used to: a, sound an alarm in case of fire; b, measure temperature; c, detect metal particles in packaged foods; d, detonate explosive rivets.

2. The cathode of an ignitron is made of: a, carbon; b, graphite; c, liquid mercury; d, tungsten.

3. A radiograph is: a, a curve showing the field-strength pattern of an industrial oscillator; b, a motor-driven pen which writes on a moving strip of paper; c, an X-ray picture; d, an instrument to measure attenuation in a waveguide.

4. Dielectric heating is commonly used to: a, surface-harden metal parts; b, solder lids on metal containers; c, spot-weld sheet aluminum; d, heat plastics.

5. Induction heating is commonly used to: a, detect flaws in metal castings; b, cure sponge rubber; c, check temperature coefficient of carbon resistors; d, surface-harden metal parts.

6. Hard X-rays are: a, higher in frequency than soft X-rays; b, longer in wavelength than soft X-rays; c, less penetrating than soft X-rays; d, not used because they endanger health.

7. A phase-controlled rectifier uses which of the following tubes: a, thyratron; b, pliotron; c, phasitron; d, pentode.

8. A dynode is: a, an instrument used to measure extremely small values of current; b, a tube used to measure pressure in vacuum systems; c, one of the electrodes in a photomultiplier tube; d, an electronic navigational device used in aircraft.

9. The scintillation counter is: a, used to detect radioactivity; b, often used to detect flaws in metal castings; c, a circuit used to remove dust particles from the air; d, another name for the binary scaler.

10. Ultra-violet rays are: a, longer in wavelength than visible light; b, shorter in wavelength than visible light; c, lower in frequency than infrared rays; d, lower in frequency than visible light.

11. An electronic device used to remove particles of dust and smoke from the air is: a, an electrostatic precipitator; b, an induction heater; c, a photoelectric pyrometer; d, a dynode.

12. Register control is used to: a, weld sheet aluminum; b, detect flaws in metal castings; c, cure sponge rubber; d, assure alignment of the successive colors laid down in multicolor printing.

13. Metal parts are commonly surface-hardened with an: a, induction heater; b, electrostatic precipitator; c, electrometer; d, ion gauge.

14. The back-to-back circuit is often used in: a, Geiger counters, b, precipitators; c, resistance welding equipment; d, register controls.

15. An intensifying screen is used in conjunction with: a, the photoelectric pyrometer; b, X-ray apparatus; c, grid-controlled rectifiers; d, dielectric heating equipment.

16. A scaler composed of five cascaded flip-flop circuits will reduce the input frequency by a factor of: a, 1/32; b, 1/5; c, 1/10; d, 1/16.

17. Another name for flip-flop circuit is: a, one-shot multivibrator; b, ignitron; c, electrometer; d, binary scaler.

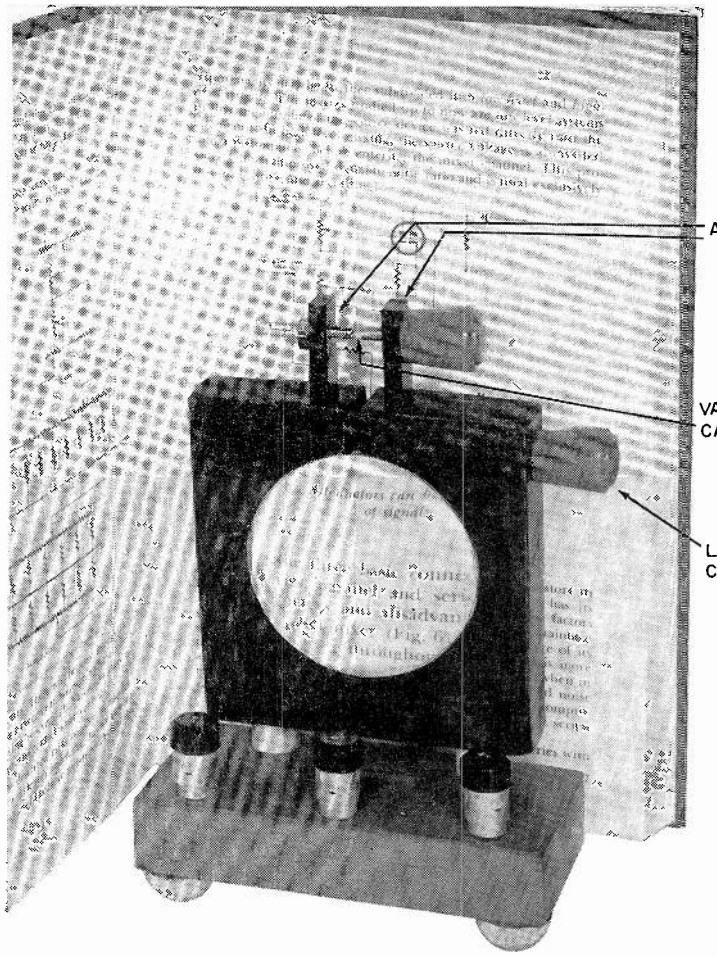
18. Electrostatic precipitation is not suitable for which of the following: a, removal of airborne bacteria; b, smoke and dust control; c, guiding paint sprays; d, welding metals.

19. The stroboscope is an instrument used to: a, detect radioactivity; b, study vibration in moving machinery; c, measure pressure of gases; d, align high-frequency radio receivers.

20. Extremely small values of current can be measured with an: a, ultrasonic generator; b, intensifying screen; c, electrometer; d, echo box. END

(*See page 97 for answers*)

*Northwestern Vocational Institute, St. Paul, Minn.



Lumistron assembly complete with microwave antenna and lens compressor which makes a homogenous lens for the three sections.

the LUMISTRON, electronoptics' new sensation

By MOHAMMED ULYSSES FIPS, I R E*

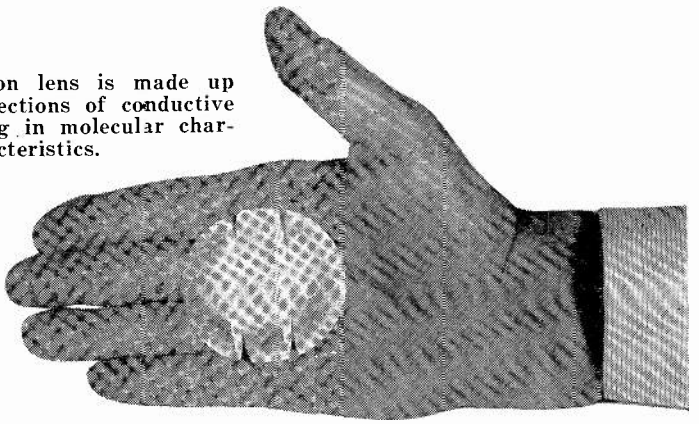
I was daydreaming pleasantly in my office, reviewing all my former accomplishments, from the famed Westingmouse Vest-Pocket Receiver in 1933 to last year's Wireless Radio Iron, when the harsh and vile sound of that detested buzzer brought me to my feet and quickly into the Big Boss' sanctum.

I saw at once from the elevated angle of his 7-inch Havana cigar that he was on the warpath. "Fips," the great man bellowed, "do your realize that we all have been asleep at the electronic switch since 1873, when the illustrious James Clerk Maxwell published his great treatise *Electricity and Magnetism*, in which he lumped electricity, magnetism and light into a single force? Long ago we knew that radio waves and light waves are in the identical spectrum, one merging into the other—but what have the engineers done about this? Nothing. Absolutely nothing! Don't you know that with today's electronic progress we should be able to *see* radio waves all about us? Look at the thousands of fantastic and useful inventions this new electronoptics science should give the world! And here we sit and dream about nonsense when the most revolutionary new field of electronics is completely unexplored!

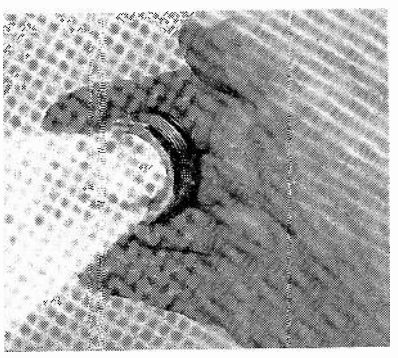
"So, Fips, hop to it. Show your readers what we can do to get them out of the old stagnant groove. *And I want action—fast!* I'll give you 60 days to come up with a electronoptical model *that works*. This is an order!"

★ ★ ★ ★

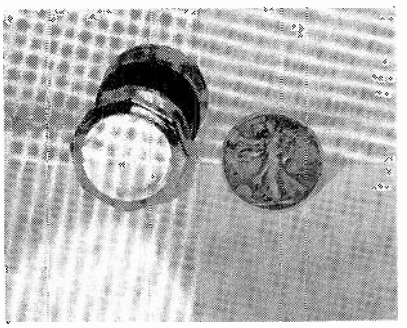
This was a tough command—the worst the Big Boss had ever thrown me. Yet I am glad he sparked me into it—it was *very* worth while.



The Lumistron lens is made up from three sections of conductive glass differing in molecular characteristics.



Miniature Lumistron for night light and other illumination uses.



The radio Lumistron, which not only emits light but radio programs as well.

In retrospect, let us review the known facts of the high-super-frequency radio waves. We all know that at the upper end of the radio spectrum we have the ultra-high-frequency (uhf) spectrum ranging from 300 to 3,000 million cycles per second and the super-high-frequency (shf) waves beyond that. Then

* Institute Radio Electronoptics.

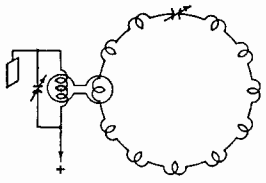


Fig. 1—Super-high-frequency transmitter consists of special Tesla coil working from tank of uhf transmitter.

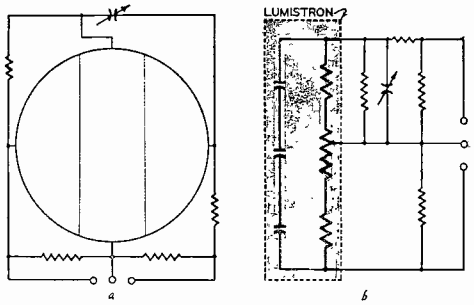


Fig. 2-a—Schematic of the transistor-like Lumistron. 2-b—Equivalent circuit.

come the millimeter waves from 100,000 to 1,000,000 million cycles. At this point the radio waves merge into the light spectrum, first into the quasi-infra-red of 1,000,000 to 10,000,000 million cycles, then into infra-red, radiant heat, finally into *visible light* at a frequency of 400,000,000 to 800,000,000 million cycles.

I started my experiments by rigging up one of my most efficient amateur transmitters, to which I coupled a Tesla type stepup transformer which gave me the needed better-than-millimeter waves. (See Fig. 1.) The Tesla coil produces a *train* of oscillations for each half-cycle of the shf transmitter output. My only trouble was to get enough inductance into the Tesla coil to give me a voltage stepup without acting as a choke of the shf signal. I solved that by winding the coil in sections—each resonant to the transmitter frequency—separated by delay lines, so each section is in phase with each other.

Now came the most ticklish as well as crucial point. What does one use for a detector of not only quasi-radio waves but light waves as well? In other words, a detector that not only receives radio waves but *converts, i.e. rectifies, the radio waves into light waves too.* This was like detecting radio waves in the old days with a crystal detector and rectifying them into sound waves.

I experimented with gases, with liquids and with hundreds of substances. Nothing worked.

Finally one quiet night I got it! I of course knew of the use of *conductive glass* in a number of industries. * This glass is a sort of *semiconductor*. A panel of it equipped with electrodes at both ends will heat rapidly and give off radiant heat when a suitable current is connected to the metal end pieces.

What I was after was a *Glass-Transistor*. But it took weeks to make one that had the right properties. I had to make many batches of special glass to which a certain percentage of selected metals had to be added to give the glass the required properties. I was much encouraged with silicon and molybdenum glass, but the final and best working transistor has a special mixture of metals which for patent reasons cannot be divulged here. I can, however, describe the physical makeup of the new and revolutionary electronoptical transistor for my readers.

It is in the form of an ordinary optical glass lens, but there are three separate pieces. (See illustration.) The center rectangular section has different conducting properties than the two semicircular side sections. The junction edges are all highly polished. The lens is now placed in a special plastic frame and the compression screw is tightened.

Here it should be noted that the compression is critical—too much or too little makes the transistor inoperable. Also, once compressed, the lens is almost perfect—unless you inspect it closely you won't see the separate pieces. Optically, it works the same as any good lens.

At the top of the plastic frame we have the "tuner." At the exceedingly high quasi-radio frequency the tuning becomes very simple. One of the tiny antennas is equipped with an insulating handle which can be screwed in or out a small fraction of an inch. The ends of the ⅛-inch thick antennas are squared and well polished. Bringing the ends close together gives you both capacitance and necessary inductance. Once adjusted to the correct frequency, the receiver operates properly and keeps operating as long as the transmitter—which can be located in another room—functions.

Well, you may ask impatiently, *what* happens at the receiver? You probably have already guessed it—IT LIGHTS UP! If close to the transmitter, the lens lights up brilliantly—without the use of a battery. Here it parallels the old crystal detector which merely converted the high-frequency radio energy collected on the aerial and rectified it into sound through the earphones.

The electronoptic transistor works in the same manner—it transforms radio waves into light waves at an exceptionally high efficiency. For powerful signals, no external batteries or other power is needed. It works as a passive power receiver (see Dr. Hollmann's article on page 85 of this issue, and Dr. Grace's article "Transistor Radio Uses No Power Supply" on page 96 of the April, 1955, issue of RADIO-ELECTRONICS). If the transmitter is at a distance, say, of 20 miles (it can't be below the Earth's horizon) external batteries are helpful. Two 1.3-volt cells (or the less compact 1.5-volt flashlight cells) are quite sufficient.

The diagram appears in Fig. 2. Since it may be incomprehensible to anyone who does not fully realize the part played by the transistorlike action of the three-section lens, I have added an equivalent circuit which, I am sure, will make its action quite clear to all advanced experimenters in the extremely high-frequency semiconductor art.

I have named the new electronoptical receiver the *Lumistron*, and before long millions will be in use. Particularly the vest-pocket type illustrated here. What use will they have? As pocket flashlights that have neither battery nor incandescent bulb and cost nothing to operate if there is a powerful shf transmitter in the vicinity.

The Lumistron has no switch—it works all the time. As it gives off no heat, you can keep it in your pocket. Thus you always have a light with you. The Lumistron makes a perfect night light, too.

Of course, the Lumistron is only a simple item in a long list of practical applications of the new principle. *It will, for instance, revolutionize television.* A single special glass panel with few additional components located in the frame will soon bring you scanless, picture-tubeless TV at low cost. With electronoptics you will no longer need bulky cathode-ray tubes nor high-tension transformers.

Thousands of other new uses will be found for this revolutionary invention.

★ ★ ★ ★

On the 56th day, I proudly took my first working model of the Lumistron to the Boss and put it through its paces. He seemed much interested at first but after a while he started to chew his cigar furiously. "Dammit, Fips," he sneered, "what good is this fool gadget? Who will buy it and what station would be crazy enough to broadcast free energy to power all those Lumistrons for nothing?"

I had been waiting for this opportunity for years, so I let him have it.

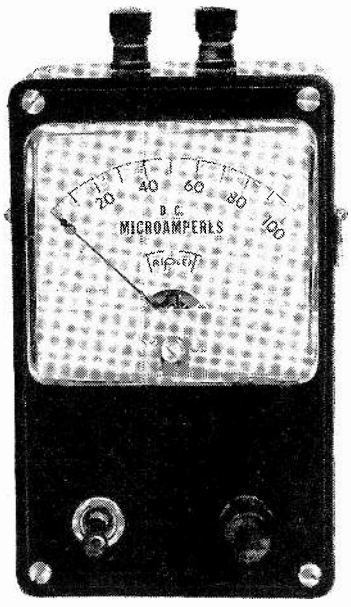
"Illustrious imbecile," I snarled, as I pulled out another Lumistron from my pocket and held it up to him, "you fancy yourself as the only great mind in the world but, my dear lamebrain, concede once and for all that your low-born hired help knows a few electronic facts, too. You note that *this* model Lumistron talks quite well, too, in addition to its undiminished luminosity. This I accomplish by modulating the light output with a photoelectric transistor when it is tuned to a powerful super-high-frequency (shf) broadcast transmitter. However, to get square with your many years of mistreatment, I won't give you the details of its construction. Good-bye, electronickel pinching boss, get yourself a new boy!"

As I left the room I smiled as the Lumistron sang out loudly in a clear laughing voice: "This is

APRIL 1"

* This is manufactured by Libby-Owens-Ford Glass Co., Toledo, Ohio.

Instrument in use measuring moisture content.



Front view of the moisture meter.

Portable Moisture Meter

Checks moisture content of soil or other material by measuring its ac conductance

By HENRY FRANCIS PARKS*

MOISTURE is defined by the dictionary as: 1. slight, sensible wetness; 2. a small amount of liquid exuding from, diffused through or resting on a substance; 3. dampness. The measurement of this wetness or dampness, its presence or absence or its quantity may directly or indirectly concern us.

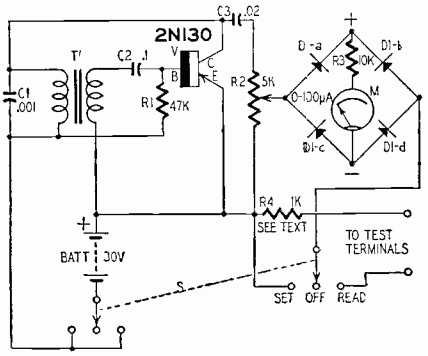
Manufacturers of dehydrated foods, face powders, gypsum, cement, etc. are mainly interested in greatly reducing moisture in their products; makers of concrete mixes, tobacco processors, horticulturists and farmers are concerned with its presence in controlled amounts; laboratories are interested in all conditions of moisture. All are interested in its measurement. This article describes a simple meter for measuring moisture with reasonable accuracy and reading directly the percentage of moisture.

When extreme qualitative measurement of moisture is desired, the analyst first carefully weighs a completely saturated sample of the material; the sample is thoroughly dried and again weighed. The weight difference provides the basic standard for this particular material. If the original material, completely saturated, weighed 8 ounces and after complete drying weighed 6 ounces, the moisture obviously weighed the difference between the two, or 2 ounces—the standard range for this material.

Next, samples of varying degrees of wetness are weighed. For example, suppose one weighed 7½ ounces. This weight (7½ ounces) less the net, completely dried weight (6 ounces) is a difference of 1½ ounces, representing the actual weight of the moisture content. Then, 1.5 (the difference weight of the sample) divided by 2.0 (the difference weight of the standard) equals 75%—the actual percentage of moisture in the second sample. This is the most accurate method of moisture measurement.

There are many instances, such as in farming, when such extremely accurate measurements are not necessary. In such cases, some sort of a direct-reading meter capable of giving the moisture percentage within a tolerance of a few percent will suffice.

Several electronic methods of measuring moisture content are available but the most practical is that using resistance measurement between two electrodes, held a predetermined distance apart, in a sensing probe, the probe being inserted into the material. Also, two types of resistance measurement are possible. One uses direct current with the inherent problems of line-voltage drop and a high susceptibility to temperature variations; the other employs alternating-current conductance of a circuit (the current is rectified and the result read either in milliamperes or microamperes, according to the design). Since I equals $\frac{E}{Z}$ after balance in a Wheatstone bridge circuit, a resultant of Z and conductance may be read out directly in terms of the percentage of moisture on a suitable meter dial scale. Since alternating-current Z is less susceptible to temperature changes than direct-current R, the second method is more desirable.



R1—47,000 ohms, ½ watt
R2—5,000-ohm potentiometer
R3—10,000 ohms, ½ watt
R4—1,000 ohms, ½ watt (see text)
C1—.001 μf
C2—0.1 μf
C3—.02 μf
V—2N130 transistor
T—interstage transformer, 1:3, primary impedance 10,000 ohms, secondary 90,000 ohms (UTC SSO-2 or equivalent)
S—dpdt switch with center-off position
BATT—30-volt hearing-aid battery (Burgess U-15 or equivalent)
D1—Bridge type instrument rectifier
M—microammeter, 0–100 (Triplett model 327-PL or equivalent)
Binding posts (2)
Meter case or box approximately 2 x 3 x 6 inches

Fig. 1—Schematic of the moisture meter.

Temperature does affect both, however. Moisture is always tied in with temperature. All experiments on this project were made at 70°F. For the practical purposes for which this meter was designed, it will operate from 40° to 140°F.

So, this Moisturometer (Fig. 1) employs the ac-conductance–Wheatstone-bridge principle. The circuitry is simple, consisting of an oscillator generating an ac signal of 1,000 cycles and an amplifier, both of which functions are combined in the Raytheon 2N130 p-n-p transistor stage. The rate of oscillation is controlled by the R-C combination of R1 and C2. R1 may have to be changed to a slightly lower value if the frequency is not high enough. This is also true of R4. These three components are discussed later.

(*Continued on page* 76)

* Henry Francis Parks Laboratory, Redwood City, Calif.

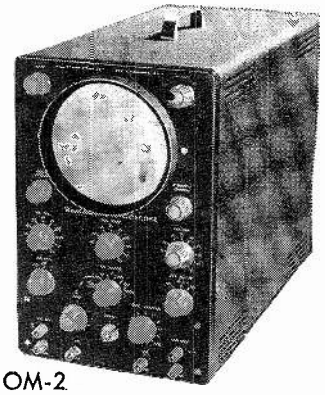
GREATEST SELECTION . . .

Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New **HEATHKIT ETCHED CIRCUIT**

5" Oscilloscope Kit

- *Brand new model with improved performance specifications.*
- *Full 5" scope for service work at a remarkably low price.*
- *Attractively styled front panel in charcoal gray with sharp white lettering.*
- *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*



This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.

MODEL OM-2

$42.50

Shpg. Wt. 21 Lbs.

HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

$3.50

Shpg. Wt. 1 Lb.

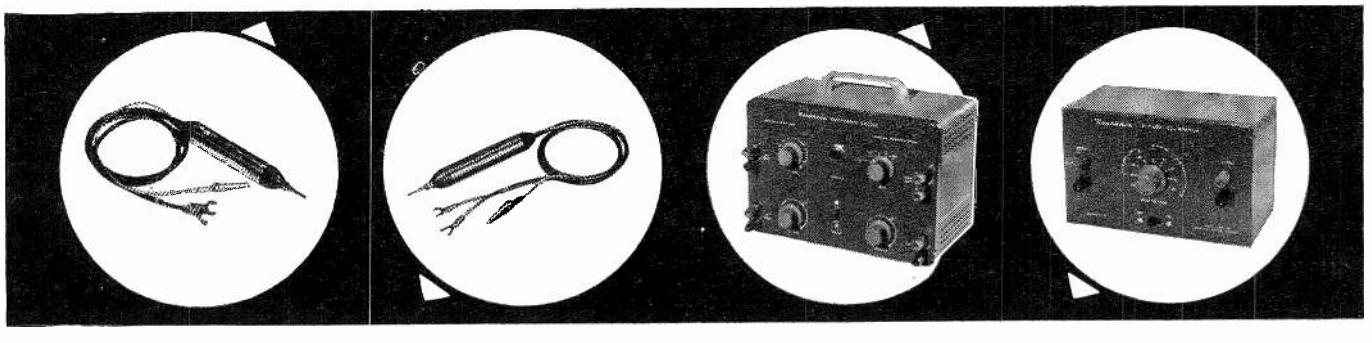
HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

$21.95

Shpg. Wt. 8 Lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

$12.50

Shpg. Wt. 4 Lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE

$24.50

Shpg. Wt. 7 Lbs.

- *Easy to build — a pleasure to use.*
- *1% precision resistors employed for high accuracy.*
- *Etched circuit board cuts assembly time in half.*

Voltmeter Kit

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1

$29.50

Shpg. Wt. 6 Lbs.

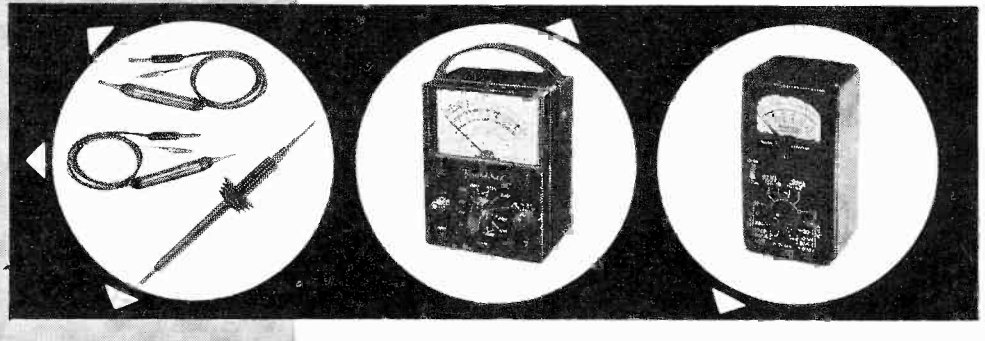
ETCHED CIRCUIT PEAK-TO-PEAK PROBE KIT

Use this peak-to-peak probe with your 11-megohm VTVM to measure peak-to-peak voltages directly on the DC scales of the instrument. Will measure p-to-p voltages in the frequency range of 5 kc to 5 mc. Employs etched circuit boards for increased circuit stability and simplified construction. Extend the usefulness of your VTVM. NOTE: Not required for the Heathkit V-7A VTVM.

NO. 338-C

$5.50

Shpg. Wt. 2 Lbs.



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336

$4.50

Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1

$14.50

Shpg. Wt. 3 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 20, MICH.

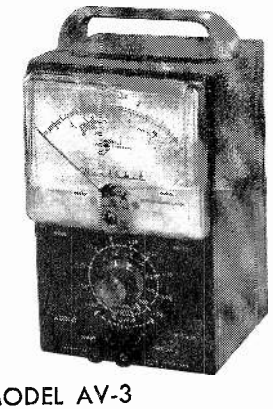
CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

* *Brand new circuit for extended frequency response and added stability.*
* *Ten accurate ranges from 0-.01 to 0-300 volts.*
* *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*



This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3
$29.95
Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

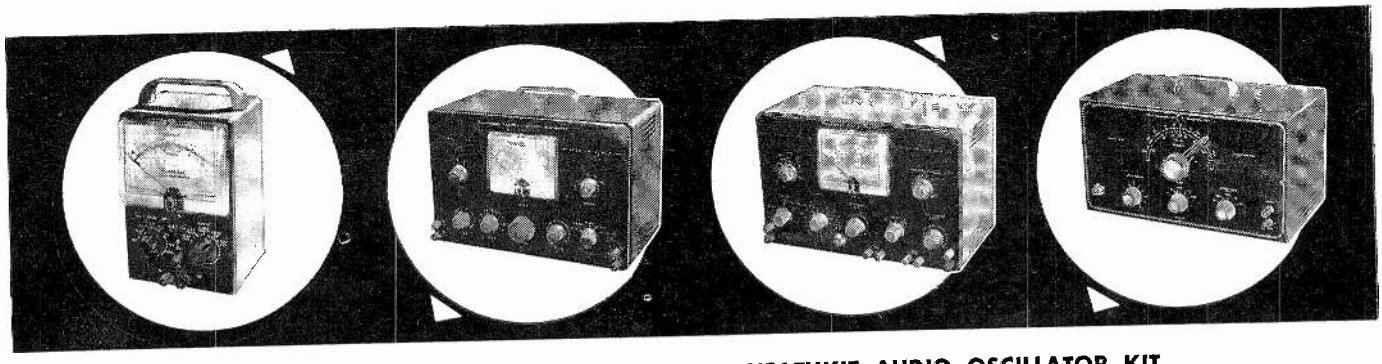
This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1
$29.50
Shpg. Wt. 6 Lbs.

HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1
$49.95
Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1
$49.50
Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

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

HEATHKIT

Audio Generator Kit

MODEL AG-9

$34.50

Shpg. Wt. 8 Lbs.

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

- *Less than 0.1% distortion — ideal for hi fi work.*
- *Large 4½" meter indicates output.*
- *Step-type tuning for maximum convenience.*

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

$29.50

Shpg. Wt. 11 Lbs.

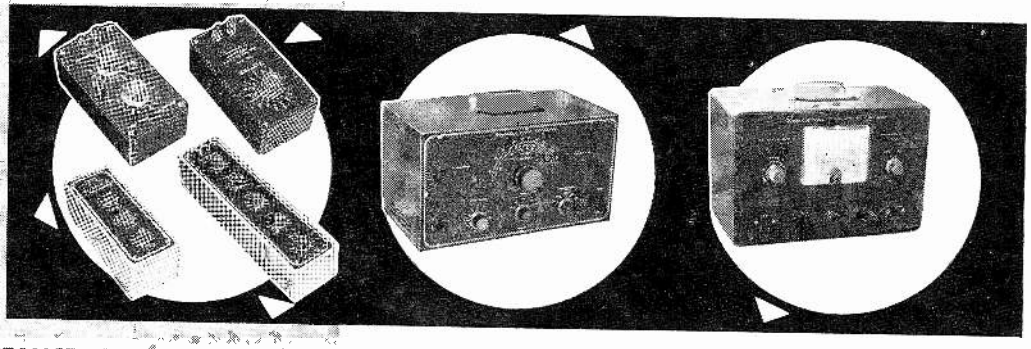
HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

$16.50

Shpg. Wt. 3 Lbs.



HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

$35.50

Shpg. Wt. 17 Lbs.

HEATH COMPANY

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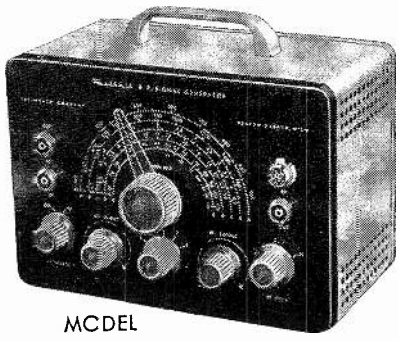
BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

* *No calibration required with pre-aligned coils.*
* *Modulated or unmodulated RF output.*
* *110 mc to 220 mc frequency coverage.*



MODEL SG-8

$19.50 Shpg. Wt. 8 Lbs.

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1

$48.95

Shpg. Wt. 16 Lbs.

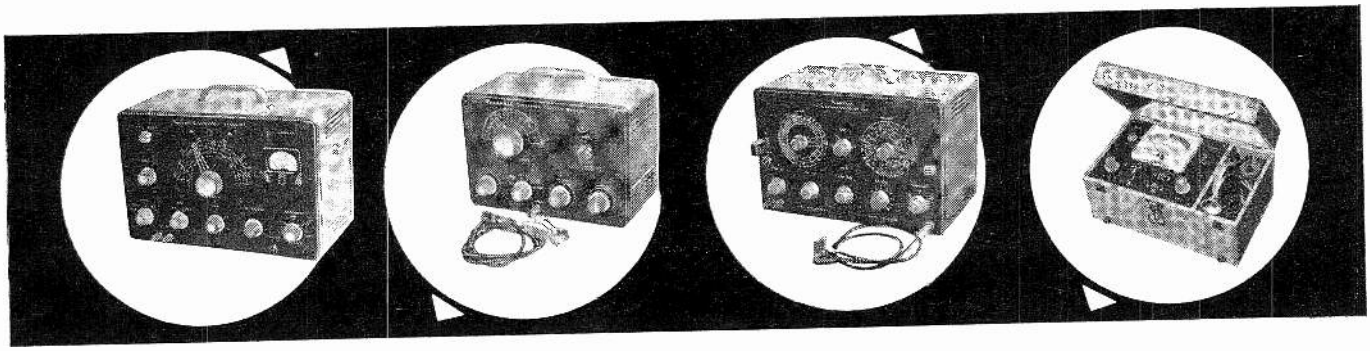
HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A

$49.50

Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2

$22.50

Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

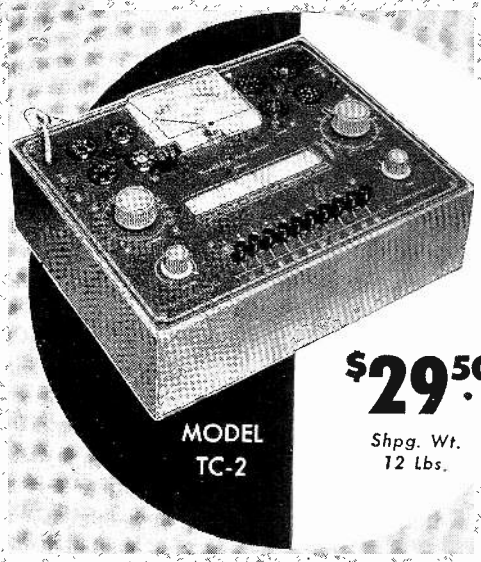
This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1

$22.50

Shpg. Wt. 10 Lbs.

HEATHKIT



MODEL TC-2

$29.50

Shpg. Wt. 12 Lbs.

Tube Checker Kit

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

- *Attractive counter-style cabinet.*
- *Wiring-harness simplifies assembly.*
- *Large 4½" meter with two-color "good-bad" scale.*
- *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

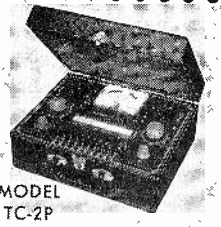
Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT



This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P

$34.50 Shpg. Wt. 15 Lbs.

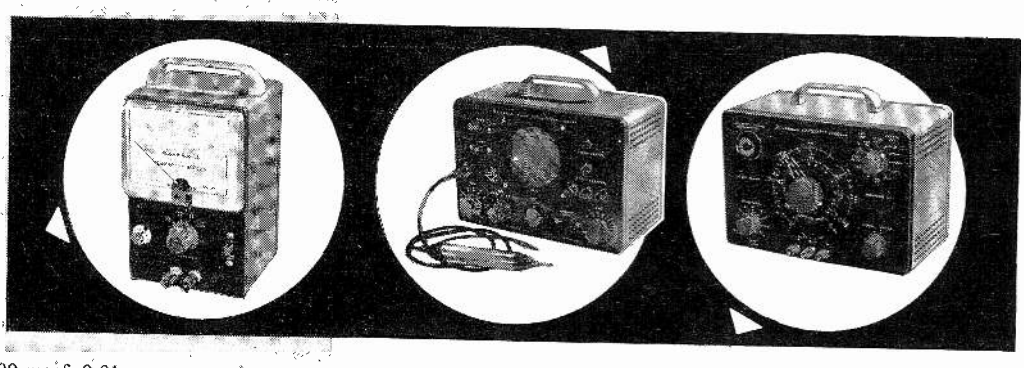
HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.



HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 20, MICH.

PIONEER DESIGN . . .

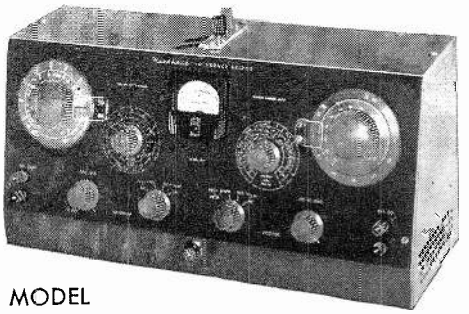
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on *kit* projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- ½% *precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.



MODEL IB-2

$59.50 *Shpg. Wt. 12 Lbs.*

HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "Q" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

$44.50

Shpg. Wt. 14 Lbs.

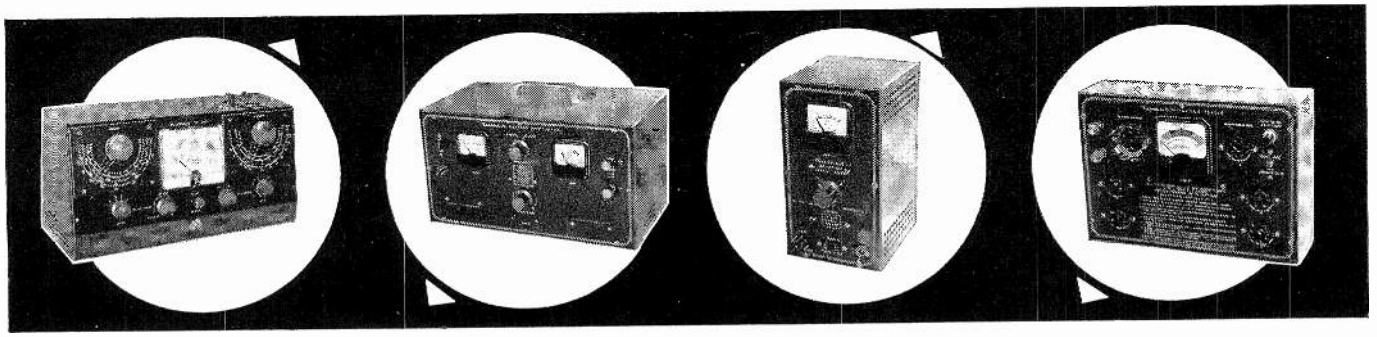
HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

$16.50

Shpg. Wt. 9 Lbs.



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

$31.50

Shpg. Wt. 17 Lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

$14.50

Shpg. Wt. 6 Lbs.

HEATHKIT DX-100 PHONE AND CW

MODEL DX-100
Shpg. Wt. 107 Lbs.

$189.50*

Shipped motor freight unless otherwise specified. $50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jack—and automatic gain control. Has built-in BFO for CW reception.

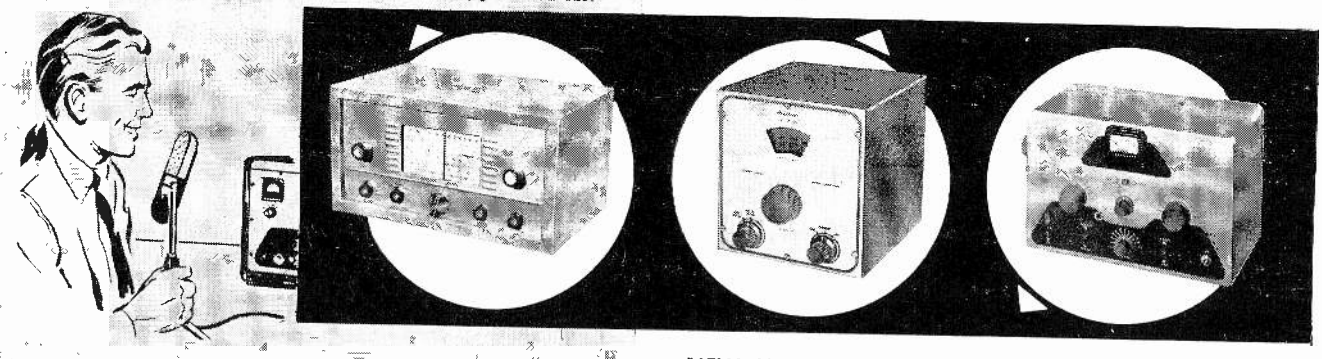
MODEL AR-3
$29.95*
INCLUDING NEW EXCISE TAX
(Less Cabinet)
Shpg. Wt. 12 Lbs.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

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



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

NEW HEATHKIT CW TRANSMITTER KIT

The brand new Heathkit Model DX-20 Transmitter is one of the most efficient little rigs available today. Featuring an entirely new circuit, it is ideal for the novice, and even for the advanced-class CW operator. A 6DQ6A final amplifier provides plate power input of 50 watts. A 6CL6 oscillator is employed, and a 5U4GB rectifier. The transmitter features one-knob bandswitching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit matches antenna impedances between 50 and 1000 ohms. Front panel controls are functionally located for your convenience. If you appreciate a good signal on the CW bands, this is the transmitter for you!

MODEL DX-20
$35.95*
Shpg. Wt. 18 lbs.

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

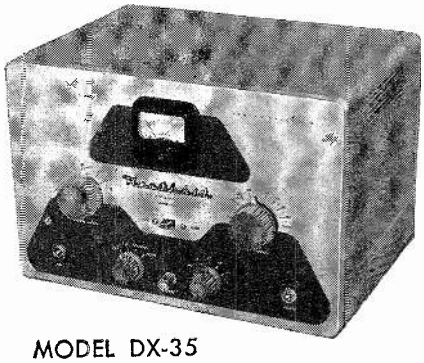
DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*



MODEL DX-35

$56.95 Shpg. Wt. 24 Lbs.

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off–CW–stand-by–phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

$14.50

Shpg. Wt. 2 Lbs.

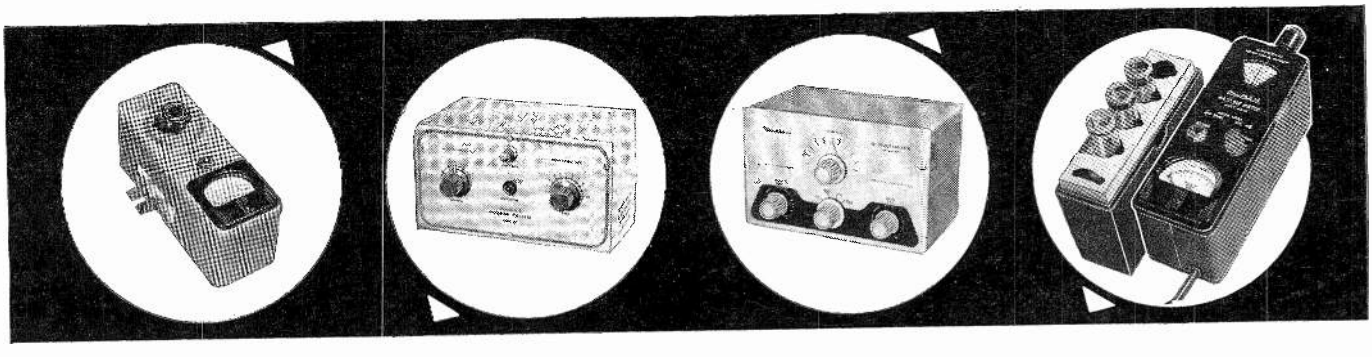
HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95

Shpg. Wt. 3 Lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50

Shpg. Wt. 4 Lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GD-1B

$19.95

Shpg. Wt. 4 Lbs.

HEATHKIT BROADCAST BAND

Receiver Kit

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$18.95
INCLUDING NEW EXCISE TAX‡

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- ✻ *Miniature tubes and high-gain IF transformer.*
- ✻ *Rod-type built-in antenna. Good sensitivity and selectivity.*
- ✻ *5½-inch PM speaker.*
- ✻ *Provision for phono jack.*
- ✻ *Transformer - operated power supply.*

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....$4.95‡

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

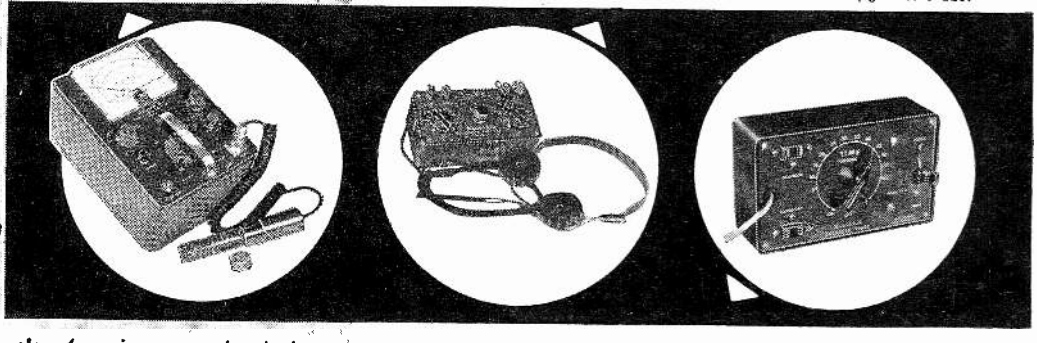
This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$7.95
INCLUDING NEW EXCISE TAX‡
Shpg. Wt. 3 Lbs.



- ✻ *Amazing new circuit for high efficiency.*
- ✻ *Compact, portable and rugged.*
- ✻ *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

HEATH COMPANY
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BENTON HARBOR 20, MICH.

COMPREHENSIVE INSTRUCTIONS . . .

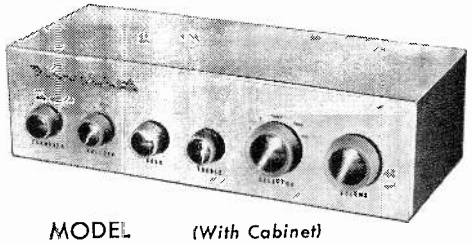
The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.



MODEL WA-P2 (With Cabinet) Shpg. Wt. 7 Lbs.

$19.75

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

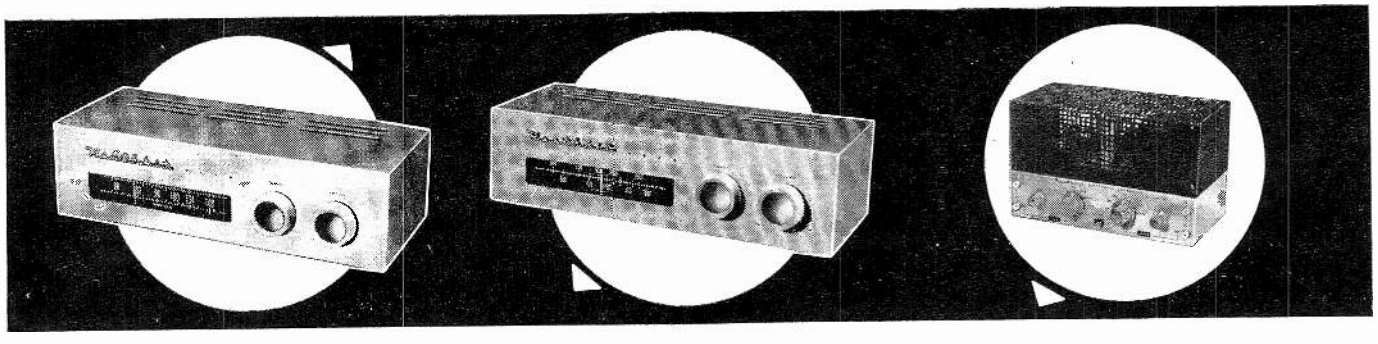
MODEL FM-3A

$25.95

INCLUDING NEW EXCISE TAX

(With Cabinet)

Shpg. Wt. 7 Lbs.



HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1

$25.95

INCLUDING NEW EXCISE TAX

(With Cabinet)

Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 3,500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1

$18.95

Shpg. Wt. 6 Lbs.

HEATHKIT ADVANCED-DESIGN

MODEL W-5M
Shpg. Wt. 31 Lbs.
Express Only

$59.75

MODEL W-5

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $79.50

* *Full 25 watt output with KT-66 output tubes.*
* *All connectors brought out to front chassis apron.*
* *Protective cover over all above-chassis components.*

HIGH FIDELITY

Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and 1M distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± .1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only..... $49.75

MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only..... $69.50

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only..... $39.75

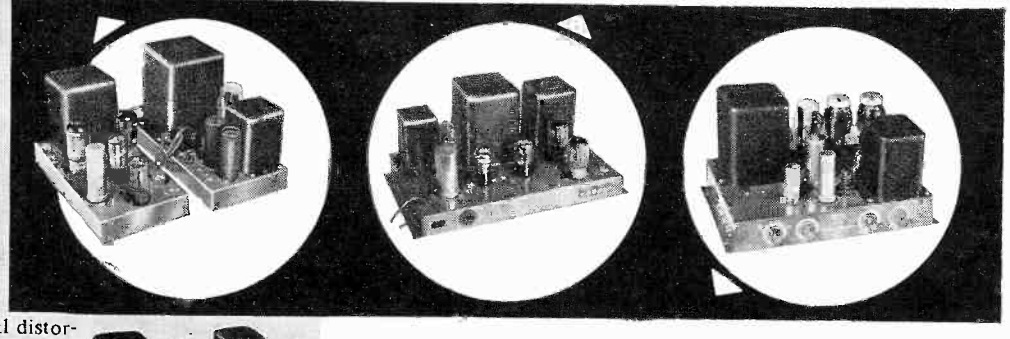
MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only..... $59.50

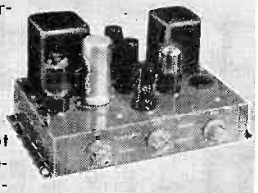
HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. *Shpg. Wt. 10 Lbs.*

MODEL A-7D
$17.95*
INCLUDING NEW EXCISE TAX

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. **$19.95‡**





HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

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

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

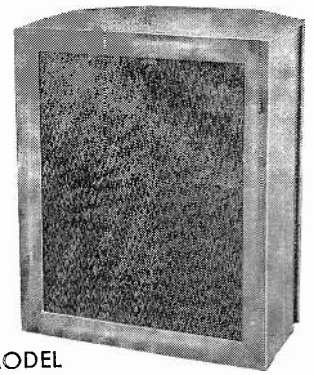
All prices marked with a ‡ include a new federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending
SPEAKER SYSTEM KIT

- *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
- *Easy-to-assemble cabinet of furniture-grade plywood.*
- *Attractively styled to fit into any living room. Matches Model SS-1.*



MODEL SS-1B

$99.95

Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**

MODEL SS-1

$39.95

Shpg. Wt. 30 Lbs.

- *Special design ducted-port, bass-reflex enclosure.*
- *Two separate speakers for high and low frequencies.*
- *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

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

ORDER BLANK

NOTE: All prices subject to change without notice.

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Please ship C.O.D. ( ) postage enclosed for_____pounds.

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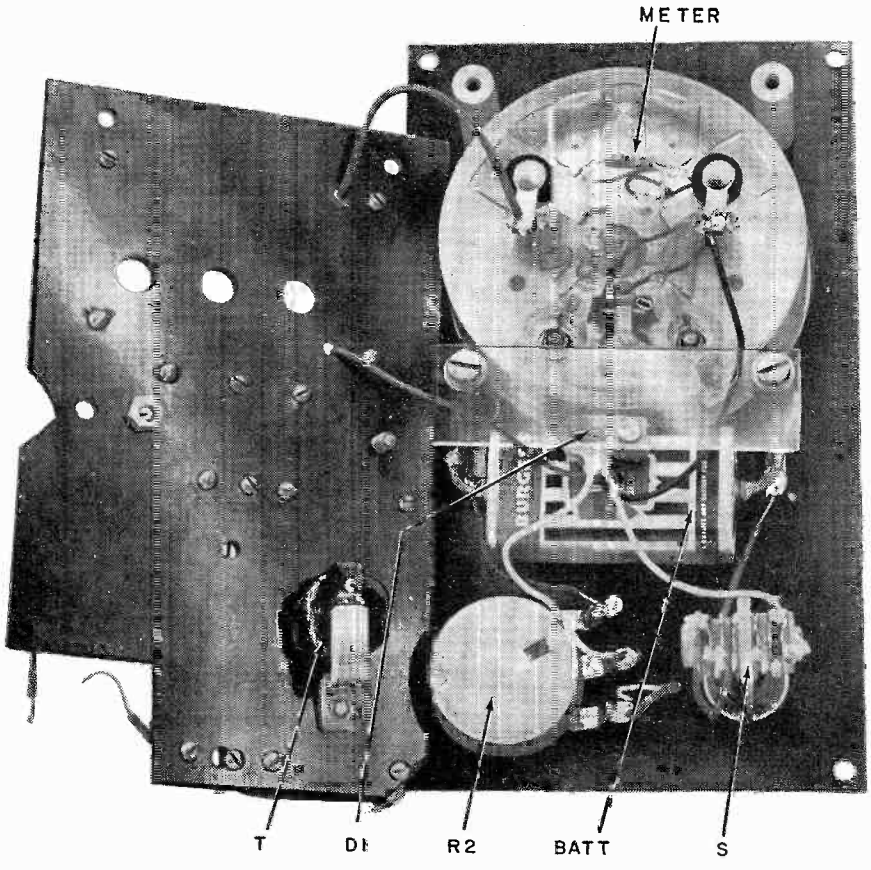
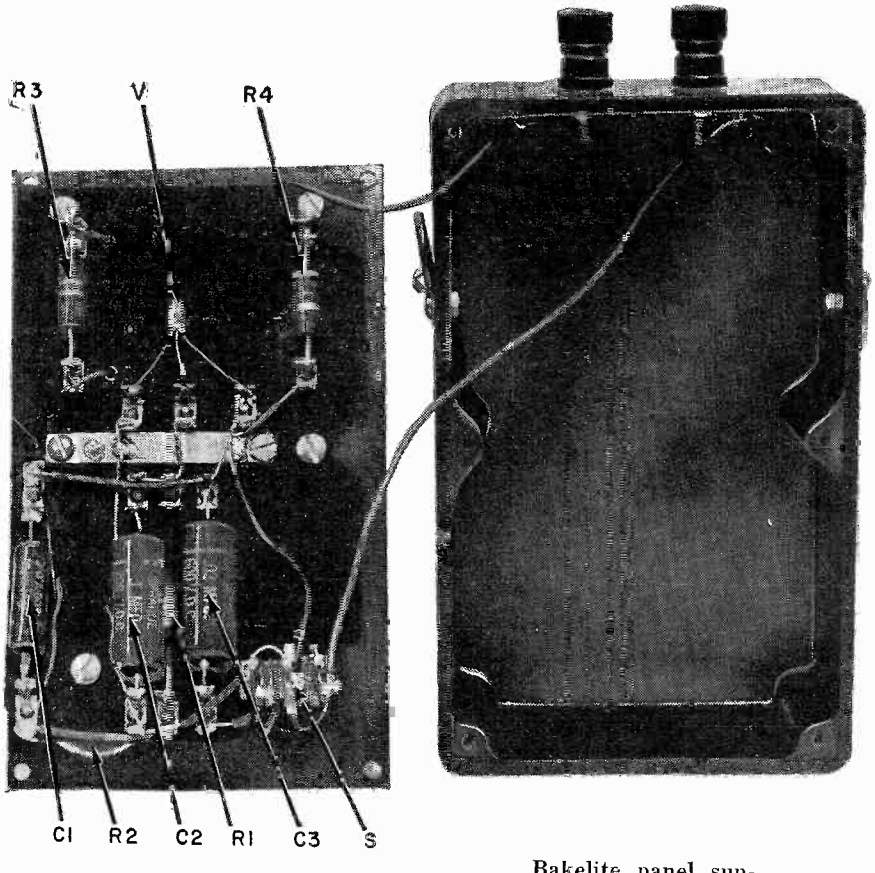
QUANTITY	ITEM	MODEL NO.	PRICE



Layout of the major components.



Bakelite panel supports circuit wiring.

(*Continued from page 61*)

Feedback to produce oscillation is provided by T. C1 in parallel with the primary winding of T blocks the flow of dc to the collector of the transistor but permits the 1,000-cycle ac signal to pass through.

The output of this oscillator–amplifier transistor is capacitively coupled through C3 to potentiometer R2 which provides a constant load across the collector and emitter output of the transistor.

The movable arm of the potentiometer passes the ac signal to the bridge rectifier where it is rectified and fed, in series with current-limiting resistor R3, to the 0–100 microammeter.

This portion of the circuit forms one arm of the Wheatstone bridge. The other, brought into the circuit by throwing the switch to READ, includes, in series, compensating resistor R4 and the sensing-probe load whose resistance in terms of moisture percentage is to be read.

Construction

The instrument was built in a bakelite meter box. When cutting holes in this material, especially when using an expansion drill, operate at very slow speeds and use a hand vise to hold the work. For the potentiometer and switch holes, drill through at ¼ inch and then ream out to the necessary diameter.

The chassis plate is made of 1/16-inch Masonite Presdwood but bakelite or similar material may be used. The rectifier shelf is also made of 1/16-inch Masonite Presdwood. The chassis plate supports are made of threaded brass or aluminum collars. The transformer mounting strap is formed from sheet brass or aluminum.

Remove the insulation from two short pieces of No. 12 solid copper wire. Solder one end of one piece to the positive pole of the 30-volt battery and one end of the other to the negative pole. The other ends go to the lugs on the meter support screws. This heavy wire keeps the battery from vibrating.

In mounting the transistor, use a cold, damp rag and a pair of long-nose pliers on the transistor terminals to dissipate the heat while soldering.

Checking and calibration

The photo shows the completed meter

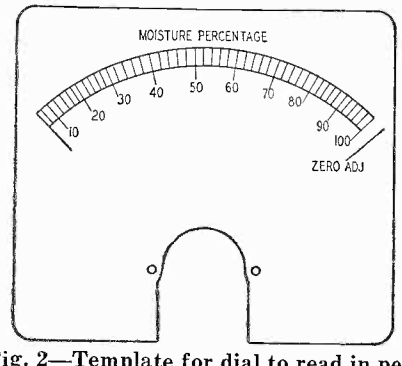


Fig. 2—Template for dial to read in percentage of moisture.

ELECTRONICS

with its original dial which is absolutely linear. Fig. 2 gives a template of a special scale to be used if so desired. This template shows moisture percentage very accurately for measurement of granular materials when the probe shown in Fig. 3 is used. If a larger probe is to be used with electrode spacing of more than 9/16 inch, the Fig. 2 scale cannot be used. This meter is designed to be used only with this probe and scale. The regular scale which comes with the meter can be used by using the conversion table.

DIAL CONVERSION TABLE

Template Dial (Reading in %)	Triplett Dial (Scale Reading)
5	2
10	4
15	8
20	13
25	17
30	22
35	28
40	32
45	41
50	46
55	52
60	58
65	63
70	70
75	76
80	80
85	86
90	90
95	96
100	100

Throw the switch to SET. The meter needle should swing to the right. Adjust the potentiometer so that meter needle swings to the extreme right of the second "0" of the "100." If the template dial scale is used, the needle should swing to the line marked *zero adjust.*

If the meter shows no current, check the wiring carefully. See if the oscillator is working by using a pair of high-impedance headphones with one terminal to the ground bus bar and the other to various points in the oscillator circuit. A very loud 1,000 cycles should be heard plainly. If there is no signal, reverse *either* the primary or secondary transformer leads.

Calibration has been simplified so that it is limited to two basic things: 1. The oscillator signal must be as close to 1,000 cycles as possible. High C, or the C on the second added line above the treble clef on the piano, is 1,024 cycles. Such a musical tone may be used to check the frequency. Usually, it is too low and the value of R1 must be lowered. As the frequency increases the meter needle will deflect well beyond the scale limits. 2. Ample current output to the meter must be available. While the increase in frequency will increase current, if it is not enough for off-scale deflection, then R3 will have to be changed for a smaller value. Again, adjust until you do get the current which the needle deflects well beyond the right end of the scale.

Hand pick your resistors and capacitors so that accuracy will almost be limited only by the tolerance of the meter itself. With a meter tolerance of ±2% and by carefully selecting components it is possible to have 4–5% accuracy with this meter.

R4 in the sampling or READ circuit

was selected for a sensing probe with electrodes spaced ½ to ⅝ inch apart. If the distance between the electrodes is increased for some special purpose, this resistor must be changed to calibrate the meter properly. R4 may be checked by inserting the sensing probe into a cup of completely saturated Cream of Wheat granules. The needle should swing all the way to 100 since there is 100% saturation. If it does not, change the resistance value.

Probe details are given in Fig. 3. Use ordinary flexible, plastic lamp cord for connecting the sensing probe to the meter. In field experiments, cord lengths up to 250 feet have shown no appreciable difference in meter readings in soil moisture checks. The bared ends

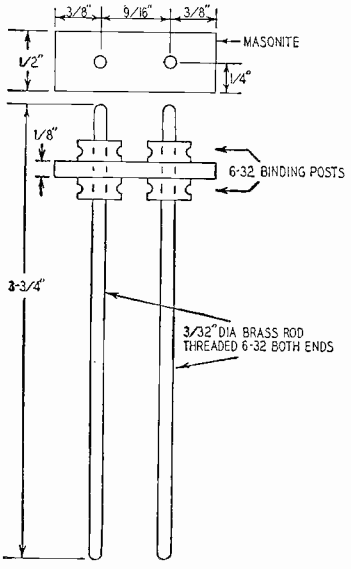


Fig. 3—Construction of the probe.

of this cord should be soldered to prevent unraveling and to provide better electrical connection. Although brass rod is specified in Fig. 3, stainless steel is recommended for foods and all materials which might be contaminated by rust or other oxidation. For explosive mixtures use *only* beryllium copper.

As the meter is designed, it will measure moisture percentage in soils, face powder, dehydrated foods, snuff, plastic granules, etc. accurately so long as the electrode spacing in the sensing probe is not changed. But, if you wished to measure the moisture in a concrete mix, for example, you might have to increase the electrode spacing. The type of material and spacing of electrodes are two variables. It is an axiom of good engineering to change but one parameter at a time. So, don't change type of material and electrode spacing at the same time. Change one and evaluate it; then do the same to the other. In any case you will have to make a new dial plate to conform as previously stated. The sensing probe, as designed here, is excellent for soil moisture testing. If used for this purpose, readings under 25% usually mean insufficient moisture; those over 75%, excessive moisture. END

"I cut testing time in half" ..."doubled our tube sales" *

"Adds to my income and saves me unprofitable call-backs."

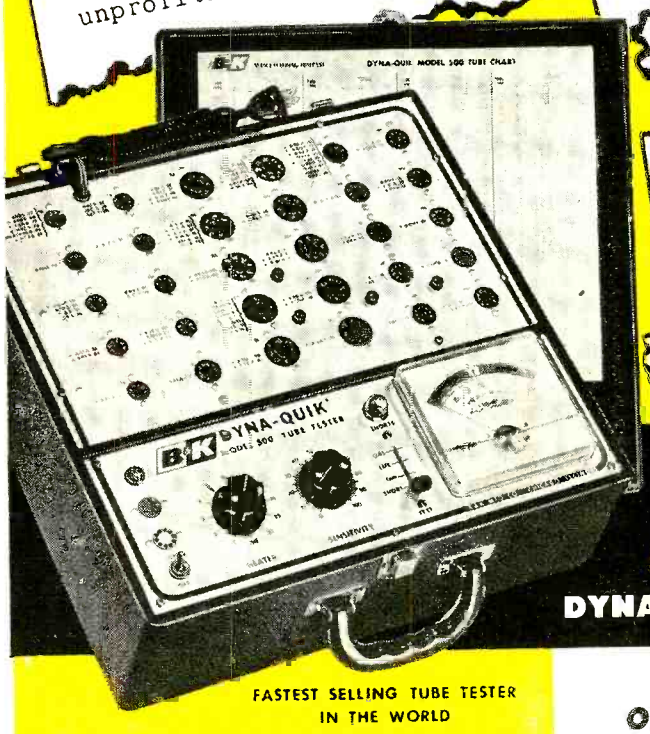
"We have two...one for the shop and one for house calls."

"Paid for itself several times. Really indispensable."

"Best tube tester I've ever owned. Simple to operate. Saves time."

"Makes lots of money for us. Wonderful instrument."

"Serves my purpose best for speed and dependability."



B&K MODEL 500 DYNA-QUIK

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FASTEST SELLING TUBE TESTER IN THE WORLD

Tests over 95% OF ALL POPULAR TV TUBES — IN SECONDS

Accurately makes each tube test in seconds Checks average TV set in minimum minutes

Tests each tube for shorts, grid emission, gas content, leakage, and dynamic mutual conductance.

Ingenious life test detects tubes with short life expectancy.

One switch tests everything No multiple switching No roll charts.

Shows tube condition on "Good-Bad" scale and in micromhos. Large 4½-inch plastic meter has two highly accurate scales calibrated 0-6000 and 0-18,000 micromhos

Automatic line compensation is maintained by a special bridge that continuously monitors line voltage.

Built-in 7-pin and 9-pin straighteners are mounted on the panel.

* NAMES ON REQUEST

One extra tube sale on each of 5 calls a day pays for the Model 500 in 30 days

Enthusiastic comments like those above* come from servicemen all over the country. *Actual experience shows an average of close to 2 additional tube sales per call.*

Instead of the "trial and error" method of substitution testing, the Dyna-Quik 500 quickly detects weak or inoperative tubes. Cuts servicing time, saves costly call-backs, shows each customer the true condition and life expectancy of the tubes in the set, and makes more on-the-spot tube sales. Helps keep customer good-will, give a better service guarantee, *and make more profit.*

The B&K Dyna-Quik 500 measures *true dynamic mutual conductance.* Completely checks tubes with laboratory accuracy under actual operating conditions right in the home *...in a matter of seconds.* Saves time and work in the shop, too. Simple to operate. Easily portable in luggage-type case. Weighs only 12 lbs. NET, **$109.95**

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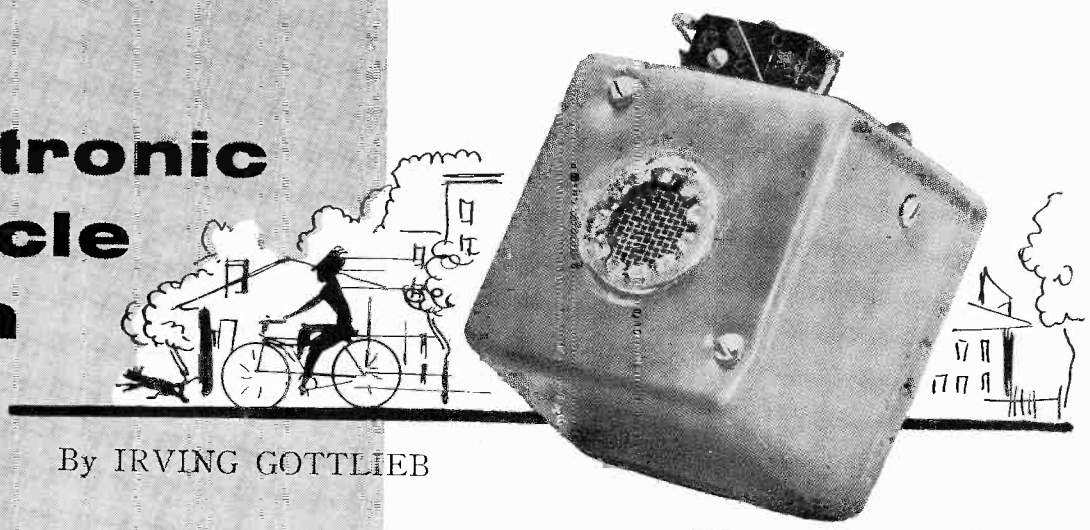
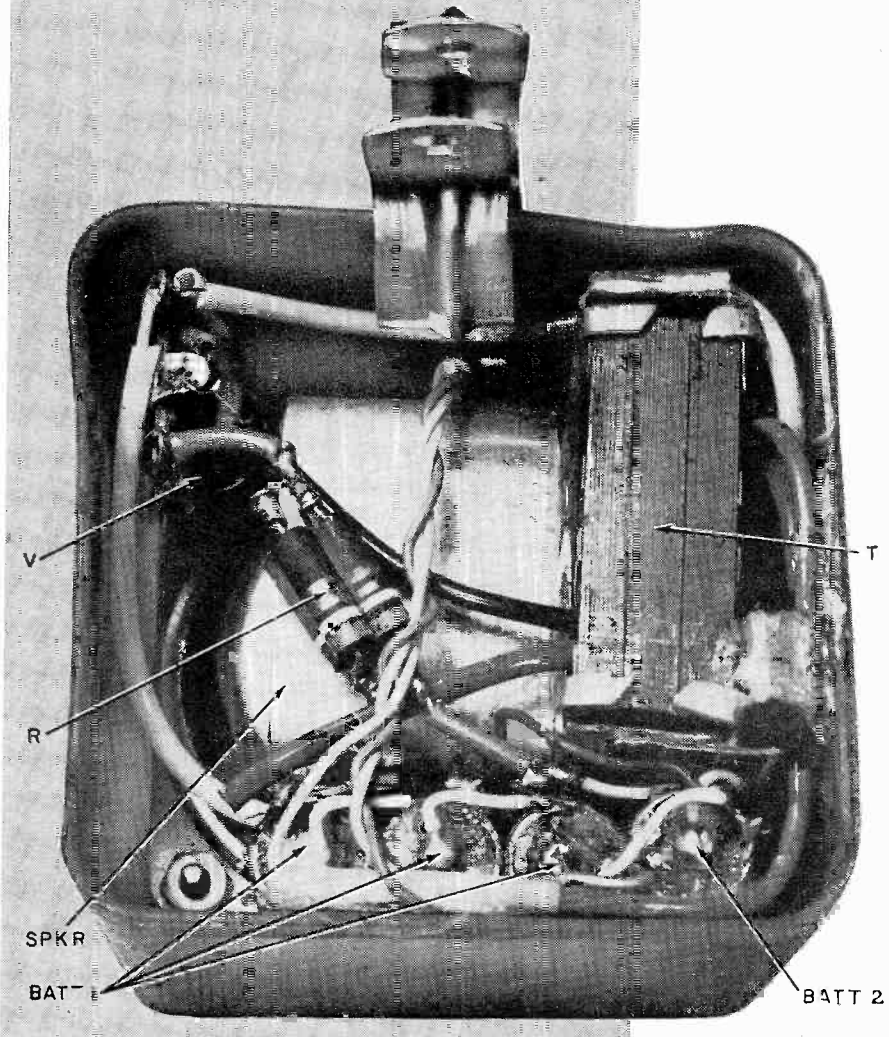


By IRVING GOTTLIEB

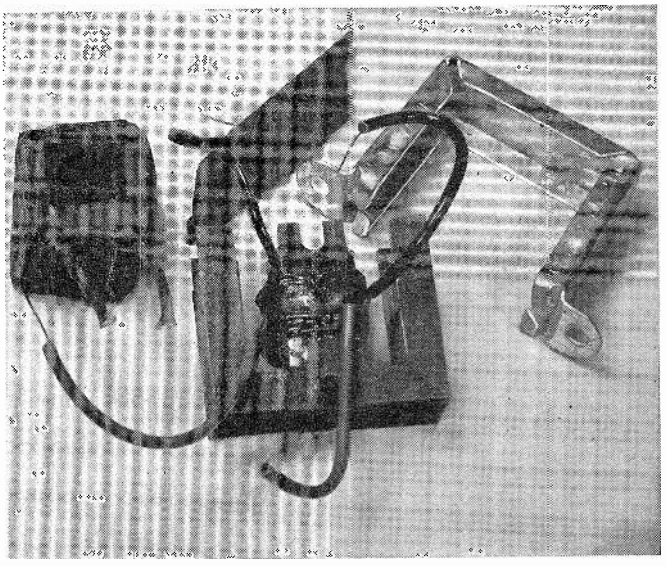


Internal view of horn. Transistor is mounted on frame of loudspeaker.

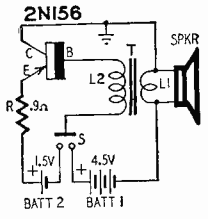
ELECTRONIC–acoustic warning devices have hitherto been unable to compete successfully with electromechanical horns and sirens. The vacuum or gas tubes used have been too fragile and short-lived or have required operating potentials not conveniently or economically obtained in vehicles.

Enter the transistor or, more specifically, the *cheap power transistor*. Here we have an audio oscillator which is mechanically rugged and can be electrically operated from a 6-volt supply. Furthermore, as the operating duty cycle of a horn is very low, battery life is long even from penlight cells. Having acquainted myself with these facts, I devised an electronic horn for bicycles. Very pleasing results were obtained. The device is not just another transistorized novelty. Rather, it is a natural for the transistor. All the horn components, including the penlight cells, are comfortably contained in a small plastic box of 20 cubic inches. A 750-cycle tone rich in harmonics is extremely effective in alerting the unwary, and 2 watts of collector input power is ample for ordinary speeds and distances.

The circuit of the electronic horn is shown in the diagram. It is basically a common-emitter arrangement with magnetic feedback. The 3.2-ohm voice coil of a 2-inch PM speaker is connected directly across the collector winding. Although this would not be permissible with small transistors, the very low collector resistance of the 2N156 power transistor permits efficient power generation and transfer by this method. In fact, no better way of coupling power into the speaker could be found. When experiments were first carried out, it was found that the best type of conveniently available transformer was a midget power transformer with two 6.3-volt filament windings. These two windings were used and the line- and high-voltage windings were unused. I felt, however, that the size



Making the transformer — removed coil is not used.



R—0.9 ohm, ½ watt (4 3.6-ohm, 5% resistors in parallel)
T—(see text)
V—CBS 156 power transistor
SPKR—2-inch PM loudspeaker, 3.2-ohm voice coil
BATT 1—3 1.5-volt penlight cells
BATT 2—1 1.5-volt penlight cell
S—3-terminal pushbutton switch, momentary contact (use dpst normally open switch or modified G-E Switchet described in text)
Box, approximately 3 x 3 x 2¼ inches

Schematic of the electronic horn.

and weight of the power transformer were excessive for this application. Consequently, I decided to perform a bit of surgery on a smaller iron-core component. A readily obtainable dc choke, the Stancor C1080, was used and the modification involves no particular skill.

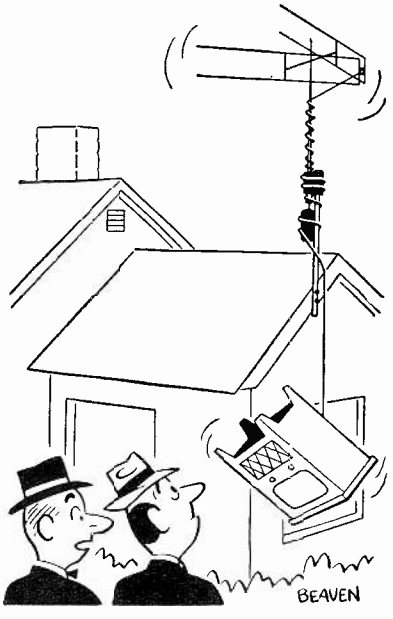
The procedure is: Remove the mounting bracket. This permits separating the I and E laminations. Next, remove the winding itself from the center leg of the E. No further use is made of this winding. Now, wrap several layers of Scotch brand electrical tape around the entire length of the center E segment. The two windings L1 and L2 consist of 25 turns of No. 28 enameled wire. These windings are scramble-wound and are adjacent to each other.

The two windings should be wound in the same direction and the start and finish leads identified by knots or colored sleeving. The windings should be so placed that they are not in contact with lamination edges. Otherwise, there will be a danger of shorted turns as the result of the iron scraping the enamel insulation from the wire. By the same token, do not allow the wire to touch the iron laminations during winding. The completed windings should be impregnated with radio Q dope. When the dope has dried, the core should be reassembled. Do not include the thin paper shim which originally separated the E's and I's. If it is used, oscillation will be weak and of too high frequency for our purpose. Check with an ohmmeter to be sure that both coils are insulated from the core.

When connecting the various components make certain that the *finish* of L2 connects to the base electrode of the transistor and that the *start* of L1 connects to the collector electrode. This will—if the two coils are wound in the same direction—provide correct phasing for oscillation. (Either coil may be designated L1 or L2 since they are identical windings.)

The transistor is mounted at one of the corner holes of the speaker frame, which serves admirably as a heat sink. The collector electrode of this transistor is electrically grounded to the metal

(*Continued on page* 84)



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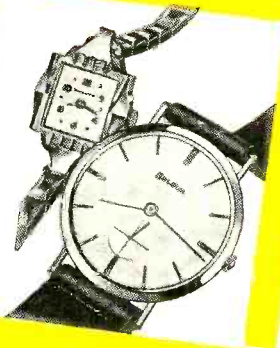

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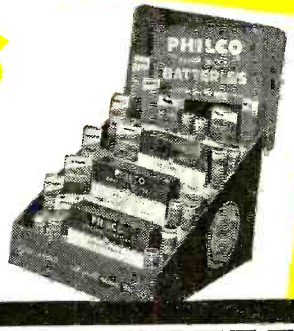

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case. Thus, the whole speaker structure is at collector potential, dc and ac. For this reason, insulate other components from the metallic portion of the speaker.

When making initial tests, do not energize the transistor for more than a few seconds to prevent damage of the transistor. The tiny penlight cells are adequate for the intended operation of occasional toots. In my model, the penlight cells were still good after nearly 6 weeks of normal use in the horn. Incidentally, the penlight cells should be impregnated with Q dope to protect them from moisture.

Several factors govern the generated tone. A slight increase in the value of R results in a substantial increase in pitch. The same result is obtained by removing a few I laminations. Variations in transistor parameters can be expected to influence the oscillation frequency. If the frequency is much too low or much too high, add or subtract turns from L2 as this involves the least disturbance of the optimum balance of power consumption and electrical efficiency.

I was unable to obtain a small pushbutton switch of the type required for this purpose. The G-E Switchet seemed ideal from considerations of size and ease of operation. However, a minor electrical modification had to be made. A fine flexible wire was soldered to the end of the armature which protrudes from the case when the pushbutton is depressed. This lead then connects to the cold side of L2. Terminals 3 and 4 of the switch are connected to the appropriate battery terminals as shown in the schematic. This switch disconnects *both* diode sections of the transistor from the battery when in the normal *off* position. END

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Modern Electric	1908
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Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In April, 1923, *Science and Invention* (formerly *Electrical Experimenter*)

Radio-Television Scheme, by Robert E. Lacoult.

Simple Dx Broadcast Receiver and Amplifier.

Ultra-Selective Shortwave Tuner, by A. P. Peck.

Future Broadcasting.

Radio For Miners.

Cheap Versus Standard Apparatus, by Bert T. Ferencz.

Wave-Traps and Interference Preventers, by A. P. Peck.

Radio for the Beginner, No. 14, by Armstrong Perry.

Radio Oracle.

Free Power Receivers

Transistor apparatus can be driven with power recovered from energy fields around us

By DR. H. E. HOLLMANN*

SINCE its invention, the transistor has become the mighty midget of modern electronics. At the present time, only a few domains are left exclusively to the electron tube—in particular, with respect to power-handling capacity and extreme high frequencies. Other limitations and drawbacks of the early semiconductor devices—temperature sensitivity, noise factor and frequency response, have been improved so much that the transistor is a veritable competitor of the amplifier tube. In many fields the transistor already is a superior substitute for the tube—as far as efficiency, size, weight and life time are concerned.

In another field, the transistor occupies a unique position—its ability to operate at a low power level, more accurately at low voltages and low currents, exceeds by far that of vacuum tubes. This extremely low power consumption paves the way for electronic apparatus and devices driven with *free power* which we can recover from various energy fields around ourselves at no extra cost. The minute amount of energy available in such a way is not enough to supply complex transistor apparatus such as computers, but suffices for driving measuring devices, communication systems, link control mechanisms and the like. Since the entire field is but a few years old, only a few examples can be presented to give an insight into the practical possibilities and applications.[1]

Many forms of potential energy fields permit the recovery of free power. One of the outstanding examples is the self-winding Atmos clock whose mechanism is actuated by the fluctuation of atmospheric pressure. Since a sensitive clock mechanism with a torsion pendulum requires only micro-microwatts, an atmospheric-pressure machine capable of producing microwatts would be the size of an automobile wheel. A similar result is obtained from the atmospheric temperature or heat gradient, from atmospheric electricity and cosmic radiation.

The only cosmic energy with a suitable level is the radiation of the Sun. With the aid of self-generating photocells and solar batteries, a substantial amount of the solar radiation can be converted into electricity. Even on a cloudy day a battery of four self-generating solar cells with a total surface of 2 x 2 inches produces sufficient power to drive a single-transistor receiver. A multistage superhet with a little loudspeaker requires a solar power pack of 32 silicon cells in series. During the night, it must be powered with artificial light or the excess solar energy may be stored in silver cells with a crystal diode to prevent the battery from discharging through the solar cells when underpowered in the shade, in twilight and in the dark.

Another form of energy surrounds us usually in a rather unpleasant way, namely noise or sound. To obtain an insight into the available power level, let us compare the intensity of sound with that of light (Fig. 1). We see that full sunlight has about the same energy as the loudest sustained man-made noise—that of a jet plane. Even from the level of heavy city traffic, an electro-acoustical transducer can derive only a few microwatts per cm² of its inter-

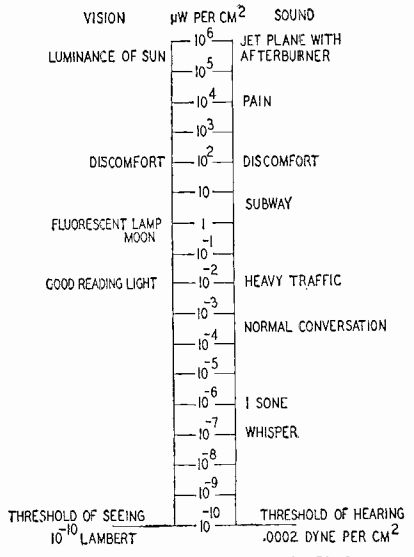

Fig. 1—A comparison of light and sound intensity scales.

cept area. Only around a missile or rocket, for example, by a sound-power microphone built into the hull, can 1 or 2 watts per cm² be recovered from the air turbulences. But that is enough to drive a complex electronic control or guidance system.

A more favorable situation is encountered by talking directly into the mouthpiece of an electromagnetic microphone and thus preventing the dissipation of energy in free space. In this respect, a sound-power mike operates favorably when addressed rather loudly. Considering the articulation of speech, namely the distribution of the low-energy consonants and the powerful vowels as well as the intervals between words and sentences, such a microphone produces an average energy of 1/10 milliwatt. In fact, a small telephone transmitter has been built whose sound-power mike not only produces the modulation signals but, at the same time, the supply energy for the oscillator. Powering and modulation are thus combined in the form of "hum" modulation.

The human voice is a manifestation of our bodily power which may be considered within the realm of free energy. In the era of the transistor, however, it is no longer necessary to crank the heavy generator of a tube type transmitter up to the verge of bodily exhaustion. Actuating a push-button of a flashlight dynamo or the like produces sufficient energy for driving a small pulse transmitter.

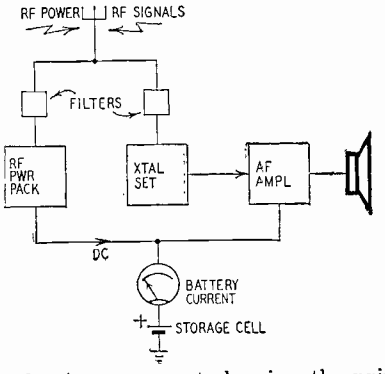

Fig. 2—Arrangement showing the principle of an rf-powered receiver.

*Consulting Physicist, Studio City, Calif.

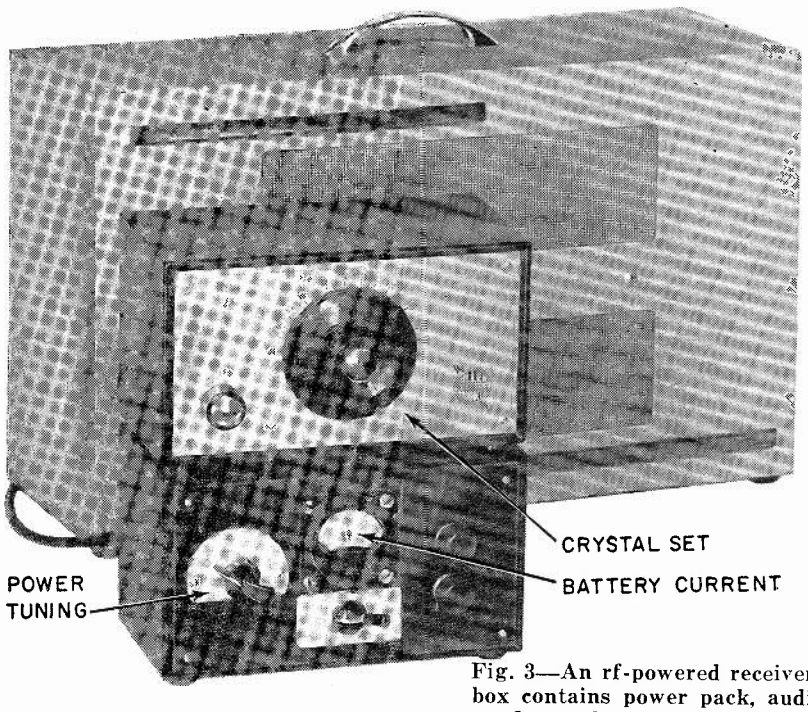

Fig. 3—An rf-powered receiver. Lower box contains power pack, audio amplifier and small storage battery.

In all civilized countries, particularly in cities, another type of free power is available—the electromagnetic radiation of telegraph, broadcast, television transmitters and the like. Up to now this form of energy has been used exclusively to control remote receivers but, within certain limitations, it can feed one or more transistor stages. Since the primary energy, after having fulfilled its original purpose—carrying the primary information signals in the forward direction—is utilized a second time for radio communication, for example, for detection and amplification of weak signals or for the generation of "new" radio frequencies, it may be called *secondary energy.*

Since transistors begin to operate satisfactorily with a supply energy of a few microwatts, a new category of receivers enters the electronic art. These receivers bridge the gap between passive types, which convert the incoming radio energy directly into audio signals, and active types, which have a local power source and thus convert its energy, according to the incoming radio signals, into sound waves. The new receivers require no local power source, and maintenance and shelf-life problems are nonexistent. Nevertheless, their sensitivity, selectivity and ability to amplify weak signals are equivalent to those of active receivers.

The most obvious example is the driving of a sensitive transistor receiver with the energy picked up from the local broadcast station and the use of this free energy for the detection and amplification of weak signals from distant transmitters. In the vicinity of a powerful radio station there is enough secondary energy for driving a little loudspeaker. A unique receiver results by amplifying the signals of the powering station itself with the aid of its own carrier energy. Such a *passive-power receiver* has an energy level several times that of a crystal set.[2]

Rf-powered receivers

The principle of an rf-powered receiver is illustrated in the block diagram of Fig. 2. A common antenna recovers the driving energy as well as the intelligence signals from distant stations. By two rf filters, both carriers are fed to their proper devices, namely the powering carrier to the rf power pack and the signal carrier to an active receiver—in this case to a passive crystal set followed by a transistorized audio amplifier. The power pack differs from a conventional crystal set only in having a large filter capacitor which eliminates the modulation signals so that a dc voltage develops across the output terminals. There are two tuning knobs: one for tuning the powering frequency and the other for tuning to various carrier frequencies of distant transmitters whose field strength is far below that of the power station. For voltage stabilization and, at the same time, for providing driving energy during those hours when the power station is not on the air, a small storare battery—such as one or two silver cells—may be used.

In using transistors to be driven with the minute amount of secondary radio energy, the major problem is operation at a low voltage and current level. Hence, greatest use of the potential efficiency is important. The audio amplifier of Fig. 2 can be provided with one or two transistor triodes in common-emitter circuits, or with one or two tandem stages, each containing either two direct-coupled transistors or a tandem transistor.[3] Fig. 3 is the photograph of a radio-powered receiver. The lower box contains the power pack and

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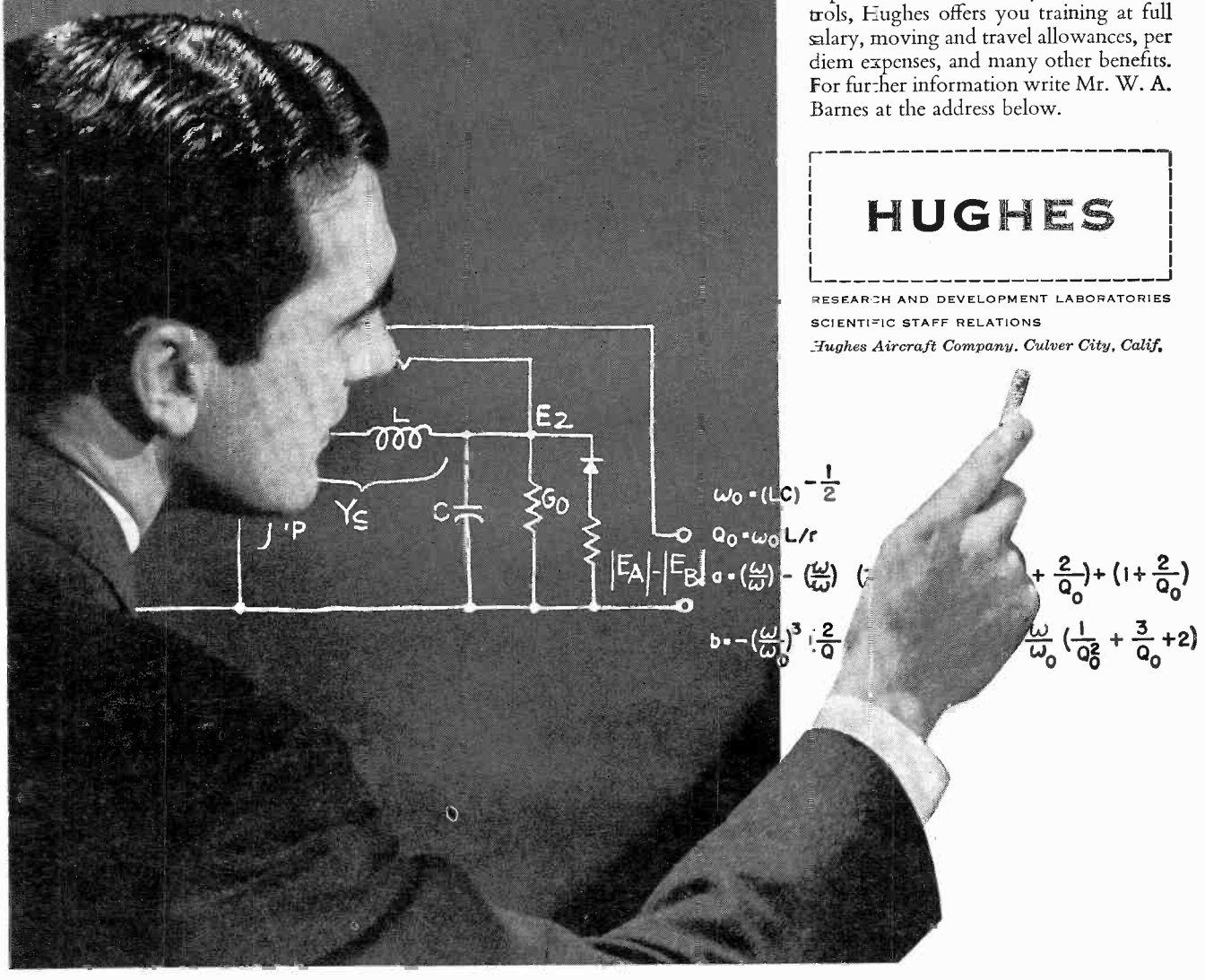

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the audio amplifier together with a little storage battery. The instrument indicates the battery current and thus permits the power tuning as well as the proper adjustment of the amplifier load to keep the battery charged. The incoming signals are picked up by a high-quality AM tuner. Provided there is a powerful transmitter within one or two miles, an efficient antenna recovers several milliwatts which is enough to drive a small loudspeaker with moderate volume.

The design and circuitry of an rf-powered broadcast receiver depends not only on the local conditions for radio reception, ie, field strength and antenna efficiency, but also on the taste, skill and purse of the experimenter. The average ham, student, design engineer and home experimenter should have no difficulty in building a satisfactory set around his transistors. The schematics in Fig. 4 may serve as a guide.

The antenna is connected directly to the tank circuit (Fig. 4-a) whose rf current is rectified by the diode D. For filtering, a large electrolytic may be used, but one or two wet cells, such as silver cells, are better. Polarization cells, each one in the form of two lead wires immersed into battery acid, are less expensive. The optimum load is adjusted by the transistor bias in such a way that the milliammeter indicates a small charging current.

Weak signals from distant stations are picked up by the crystal set which, in turn, is connected to the antenna via a small coupling capacitor C2 without dissipating too much rf energy from the powering transmitter. The receiver's output drives the audio amplifier. Its simplest form is a single common-emitter stage, but in many cases, in particular, in the cities, there is sufficient rf energy to feed a two-stage cascade. To obtain good gain with a minimum of driving power, transformer coupling is recommended. Potentiometers R1 and R2 provide the input-base bias for both transistors and are adjusted in such a way that the output transistor receives most of the available supply current. The input stage requires only a fraction of a milliampere to operate as a satisfactory preamplifier.

If the amplifier is built around tandem stages, Fig. 4-b may be utilized. Each tandem stage can be built with two separate transistor triodes inserted into a six-pin socket or with tandem transistors.[3] The high impedance ratio permits an efficient R-C coupling so that there is a single output transformer for matching the loudspeaker.

The passive crystal set can be replaced with an active transistor receiver such as a regenerative, super-regenerative or superheterodyne unit. At the threshold of supply energy, however, the various receiver types exhibit a unique characteristic in that the gain–bandwidth product is not altered. In other words, the overall quality of a receiver expressed in terms

of its gain–bandwidth product does not depend on the receiver type but is a function of the supply energy. This becomes evident if we take the distribution of energy into consideration. In a two-stage regenerative receiver, for example, the input transistor requires a minimum supply energy by which the supply energy for the audio transistor and its amplification is reduced. The net result is that the greater sensitivity of the regenerative transistor is neutralized by less af amplification. This picture is more pronounced in a superheterodyne receiver where the limited supply energy must be distributed carefully to at least three transistors—the converter, if stage and output amplifier. With regard to this rule, the described combination of a passive crystal set with an active audio amplifier has been found to operate most satisfactorily.

A peculiar situation occurs if the receiver is tuned to the powering frequency itself or a harmonic, in which case the local broadcast station provides the energy for the amplification of its own signals. Since there is only a single frequency for powering as well as for the signals, the receiver can be simplified as shown in Fig. 5. The transistor is in a common-base circuit and performs the following operations: Its emitter diode charges the large filter capacitor C1 and thus produces the dc energy for the collector; the emitter diode acts as signal rectifier and impresses the audio signals, according to the modulation envelope, upon the input; the collector junction amplifies the audio signals which drive headphones or, in the vicinity of a powerful station, a small loudspeaker.

Because the transistor produces its own dc energy, its type of conductivity does not matter. Thus, the passive-power receiver operates with n-p-n transistors as well as p-n-p types.

Using free power

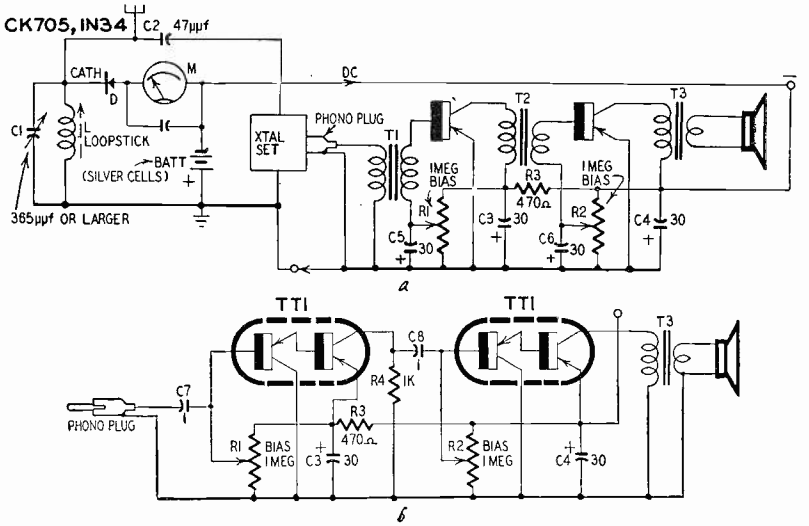
The superiority of the new transistor receiver over passive signal detection is confined to two conditions. First, the degree of modulation must be less than 100% so that there is more carrier than af energy. Secondly, there must be sufficient input energy to drive the transistor at a satisfactory power level. Although modern junction transistors begin to operate as oscillators with driving power below a single microwatt, a useful audio gain requires approximately 50 microwatts. Based on this, it is possible to evaluate the conditions at which the passive-power reception becomes inferior to passive-signal detection because of insufficient radio power. If P_{tr} is the rf energy of the powering transmitter in kilowatts, l the effective length of the receiving antenna in meters and D the distance in kilometers, the available dc energy can be found with the formula

$$P_{dc} = 50P_{tr}\left(\frac{l}{D}\right)^2 \text{ in microwatts.}$$

Inversely, if the right side is set equal to the minimum energy of 50 microwatts, the formula permits the evaluation of the critical distance

$$D = l\sqrt{P_{tr}}$$

at which the transistor gain drops so much that the output level of the transistor receiver equals that of a simple detector set. For example, a broadcast transmitter having 25-kw rf energy and a receiving wire of 10 meters makes the passive-power reception superior to passive rectification within



R1, 2—1-megohm potentiometers
R3—470 ohms, ½ watt
R4—1,000 ohms, ½ watt
C1—365 μμf, or larger, variable
C2—47 μμf
C3, 4, 5, 6—30 μμf, 6-V electrolytic
C7, 8—1 μf
L—ferrite-core loopstick
D—CK705 or 1N34
M—meter, 100–500 μa
BATT—one or two wet cells (may be replaced with large electrolytic capacitor)
Crystal set (Miller hi-fi tuner, Heathkit crystal receiver or equivalent)
T1—Input transformer, primary 40,000 ohms, secondary 100 ohms (Argonne AR-150 or equivalent)
T2—driver transformer, primary 15,000 ohms, secondary 200 ohms (Argonne AR-107 or equivalent)
T3—output transformer, primary 500 ohms, secondary 3.2 (Argonne AR-119 or equivalent)
Loudspeaker, 3.2 ohms
Chassis

Fig. 4—Rf-powered receivers: a, with two transistor triodes in common-emitter connection; b, with a tandem amplifier.

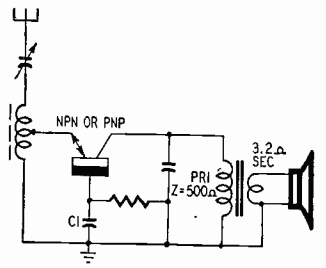


Fig. 5—Simple passive power receiver whose transistor obtains power and intelligence from single station.

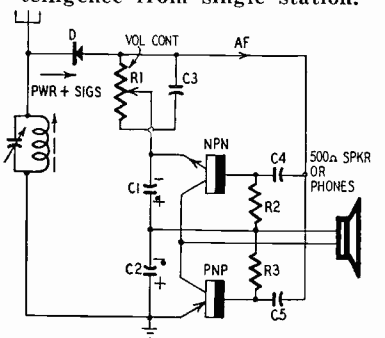


Fig. 6—Passive power receiver using complementary-symmetric push-pull

a radius of approximately 50 km.

For better quality and greater output level, the transistor offers a complementary–symmetric amplifier stage Fig. 6. The two transistors of opposite types, together with filter capacitors C1 and C2, form a bridge circuit with a 500-ohm loudspeaker or an equivalent headphone in the diagonal branch. The rf power pack contains the input tank circuit, and diode D which charges the series C1 and C2. At the same time, the diode is the signal detector and produces audio voltages across resistor R1 bypassed by C3. The audio signals are impressed upon the bases of the two transistors in single phase via C4 and C5. The base-leak resistors R2 and R3 determine equal dc levels. Volume control R1 permits adjustment of the audio amplitudes according to the available energy and the tolerable distortions. Fig. 7 is the photograph of a passive-power receiver with a complementary–symmetric amplifier. Driven by the energy of a 50-kw broadcast station only a single mile away and with a 30-foot mast, the receiver produces sufficient output energy to drive the loudspeaker with excellent volume and quality.

In the same way as a receiver is powered with secondary radio energy, it is possible to feed a small oscillator with secondary power and to convert the incoming rf via dc or *frequency zero* into another frequency band. Fig. 8 illustrates such an rf-powered transmitter. The left device is the rf power pack which includes a small storage cell for voltage stabilization; the right one is a crystal-stabilized oscillator operating at 27.255 mc. A key permits using the free rf power of the local broadcast station for radio control of model cars, boats, airplanes, etc.

Once a transistor oscillator is fed by secondary power, it may be mod-

ulated in various ways. The resulting possibilities and modifications are far too numerous to be described in detail but a single example may give a general idea. Fig. 9 is the basic circuit diagram of an unattended converter which reradiates the incoming broadcast program on another carrier frequency. For this purpose, filter capacitor C2 is in series with the C1–R1 network across which the diode produces the audio signals according to the modulation envelope. The imperfect filtering results in a type of hum modulation so that the incoming audio signals are reradiated upon the new carrier frequency. Instead of a repeater station, the radio-powered transmitter may be modulated with extra signals with AM or FM.

Since transistors entered the vhf region the principle is very useful for unattended repeater stations for FM, TV, telemetry and the like. With the aid of directional antennas with sufficient intercept area, tiny and completely unattended TV boosters can be developed which recover their supply energy from the master TV station itself or which are fed by a microwave beam with just enough power to pull the TV signals over a mountain and aim them at a town in a valley.

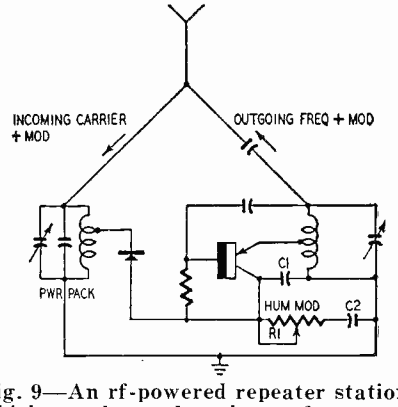


Fig. 9—An rf-powered repeater station, which may be used to change frequency.

This principle of powering small transmitters by wireless energy transmission from a master station is very interesting for telemetry and automatic-control purposes in all cases in which no local power source can be tolerated. A significant project of this type is, for example, the powering of a meteorological radiosonde by radar, which, at the same time, is used to measure wind velocity. Many intriguing problems offer themselves to the electronic expert and engineer in the field of radio communication, telemetry, remote and automatic control, etc., the practical consequences of which can hardly be predicted.

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[3] H. E. Hollmann, "Applications of Tandem Transistors," *Tele-Tech*, February, 1956. END

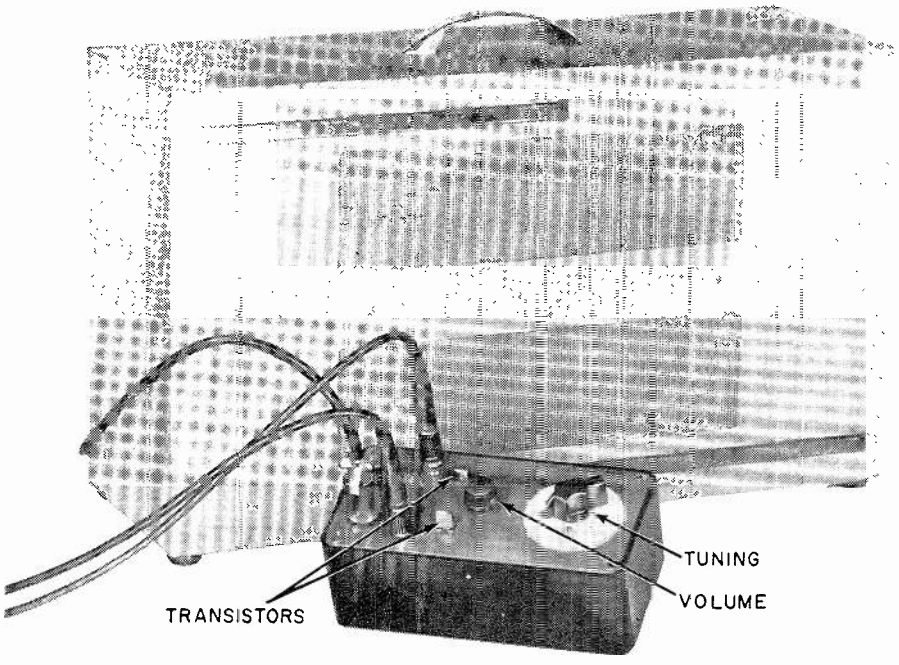


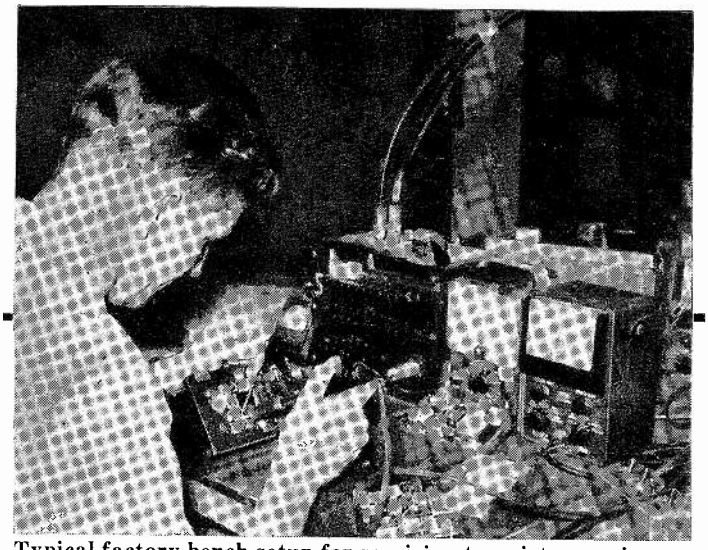
Fig. 7—Passive-power receiver and speaker.

Fig. 8—An rf-powered transistor oscillator for radio-control use.

servicing transistor radios

By LEONARD J. D'AIRO

They're really not so different—just a few new techniques



Typical factory bench setup for servicing transistor receivers
(Courtesy Regency Division, I.D.E.A., Inc.)

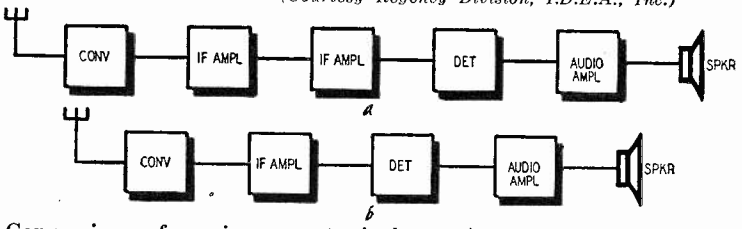


Fig. 1—Comparison of receivers: a, typical transistor set; b, vacuum-tube radio.

I'LL never forget the time I serviced my first transistor radio. I was all thumbs, scared, and knew next to nothing about them. But, as they say, "Experience is the best teacher," and after working on many makes and types for the past few years I find that they are actually simpler to service than their vacuum-tube cousins.

Basically transistor and vacuum-tube radios are alike. Both have a converter stage, one or more if stages, a detector and one or more audio stages. Fig. 1 is a block-diagram comparison of both types; Fig. 2 shows a schematic diagram of a typical transistor receiver.

There are precautions and rules to follow when working with transistors and printed circuits. And many articles have been published in RADIO-ELECTRONICS concerning the care and handling of these items. Before you attempt to service any transistor radio I suggest that you read and reread these articles to acquaint yourself with all the *do's* and *don'ts*.

In this article, rather than treat each make receiver separately, I list the troubles common to all. Otherwise, in many cases, the troubles and their causes would only be repeated. If there is a trouble that is typical to one make set only, it is so noted. Before doing so, though, I would like to give a few servicing pointers that will save time, trouble and aggravation.

When aligning the if stages in a vacuum-tube receiver the standard procedure is to disable the local oscillator (to prevent interference) and feed an if signal into the injector grid of the converter tube. This does not hold true for transistor receivers that do not have a separate oscillator. If you disable the oscillator you disable the entire converter stage, and it would be necessary to inject a strong signal into the receiver to get any indication. This may damage the converter transistor and lead to a false indication of alignment.

To align a receiver (where a separate oscillator is used it can be disabled without any effect) the signal generator should be coupled loosely to the antenna coil and the tuning capacitor set to a point on the dial where a station cannot be heard. Then the receiver can be aligned properly. For alignment indication a vacuum-tube voltmeter should be used in the avc circuit. Fig. 3 shows the proper method of coupling the signal generator to the receiver.

Never, under any circumstance, connect the signal generator directly to a transistor or its associated parts. The low output impedance of the generator would have a serious effect upon the performance and operation of the transistor and circuitry impedances.

As in a vacuum-tube portable receiver, whenever a transistor radio comes into the shop for repairs, the first thing to do is to check the battery voltage under load. Of all the transistor

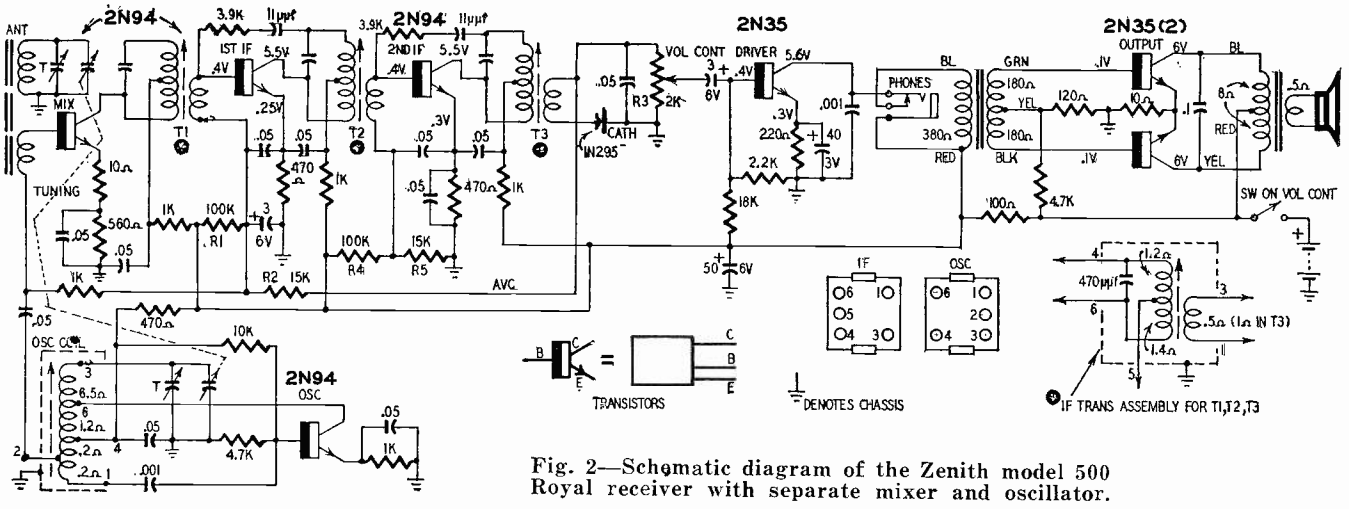
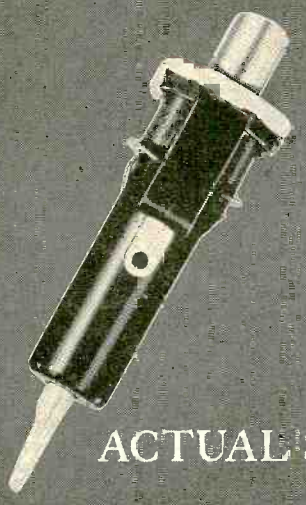


Fig. 2—Schematic diagram of the Zenith model 500 Royal receiver with separate mixer and oscillator.

another LITTELFUSE



ACTUAL SIZE

FIRST in service

The new Limited Current (LC) fuses are being used by more and more TV set manufacturers. The LC fuses are designed to protect the TV set manufacturer, the serviceman and the set owner by making it mechanically impossible to replace a fuse with anything but another fuse of the proper amperage range.

LC fuses demand exact replacement.

The table printed below is a quick check list to speed stock planning and replacement identification by TV set brands. The cross reference table is designed to fit the top of the LITTELFUSE fuse caddy. For additional copies see your Littelfuse jobber.

Tear on dotted line

NAME	FUSE DESCRIPTION		LF PART NO.
Admiral	*3/10 amp	Type C	332.300
Admiral	*3/4 amp	Type C	332.750
Admiral	*2 amp	Type C	332002
Airline (Montgomery Ward)	4/10 amp	Type N	333.400
Bendix	2 amp	Type N	333002
Capehart Farnsworth	1/2 amp	Type N	333.500
CBS Columbia	1-6/10 amp	Type N	33301.6
Coronado	4/10 amp	Type N	333.400
Crosley (Elcorado)	2-8/10 amp	Type N	33302.8
DuMont	3/4 amp	Type N	333.750
Emerson	6/10 amp	Type N	333.600
Emerson	1 amp	Type N	333001
Emerson	1-1/4 amp	Type N	3331.25
Firestone	4/10 amp	Type N	333.400
General Electric	1-1/4	Type N	3331.25
Motorola	2 amp	Type C	332002
Olympic	3/8 amp	Type C	332.375
Packard-Bell	2/10 amp	Type N	332.200
Packard-Bell	*3/10 amp	Type C	332.300
Packard-Bell	1/2 amp	Type N	333.500
Packard-Bell	*3/4 amp	Type C	332.750
Philco	7/10 amp	Type N	330001
Raytheon	*1/4 amp	Type N	333.250
Raytheon	*1/2 amp	Type N	333.500
RCA	3/10 amp	Type C	332.300
RCA	*3/4 amp	Type C	332.750
Setchel Carlson	2-1/2 amp	Type C	33202.5
Silvertone	*3/10 amp	Type N	333.300
Silvertone	*3-1/2 amp	Type N	33303.5
Stromberg Carlson	1/4 amp	Type N	333.250
Sylvania	2-1/2 amp	Type C	33202.5
Truetone	4/10 amp	Type N	333.400
Westinghouse	*1/2 amp	Type C	332.500
Westinghouse	*3/4 amp	Type C	332.750
Westinghouse	*7 amp	Type C	332007
Zenith	1/4 amp	Type N	333.250
Zenith	3/10 amp	Type N	333.300

*Color TV

LITTELFUSE, INC.

LITTELFUSE

Des Plaines, Ill.

sets that I have serviced I have found that approximately 80% of them required just a battery change. You'd be surprised at how many troubles are caused by low battery voltage.

When replacing a defective transistor in a class-B audio output stage, it is wise to replace both, whether or not the second transistor is good. These transistors are used as matched pairs and therefore replacement should always involve both.

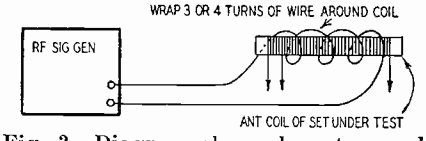


Fig. 3—Diagram shows how to couple signal generator to transistor receiver.

Now on to the troubles and their causes. You may come across some trouble that is not listed here but you will find that in one way or another it will be similar to the ones listed. With a little patience and fortitude you will be able to service and repair any transistor radio, regardless of what is wrong.

TROUBLE	CAUSE	NOTES
Receiver operates intermittently	Dirty switch contacts Dirty volume control Corroded battery terminals Poor phone jack contact Dirty wiper contacts on tuning capacitor Dirt between plates of tuning capacitor Poor solder connection	1 2 3
Fades after short period of operation	Weak battery	
Station drift	Weak battery	
Heterodyne on all stations	Weak battery Misalignment Change in value of avc filter capacitor Change in value of if neutralizing capacitor Defective if transistor	1 4
Motorboat or squeal	Weak battery Defective electrolytic capacitor	 5
Poor sensitivity at low-frequency end of band only	Defective converter transistor Defective if transistor	6 6
Change in volume as receiver is tuned	Shorted avc filter capacitor Defective detector transistor	 7
Low audio output	Weak battery Defective audio transistor Defective detector transistor	 7
Distorted audio	Weak battery Defective audio transistor Defective speaker	 8
Short battery life	Defective switch Defective transistors Shorted, or leaky electrolytic capacitor	9 10 5

NOTES:

1. This trouble is typical of the Regency TR-1 receiver.

GUIDE

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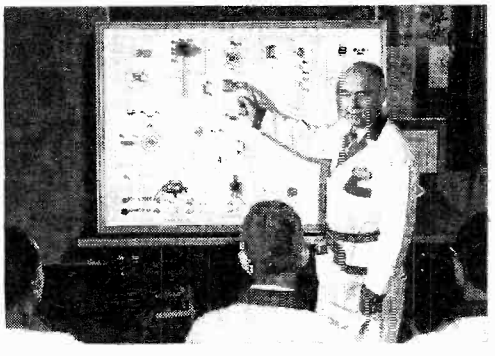
Courses for experienced service technicians provide latest repair information—enable you to do the job faster and more efficiently.



Jumbo-size operational panel of Guide's Autronic-Eye Circuit puts all parts out front for better, more efficient instruction.

Quick, accurate circuit diagnosis and repair to factory specifications boosts your profits. That's why so many qualified auto technicians attend these Guide training courses at no cost other than transportation and living expenses.

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BLINKY MEANS BUSINESS!

RADIO

2. This is a common trouble in sets that provide for earphone reception. After some use the jack contacts lose tension and do not make proper contact.

3. Even though dip-soldering is used for connections on printed circuits, a few connections may not be properly soldered. It is best to examine all solder connections on the receiver board to prevent future troubles.

4. The value of this capacitor changes with the slightest amount of heat. When replacing, use a zero-temperature-coefficient capacitor.

5. This capacitor is connected across the supply voltage to keep the supply voltage constant and to present a low-impedance supply source. Any change in value or any leakage will cause motorboating and short battery life, respectively. Its value is usually 100 μf.

6. Poor sensitivity may be due to any number of things too numerous to mention here. The transistors listed are usually at fault. If not, substituting parts may reveal the cause of this trouble.

7. Heat plays an important part in the operation of these receivers. If the transistor detector has been heated externally, the operating point is shifted so that collector cutoff current is increased. This prevents the avc voltage from changing in proportion to the received signal.

8. To determine if the speaker is defective, plug in the earphones, if there is provision, or substitute for the speaker. Set the volume control at midpoint and listen for distortion. If there is no distortion then replace the audio transistor.

9. The switch does not open the circuit when the control is turned to the off position.

10. Usually the audio transistor is at fault, drawing excessive current even though seeming to operate properly. Current for a class-A amplifiers with 9 volts on the collector is 4.5 ma; at 22.5 volts it is 3.7 ma. For class-B amplifiers idling current is approximately 3.2 ma at 9 volts; 38 ma on peaks. END

In May Radio-Electronics

TV Customers We Could Do Without

Art Margolis tells us about that small minority who turn the technician's hair gray and how to avoid loss of money and sanity dealing with them.

Low-Cost Remote Amplifier

Designed for broadcast station use, this easily constructed piece of equipment finds numerous uses wherever a light-weight, good-quality amplifier is needed.

RADIO

DEFECTIVE IF TRANSFORMERS

MOST radio technicians know that a small positive voltage on the grid of an audio amplifier can spoil set performance. Yet, often, a small positive voltage on the grid of an if amplifier is ignored. It should *not* be ignored.

A positive voltage, even a very small one, on the grid of an if tube causes dc to flow through the if transformer secondary, reducing circuit Q, sensitivity and selectivity, killing avc action, and many times causing static and sputtering.

How does a positive voltage get on if grids? One way is from gassy or otherwise defective tubes; another is from a defect in the avc circuit. But most of all, though least suspected, through the if transformer itself—midgets in particular. The plastic insulation at the base of these transformers develops a high-resistance leakage path which allows the positive primary voltage to apply a positive voltage on the grid of the following if tube.

When checking a weak, unselective, noisy or intermittent radio, test for positive voltage on the grids of the if's. Use your lowest meter voltage range since even ½ volt positive indicates trouble. Try replacing the if tubes first, then check the avc circuit if trouble persists.

If everything is normal there, disconnect the leads going to the transformer's secondary terminals—leaving the primary intact. Then, check for dc voltage at the secondary terminals. If the transformer is defective, don't be at all surprised if you read 40, 60 or even 120 volts—though usually it's less. Don't use a soldering iron to remove the leads from the if secondary for a test because the heat will often produce a temporary correction which will only complicate and delay the repair. Clip them off.

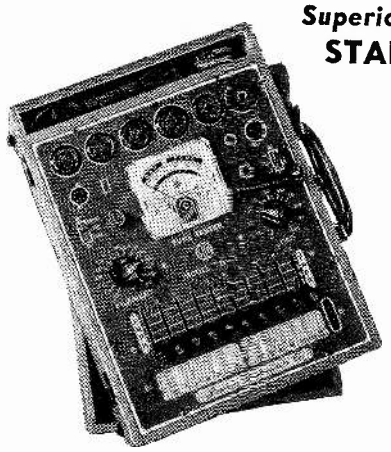
When installing a new if transformer, be sure that *no* dc voltage of *any* polarity can be found on its secondary terminals when the primary is hooked up but before any connections are made to the secondary. With the secondary hooked up, a normal negative voltage of about 1.5–2 exists between stations.

Apparently this is a common trouble—the local parts distributor in my area couldn't keep up with the demand for replacement if transformers last summer.—*Charles Garrett*

ANSWERS TO ELECTRONIC QUIZ, Page 58

1. b	8. c	15. b
2. c	9. a	16. a
3. c	10. b	17. d
4. d	11. a	18. d
5. d	12. d	19. b
6. a	13. a	20. c
7. a	14. c	

Superior's New Model TW-11
STANDARD PROFESSIONAL TUBE TESTER



- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because **all elements are numbered according to pin-number in the RMA base numbering system,** the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-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. All tube listings printed in large easy-to-read type.

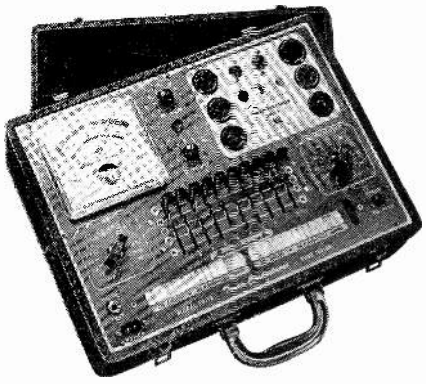
NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES—Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

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

$47.50 NET



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

ALSO TESTS TRANSISTORS!

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.

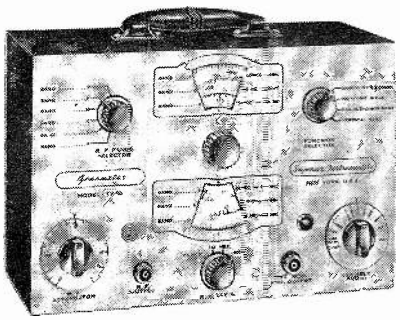
TESTING TRANSISTORS

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

$72.50 NET



Superior's New Model TV-50
GENOMETER

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- R.F. Signal Generator for A.M.
- R.F. Signal Generator for F.M.
- Audio Frequency Generator
- Bar Generator
- 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.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

BAR GENERATOR: The Model TV 50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only .....

$47.50 NET

Superior's New Model TV-40
PICTURE TUBE TESTER

NOT A GADGET—NOT A MAKE-SHIFT ADAPTER, BUT A WIRED PICTURE TUBE TESTER WITH A METER FOR MEASURING DEGREE OF EMISSION—AT ONLY $15.85

Of course you can buy an adapter for about $5—which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adapters or neon gadgets 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.

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.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

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.

Model TV-40 C.R.T. Tube Tester comes absolutely complete — nothing else to buy. Housed in round cornered, molded bakelite case. Only

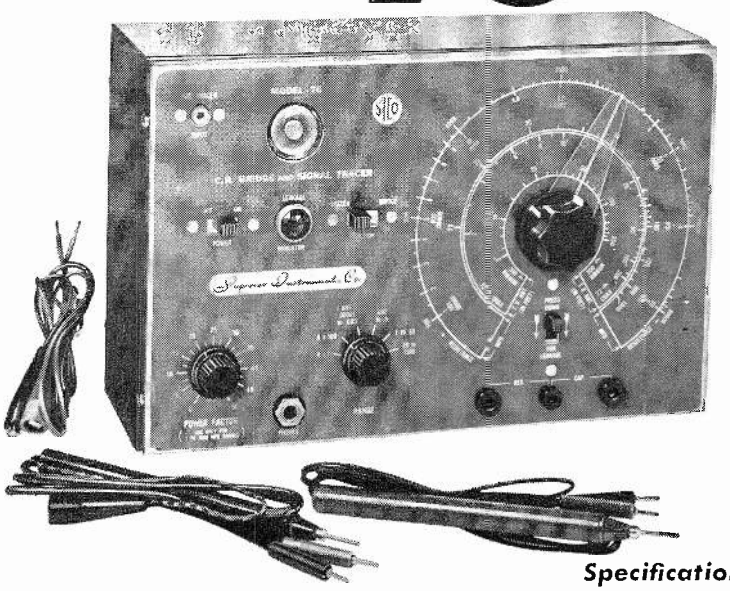
$15.85 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!

Superior's New Model 76



IT'S A CONDENSER BRIDGE

with a range of .00001 Microfarad to 1000 Microfarads (Measures power factor and leakage too.)

IT'S A RESISTANCE BRIDGE

with a range of 100 ohms to 5 megohms

IT'S A SIGNAL TRACER

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

IT'S A TV ANTENNA TESTER

The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

Specifications

✓CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakages up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

✓RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
L. MELENKEVITZ

✓SIGNAL TRACER SECTION

A built-in high gain pentode voltage amplifier, plus a diode rectifier, plus a direct coupled triode amplifier are combined to provide this highly sensitive signal tracing service. With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

✓TV ANTENNA TESTER SECTION

Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna firs^? The Model 76 will enable you to locate a break in any TV antenna and if a break does exist, the Model 76 will measure the location of the break in feet from the set terminals. 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

Model 76 comes complete with all accessories including R.F. and A.F. Probes; Test Leads and operating instructions. Nothing else to buy. Only

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NO MONEY WITH ORDER — NO C.O.D.

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

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Dept. D-339, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

Address.....

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

All prices net, F.O.B., N. Y. C.

☐ Model TW-11.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

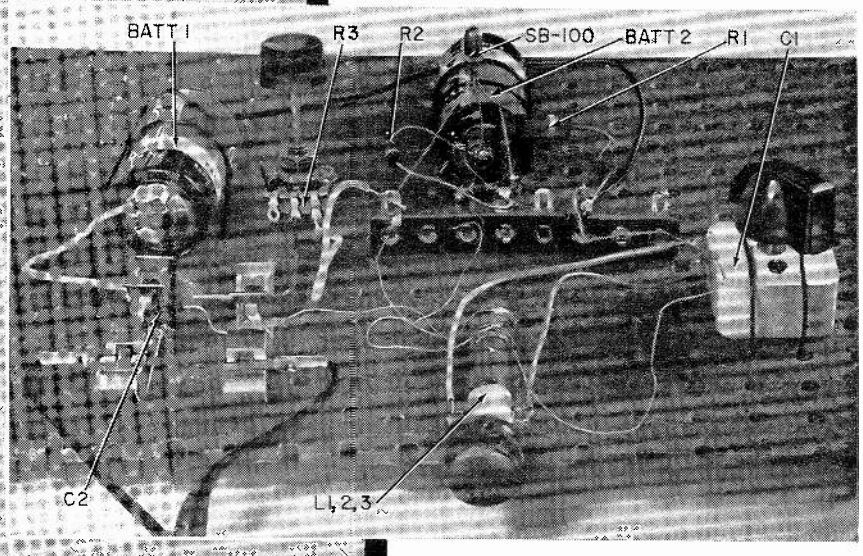
☐ Model 76.....Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.

☐ Model TV-12.....Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.

☐ Model TV-50.....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TV-40.....Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

Regenerative Radio Uses New SB TRANSISTOR



Higher cutoff frequency of new surface-barrier type improves regenerative action

Experimental model was built on pegboard —can be mounted easily in a small case.

By EDWIN BOHR

THIS new transistor regenerative detector outperforms previously tested circuits. Two distinctive features make it a really new detector. First, without sacrificing audio gain, all long time constants have been completely eliminated from the detector. This, for all practical purposes, does away with audio bypass capacitors and the familiar regenerator squeal, growl or motorboat sounds. Second, but also of first-order importance, we have used the Philco surface-barrier transistor which performs circles around conventional diffused-, alloy- or grown-junction transistors.

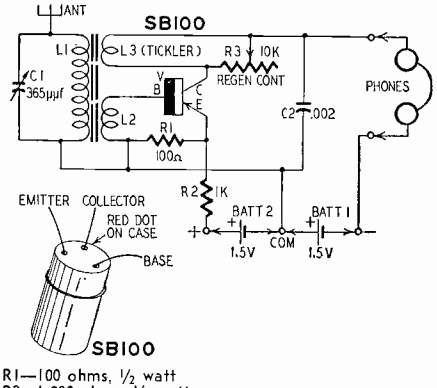
The SB (surface-barrier) transistor is a hot-performing detector at radio frequencies. It is worth while to the reader to know why this is true. So let us lay some explanatory background. The cutoff frequency of a transistor is the frequency at which the transistor gain is 3 db below its low-frequency value. This cutoff frequency is measured *with the transistor in the grounded-base connection.* The reader should also know that beta is the transistor's ground-emitter current gain.

The grounded-base transistor connection does not give current gain. However, the grounded-emitter connection provides plenty of current gain at low frequencies. This is because the base circuit must be supplied with only enough current to make up for the small difference between emitter and collector currents. Current gains of a hundred or more are common in the grounded-emitter connection.

But, this current gain can be realized only when the emitter and collector currents are in phase. As the frequency is increased, the emitter and collector currents get further and further out of phase. This phase difference causes the emitter current to have a much different value from the collector current at any given instant. This results in a lowered current gain at high frequencies. And the higher the beta gain of the transistor, the more this effect is magnified at high frequencies.

The high-frequency gain of a grounded-emitter stage begins to roll off at a frequency equal to the quotient of the transistor cutoff frequency divided by the beta gain.

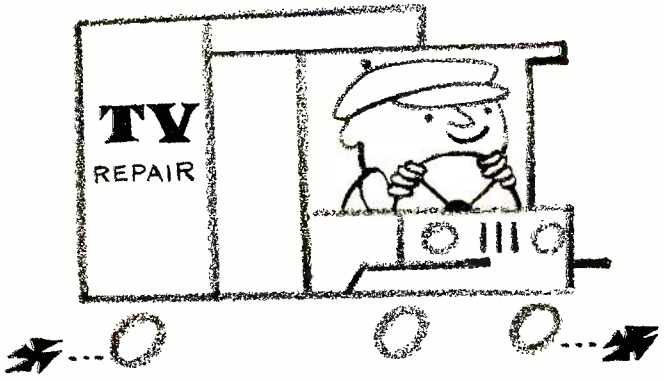
Suppose we have a transistor with a beta of 40 and a 10-mc cutoff. With these conditions, the performance of a grounded-emitter stage will begin to drop at 250 kc (10 mc divided by 40), well below the broadcast band. Usually, high-frequency transistors also have



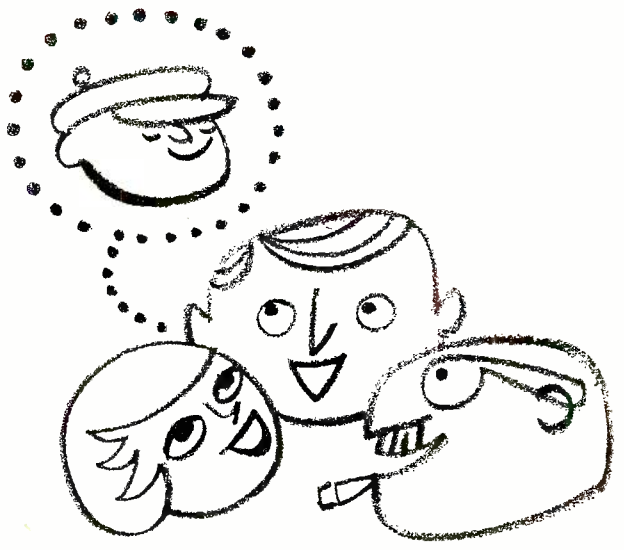
R1—100 ohms, ½ watt
R2—1,000 ohms, ½ watt
C1—variable capacitor, 365 μμf
C2—.002 μf, ceramic or paper
L2, L3—special windings, see text
L1—ferrite-rod antenna, see text
V—Philco SB-100 surface barrier transistor
BATT 1, 2—dry cells, 1.5-volt
Pegboard, Fahnestock clips, wire, knobs, solder, screws, terminal strip, etc.

The SB regenerator uses a balanced battery, throttle regeneration control.

Reputation Builder #1: it pays to get along with everybody



- Only 13% of your customers chose you because you were nearby



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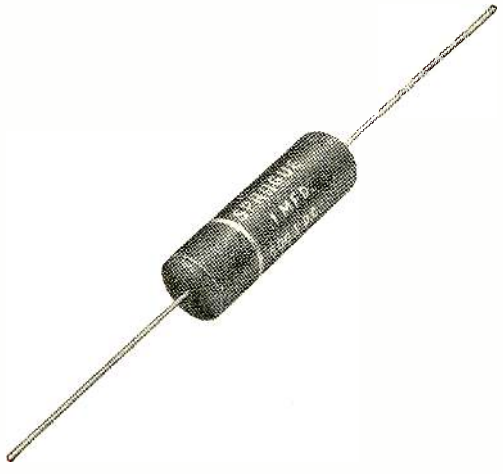

- Another way to build and hold a reputation is to insist on top quality replacement parts. Callbacks due to replacement failures not only cost you *money* . . . they also cost you customers! Replace with less than the best and you place your reputation at stake. In capacitors, the best is *Sprague*.
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- Get your copy of Sprague's latest radio and TV service catalog, C-455. Write Sprague Products Co.*, Distributors' Division of Sprague Electric Company, 81 Marshall Street, North Adams, Mass.

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very high betas. This makes conditions, usually, somewhat more unfavorable than those just presented.

For the reasons just presented, low-frequency transistors (the 2N107 or CK722, for example) are most useful in the broadcast band as grounded-base-connected amplifiers or detectors. High-frequency units like the 2N136, however, are suitable in the grounded-emitter connection.

Surface-barrier transistor

In contrast to junction types, with their degraded high-frequency performance, the surface-barrier transistor just begins to show its clear-cut superiority at radio frequencies. It is designed to give optimum performance at high frequencies.

Typically, a SB transistor may have a cutoff *frequency of 50 mc and a beta of 10!* This means performance is excellent through the broadcast band and far into the shortwave bands. The SB transistor gives this type of performance with only a volt of collector supply and a power consumption only one-tenth that of a junction transistor.

SB detector circuit

The figure shows the new regenerator circuit using the Philco type SB-100 surface-barrier transistor. Notice the emitter is biased from the drop across a 100-ohm resistor. This value of resistance is low enough to obviate the need for a bypass capacitor. Because the bypass capacitors are eliminated, the usual audio howls are gone. Admittedly, there is a bypass capacitor across the headphones, but this has little effect at audio frequencies.

The usual emitter or base bypass capacitor has been dispensed with at the expense of some power loss in the 1,000- and 100-ohm resistors. Even then the resulting power consumption is still far less than for a junction-transistor stage.

An interesting facet of this circuit points up the marvelous characteristics of the SB transistor. Once the detector has gone into oscillation, the emitter bias can be reduced to zero and the circuit will continue to oscillate strongly! As many experimenters will know, this just can't be done ordinarily. It is indicative of the circuit's high gain and merit.

This was the reason we *had* to control regeneration with a shunt resistor across the tickler coil. If a bias type regeneration control had been used, it would have lost control immediately with the beginning of oscillation. The only way to stop oscillation under these conditions would be to turn off the battery supply.

Construction and operation

The original circuit was built on a pegboard, allowing the circuit to be quickly modified without the confusion that usually rules the breadboard layout. This arrangement is very con-

venient. Otherwise hard-to-mount components are easily attached to the board with wire harness running over the component and through the pegboard holes. As the photo shows, the tuning capacitor, antenna and dry cells were all attached that way. Almost any component can be jockeyed around on the board's surface until its mounting holes coincide with those punched in the board.

As a design rule of thumb, any regenerator tuned circuit should have the highest possible Q. This is the reason a ferrite-rod antenna, or loopstick, is used. It must have two additional windings—one for the transistor base circuit and the other to provide feedback from the collector. Winding L2 is seven turns and L3 two turns of flexible wire wound over the main winding. The wire size is not too important. It is advisable, though, to wind tickler L3 on a small paper sleeve so it can be slid on or off the ferrite rod. This provides a rough regeneration control that can be adjusted to account for changes in antenna length and loading.

Some of the newer ferrite-rod antennas are tapped for transistor use. The Lafayette MS-299 is the latest example. If this type is used, simply connect the transistor base to the tap and add only the tickler coil L3.

Connect the emitter and collector cells, observing the proper polarities, which are exactly the same as for a junction p-n-p transistor. The emitter is biased with a positive current and the collector operated with a negative voltage.

Now, connect a short antenna—say 10 feet—to the detector and rotate the regeneration control back and forth. The detector should go into oscillation with a plop sound or a click. If it does not oscillate, reverse the leads to the tickler coil.

Adjust the tickler position so the detector goes in and out of oscillation near mid-position of the control. With these adjustments made, stations should be picked up easily. Local stations will be loud and clear with plenty of volume. Some can even be picked up without an antenna. Distant stations can be picked up even in the daytime but the audio level will be too low to hear comfortably. Two stages of additional transistor audio amplification can be added if desired for distant reception.

The new solid-dielectric type of tuning capacitor was used on this model. We are glad to report it does not produce the annoying swish during rotation that earlier models had exhibited. As shown in the picture, the tuning screw on the antenna coil has a knob attached and is used for fine tuning. Knobs are now available on the market that exactly fit the diameter of this tuning screw.

If you are interested in transistor regenerators, try this circuit. We believe it will outperform anything you've seen yet. END

The Navy steers Bernie on the right course

When Bernie graduated from Croton, N. J. High School in 1950, he received a general diploma—mathematics and science made up a small part of his curriculum. Enlisting in the Navy in 1951, Bernie proved his aptitude for technical work and was assigned to the electronics preparatory school in Jacksonville, Fla. Later, he attended the Class A Aviation Electronics School in Memphis, Tenn. . . . probably the most important phase of his naval training because it was in Memphis that he became convinced that a technical career was "Right up my alley." But an event that occurred during a furlough in the spring of 1955 put a brand-new light on Bernie's future.

Here, he scans the schematic of computer circuits.

Reports for training

Bernie smiled when he mentioned that his mother had a tendency to clip want ads. "It was just pot-luck that one of the ads she spotted was for IBM Kingston and Project SAGE." Soon afterwards, Bernie hopped a bus to Newark for an interview with the IBM representative. He took the required number of tests—talked over his hopes and ambitions, and "That's about all there was to it." In July, Bernie notified IBM that he was definitely available, and supplied the necessary references. Meanwhile, he made a study of IBM's history, its policies, its growth, and its future—all of which impressed him favorably. One day in September, Bernie received instructions to report to Kingston to begin training in the applications of electronic computers.

The material he studied at Kingston

"The Kingston program is a real experience, and quite an eye-opener in electronic techniques. First of all, I studied basic circuitry. Then, I actually learned a new way to think—the ability to comprehend the whole from the assorted parts. The student must know how to form logic blocks, and in time, he should be able to design his own circuits. All of this proved especially helpful once I got out into the field. Later on, I studied the various input-output devices which are used as auxiliary units to the central computer. Finally, I analyzed the methods that supply the power for this electronic giant. Millions of watts are needed—a phenomenal amount. In general, I'd say that you couldn't find a better training ground for understanding the uses of electronic as well as electro-mechanical equipment."

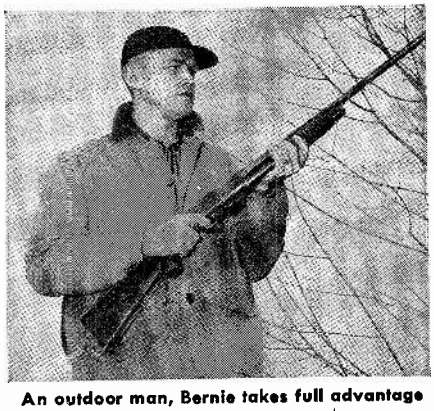
Bernie checks a unit in one of the operating consoles.

How does Bernie feel about his current assignment?

"I'm responsible for the performance of the input-output devices—the auxiliaries that supply information to the central computer. The many Project SAGE outposts—picket ships, reconnaissance planes, Texas towers—flash their signals to the input devices which, in turn, correlate and compile the data. You might say the input devices prepare the food for digestion by the main electronic computer. This, incidentally, is one of the world's largest computers, which is built and tested at Kingston, then disassembled and shipped to a directional control site such as McGuire. Sometimes, I have the chance to assist in systems and displays. Now displays really fascinate me. There's a kind of television screen on which you can detect a plane, determine whether it's friendly or hostile, and where it's headed. My work is always different, never routine, and that's very important to me."

How does the future look to Bernie?

A happy and prosperous future is in the offing for Bernie Roth. And, based on the records of his older associates, he's confident that in five years' time he will qualify as a Systems Engineer, at the very least. The next steps going up the ladder are Group Supervisor and then Group Manager. "The real satisfaction in working with IBM is the opportunity to understand more and more about electronic techniques. And IBM is quick to recognize and reward improved ability through greater knowledge."



An outdoor man, Bernie takes full advantage of the New Jersey game preserve.

What about you?

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Patents

HIGH-FREQUENCY PHASE SHIFTER

Patent No. 2,753,519

Martin Fischman, Wantaugh, N. Y. (Assigned to Sylvania Electric Products, Inc.)

Phase-changing networks are well known and widely used. The simplest consist of resistance and capacitance in series. The voltage across a capacitor *lags* the voltage across a resistor. This invention utilizes a diode rectifier instead of a resistor. When its bias is varied there is a change in its internal resistance and this permits control over the total phase shift. Thus shifting may be done at a high rate.

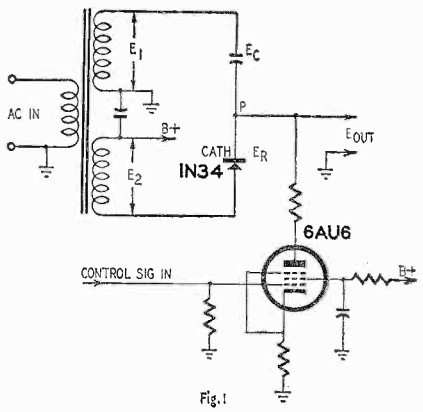


Fig.1

Fig. 1 shows the phase changer. A tapped transformer winding provides the two equal and opposite voltages E1 and E2. The phase-changing network consists of a capacitor and a 1N34 which acts as a variable resistor. It is biased by current from the 6AU6, which in turn is controlled by its grid signal.

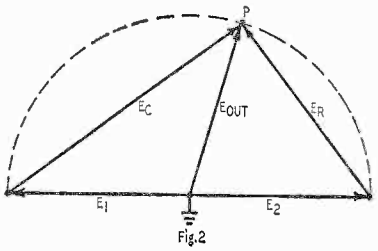


Fig.2

The vector diagram of this circuit is drawn in Fig. 2 This diagram indicates that E1 and E2 are equal and opposite (with respect to ground). E_{out} is the vector sum of E1 and Ec and also of E2 and E_R. In addition, Ec must be at right angles and lagging the voltage E_R by 90°. The dotted line is a semicircle which must intercept the three vectors at point P. Fig. 2 shows that E_{out} may vary in phase over 180° range. The 6AU6 signal, and therefore the rate of phase change, may be dc, af or even rf.

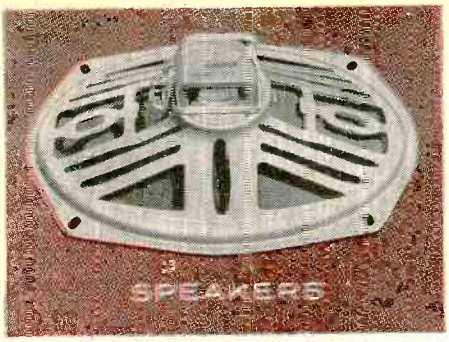
FLASHLAMP

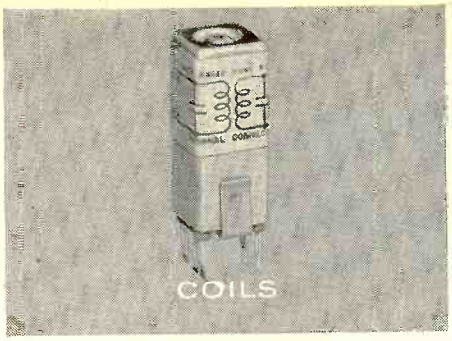
Patent No. 2,756,365

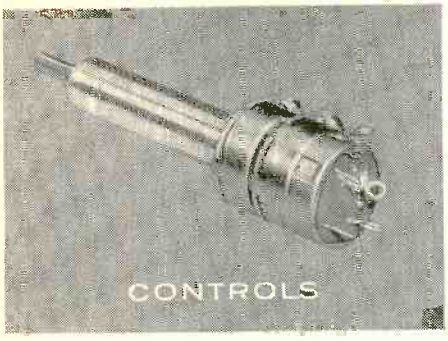
Kenneth J. Germeshausen, Newton Centre, Mass.

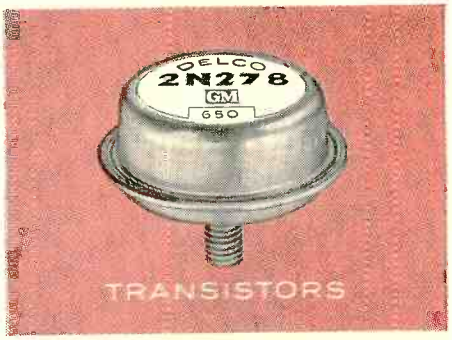
Most three-element electron-discharge flashlamps can handle higher powers than two-element types, but require higher ignition voltage. This invention uses a three-element lamp flashed at relatively low voltage.

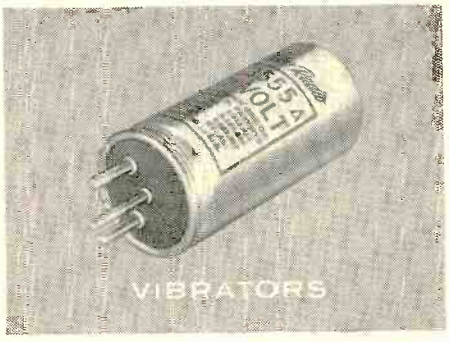
When S1 is closed, the main capacitor C1 is charged through limiting resistor R1. C1 is

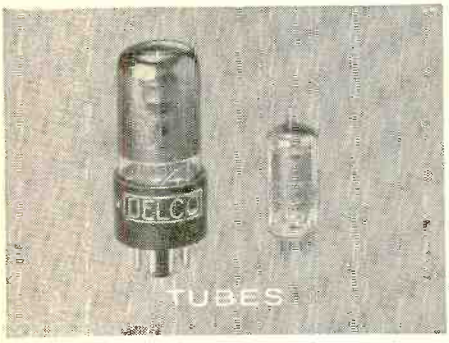












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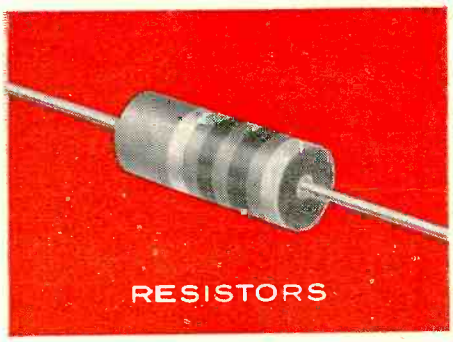

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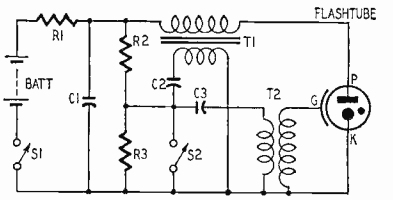


shunted by bleeder R2–R3. Two capacitors are energized from a tap on the bleeder: C2 (through the primary of T1, a saturable transformer) and C3 (through the primary of trigger transformer T2).

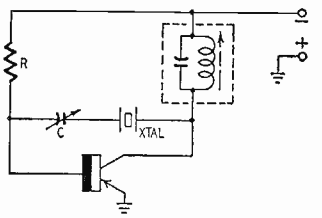
When S2 is closed, both capacitors discharge. T2 sends a pulse to G, the lamp's control element starting a partial discharge in the lamp. At the same instant a pulse from T1 arrives at the anode P. T1 steps up the pulse which (with the aid of the trigger pulse at G) ignites the lamp, resulting in full discharge. The voltage source may be as low as 450 or 500.

TRANSISTOR CRYSTAL OSCILLATOR

Patent No. 2,755,384

Karl E. Pierson, Los Angeles, Calif., and Eugene D. Meng, Torrance, Calif. (Assigned to Hoffman Electronics Corp.)

This oscillator relies on the *series*-resonant frequency of a crystal, therefore it is not affected by differences in crystal Q. Also, it has provision for making small changes in the crystal frequency.



The tank (within dotted box) is connected in the collector circuit. A variable capacitor in series with the crystal permits small frequency variations. R determines base bias.

The tank is tuned to the low side of the crystal frequency to give it capacitive reactance. Thus it forms an equivalent voltage divider with the *capacitive* base-emitter reactance. At the crystal frequency the crystal impedance is negligible. This voltage divider feeds back energy from collector to base and sets the circuit oscillating.

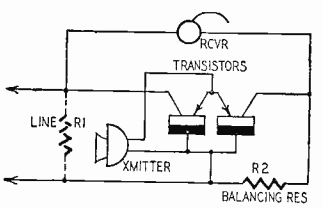
The tank Q should be low to match the low Q of the transistor input.

TELEPHONE CIRCUIT

Patent No. 2,762,867

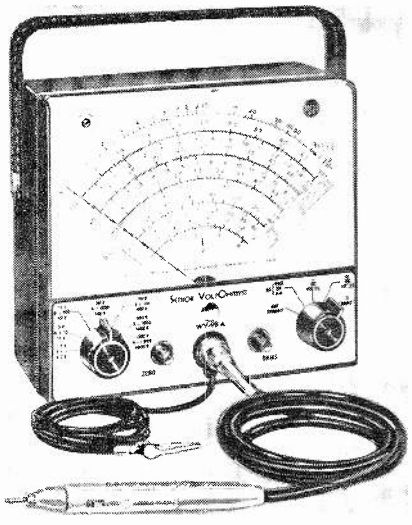
Larned A. Meacham, New Providence, N.J. (Assigned to Bell Telephone Labs, Inc.)

This circuit eliminates sidetone from a telephone. Sidetone is the interference that may occur in a receiver due to sounds originating in the transmitter of the *same* telephone.



Signals coming in from the line (shown as an equivalent resistance R1) are heard in the receiver after passing through R2. Each of these is 600 ohms. The receiver resistance may be 1,200 ohms. The signal is attenuated only slightly in passing through R2.

Sound and noise originating at the local transmitter are amplified in both transistors. They cancel out in the receiver because it is connected to both collectors (which are out of phase). Only one transistor feeds the line, however, so the signal is transmitted outward as desired. END



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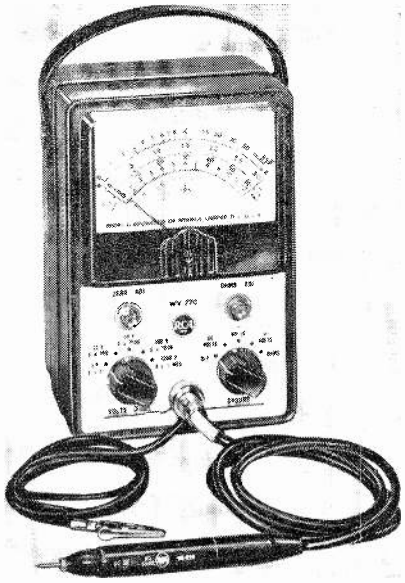

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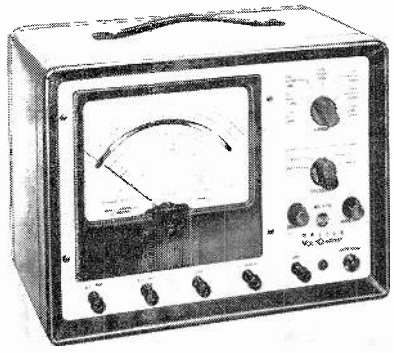

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AC (peak-to-peak) Voltage	0.2-4200v	0.2-4200v	—
Resistance	0.2-1000 meg.	0.2-1000 meg.	0.2-1000 meg.
Current	10 uamp -15 amp.	—	—
Accuracy:**			
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DC Voltage	±3%	±3%	±3%
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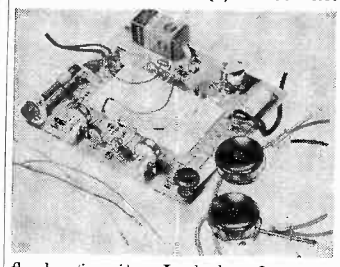

flash circuits. Includes 2 transistors, dual headphones, plug-in circuit leads, guide cards, solder, relay, photocell and instruction manual.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.

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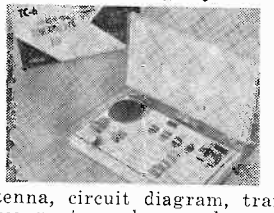

antenna, circuit diagram, transistor part numbers and manufacturers' names. *Vo-Tron TC-6-T* complete with 6 transistors. —**Vokar Corp.,** 7300 Huron River Dr., Dexter, Mich.

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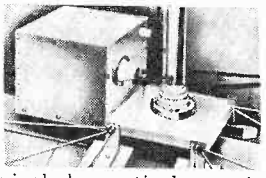
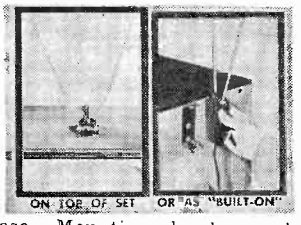


bly includes vertical mast, base, tuning network and relays, control box for remote operation, 6 nylon guy ropes and installation and operation instructions.—**E. F. Johnson Co.,** 2902 2nd Ave. S.W., Waseca, Minn.

INDOOR TV ANTENNA, *V-8 Universal model 185.* Usable as both top-mount and built-on antenna for uhf and vhf. 3-section nickel-plated steel dipole. High-impact polystyrene mahogany

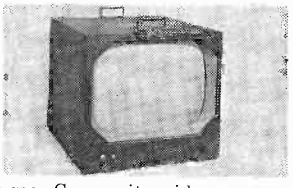


case. Mounting hardware included.—**Radion Corp.,** 1130 W. Wisconsin Ave., Chicago, Ill.

CONVERSION KITS from metal to all-glass picture tube in older models of 21-inch TV sets. *No. C-6* fits Wells-Gardner, Airline, Truetone, Firestone, Coronado and Arlington; *No. C-7,* Arvin

and Silvertone; *No. C-8,* RCA 27-inch sets; *No. C-9,* Crosley models.—**Colman Tool & Machine Co.,** Box No. 6001, Amarillo, Tex.

VIDEO MONITORS. *Model DVM,* 14, 17 (illustrated) and 21 inches. For closed-circuit TV, studios, labs and manufacturing. 11 tubes and aluminized picture tube. Dc restorer circuit. Video response flat within 1 db up to



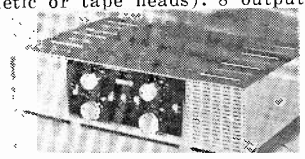
10 mc. Composite video or separate sync and video input handles peak-to-peak voltage range from 0.25 to 5. Draws 140 watts from standard 105–130-volt 60-cycle power source. Operating temperatures from −10 to 50°C. —**Blonder-Tongue Laboratories, Inc.,** 9 Alling St., Newark 2, N.J.

REPLACEMENT YOKES. 5 new yokes cover replacements in more than 150 G-E models and chassis without mechanical or electrical changes in set. *MDF-83* for RLD-013; *MDF-84* for RLD-025; *MDF-85* for RLD-041 and 045; *MDF-86* for RLD-042

and *MDF-87* for RLD-052 and 067.—**Merit Coil & Transformer Corp.,** 4427 N. Clark St., Chicago 40, Ill.

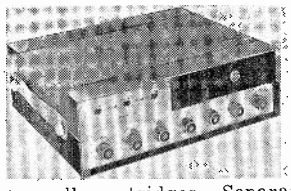
(Continued)

HIGH-FIDELITY AMPLIFIER, *2300.* Built-in preamplifier provides inputs and equalization for playback from tape head or ceramic cartridge as well as standard high- and low-level magnetic cartridges. Power output 20 watts at less than 0.3% harmonic distortion and 40 watts peak. 7 inputs (two for low magnetic or tape heads). 8 outputs



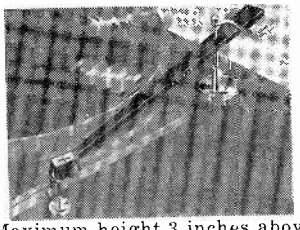
for 4, 8, 16 ohms and Hi-Z recording. 2 outputs for switching speakers. 2 ac outlets. 4-position input selector, 5-position equalization, 3-position speaker switches. Separate rumble and scratch filters. Continuously variable loudness control.—**Bell Sounds Systems, Inc.,** 555 Marion Rd., Columbus, Ohio.

PUBLIC-ADDRESS AMPLIFIER, *Flex-Pak Line.* 12 models. Constant-voltage output taps to help determine speaker-matching transformers. Special filters. Equalized phono input accommo-



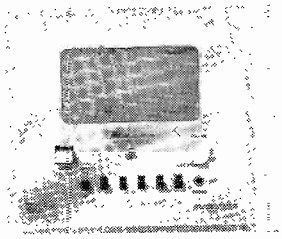
dates all cartridges. Separate bass and treble controls. Plug-in sockets for low-impedance transformers. Anti-feedback control minimizes acoustical feedback. Built-in remote gain-control circuit allows changes in gain from distances up to 2,000 feet. 3-position microphone, tuner or phonograph cartridge switch.—**David Bogen Co., Inc.,** Forrest Ave. & Route 4, Paramus, N. J.

ARM AND PICKUP ASSEMBLY, *Fluxvalve-Unipoise, model 194-D.* Molded pickup and arm with single needlepoint bearing. Integral cartridge designed for high-compliance, low-dynamic-mass stylus inserts. Output at 1,000 cycles with 10 cm/sec stylus velocity–15 mv. Flat frequency response from 20 to 30,000 cycles, ±2 db. Length, 11¾ inches. Mounting hole 8 inches from turntable center.



Maximum height 3 inches above motor board.—**Pickering & Co.,** 309 Woods Ave., Oceanside, N. Y.

HOME INTERCOM, *Masco Multi-Talk.* For communications between rooms as well as master and remote stations. Also, music can be distributed to selected points by plugging in any radio, phonograph, recorder or record changer. Flush-mount or portable radio can be installed as

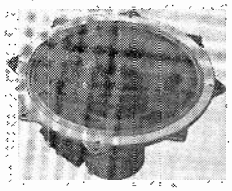


additional equipment. Gold, copper or stainless steel.—**Mark Simpson Manufacturing Co., Inc.,** 32-28 49th St., Long Island City 3, N. Y.

EXPERIMENTAL CARTRIDGE, *model XP-2.* Hand-constructed.

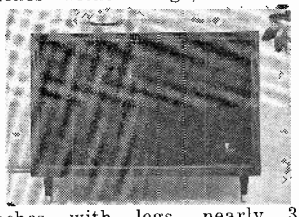
Moving-coil type. Bonded diamond stylus assembly.—**Fairchild Recording Equipment,** 10-40 45th Ave., Long Island City 1, N. Y.

CONCENTRIC LOUDSPEAKER, *British Stentorian Duplex 15.* Pressure type high-frequency unit driven by lightweight diaphragm through center pole of magnet forming a phase-matched horn. Audio range from 20 to 20,000 cycles. Low-frequency resonance at 35 cps. Adjustable curvilinear cambric low-frequency cone with mid-range stabilizers. Built-in electrical crossover. Nonresonant die-cast frame. 16-pound Alcomax series magnet system for the two 2-inch-diameter voice coils. 25-watt power rating. Dispersion of high-frequency sound over 180° with twin diffusers.—



Barker Sales Co., 996-8 Edgewater Ave., Ridgefield, N. J.

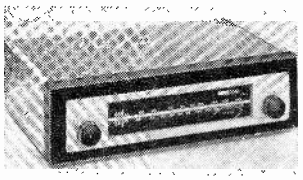
REAR-LOADING HORN, *JBL Harkness, model C40.* For smaller rooms. Entirely contained and independent of room position. Extended range speakers. Lowboy enclosure under 24 inches without legs, under 30



inches with legs, nearly 38 inches wide and 20 inches in depth. — **James B. Lansing Sound, Inc.,** 2439 Fletcher Dr., Los Angeles 39, Calif.

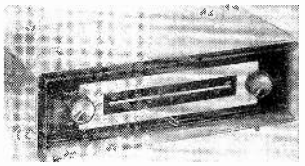
AM–FM TUNER, *Theme II, T-1040.* Armstrong circuit with dual double-tuned limiters and Foster-Seeley discriminator. Variable afc. Variable noise gate. Illuminated tuning meter. FM rumble filter. Superheterodyne AM with tuned-rf stage,

(Continued)



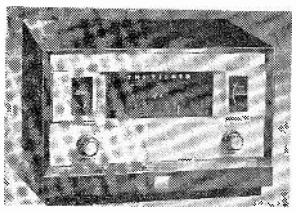
10-kc whistle filter. Output terminates into a dual cathode follower with adjustable level control. — **Harman Kardon,** 520 Main St., Westbury, L. I.

FM TUNER KIT, *Stock No. 83 Y 751.* Contemporary cabinet styling, printed circuitry, flywheel tuning and automatic frequency control. 2 output jacks. Sensitivity 10 μv for 20-db



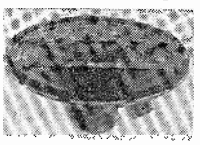
quieting any point on FM band. 7 tubes plus 6 x 4-inch rectifier. Illustrated instructions.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill.

GOLD CASCODE FM TUNER, *model FM-90X.* 2 meters for



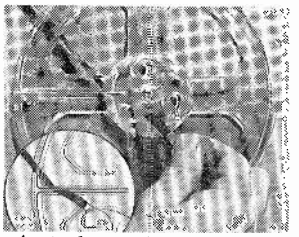
micro-accurate tuning. Dual dynamic limiters. Full wide-band detector. Variable interstation noise eliminator. Full limiting on signals as low as 1 microvolt. Dual-triode, cascode-tuned rf stage, 4 if stages. Uniform response 20 to 20,000 cycles. Main, recorder and multiplex outputs. 72- or 300-ohm balanced antenna inputs. 4 controls. 10 tubes plus 4 matched germanium diodes. Special circuits for meter operation. Shielded and shock-mounted chassis, 13 7/16 x 6⅛ x 8⅜ inches. 15 pounds.—**Fisher Radio Corp.,** 21-21 44th Dr., Long Island City 1, N. Y.

SPEAKERS, *CA-12.* 12-inch coaxial (illustrated). High flux density (woofer and tweeter 12,000 and 8,500 gauss, respectively). Frequency range 40–14,000 cycles. Elliptical cone tweeter for wide dispersion. Complete L-C dividing network. *W-12,* 12-inch woofer. for multiple-speaker systems using several woofers or stereophonic systems. Features large Alnico



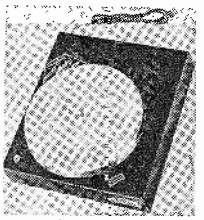
V magnet. — **Sonotone Corp.,** Saw Mill River Rd., P. O. Box 200, Elmsford, N. Y.

TAPE REEL, *Quick-thread.* 5 and 7 inches. Single operation loading because of slot at outer edge of reel where tape is inserted and automatically guided to hub. Wide angle formed by spokes and hub permits con-



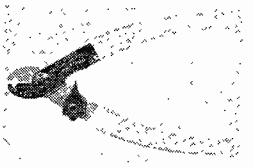
venient finger loading. Special write-on surface indexing area on each side. — **Reeves Soundcraft Corp.,** 10 E. 52d St., New York 22, N. Y.

PROFESSIONAL TURNTABLE, *model No. 45* for 33⅓ and 45 rpm; *Model No. 78* for 33⅓ and

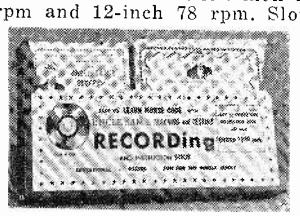


78 rpm. 65-db rumble. Less than 1/10 of 1% rms flutter and wow. Positive action-speed control lever. Belt-driven, heavyweight, nonmagnetic 12-inch turntable. Precision 4-pole constant speed magnetically shielded motor. Nonslip cork pad.—**Components Corp.,** Denville, N. J.

PRECISION TOOL, *Strip-Er-Clip.* Strips and clips wires from 14–26 gauge. 7-stop gauge adjusts to wire size, quickly set with thumb, prevents nicking wire or clipping off strands. Jaw design permits use in cramped places. — **Walsco Electronics Mfg. Co.,** 3602 Crenshaw Blvd., Los Angeles 16, Calif.

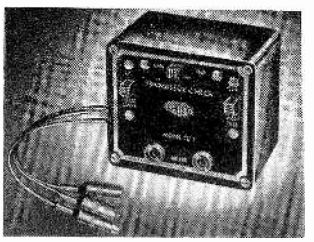


INTERNATIONAL MORSE CODE RECORDINGS. 7-inch 45 rpm and 12-inch 78 rpm. Slow



and fast signals transmitted for duplication by student in "didah" language. Messages for decoding. Explanation of "didah" and its use. Instructions for using Morse code with flashlight.—**Uncle Sam Recordings,** 59 E. Van Buren St., Chicago 5, Ill.

TRANSISTOR CHECKER, *model TC-1 Transistor Check.*



DON'T REMOVE THAT PICTURE TUBE!

SNAP CR TUBES BACK TO NORMAL BRILLIANCE LIKE MAGIC WITH "NU LIFE" KINECURE

SAVES SERVICEMEN TIME • MONEY • IRRITATION

"Nu Life" Kinecure is a joy to servicemen. Saves time and effort pulling CR tubes. Solves the service problem when the customer will not permit the set to leave the house. Eliminates the need for a long haul back to town for the replacement of CR tube. It's easy for a trained technician to follow furnished diagrams. Locate and instantly correct 33 combinations of CR tube element shorts and opens. The "Nu Life" Kinecure is guaranteed to correct permanently open cathode, shorted control grid to cathode, shorted cathode to filament, and open control grid. It is a superior "boost" for low emission and slow heating, and is equally effective on any receiver in series, or parallel, or on electro-static focus CRT's. When the "Nu Life" Kinecure is installed on a picture tube, the life of the filament will be equally as long as if the same picture tube were equipped with a "Brightener". You can't go wrong with a "Nu Life" Kinecure; and your customer will be delighted when his set snaps back quickly without long and irritating "trouble shooting". Your jobber has Kinecure now. Get the full facts and complete technical explanation. Send coupon below.

HERE'S HOW IT WORKS

The "Nu Life" Kinecure can be quickly, easily, and permanently installed by a television technician. Merely follow diagrams (included with each unit) to place terminal strip jumpers in the proper lugs for a specific defect or combination of defects, and adjust the unit's control. Proper diagnosis is not an immediate problem because the "Nu Life" Kinecure cannot harm the picture tube or the receiver even if the jumpers are placed incorrectly. An experienced technician will immediately suspect symptoms at first glance, and can use the elimination method to try suspected shorts or opens until the picture appears. To the scientific minded, the "Nu Life" Kinecure operates on the 1/"mu" E.G. formulae to produce excellent picture quality. Try it. It works like a charm. Send coupon below for full information and technical data. Or ask your jobber.

"Nu Life" Kinecure is a Product of

CIRCUIT MANUFACTURING CO., INC.

6211 Market Street, Phila., Pa.

Sold only through television service dealers

CORRECTS ALL THESE DEFECTS PERMANENTLY

Permanently eliminates defects of: Open Cathode — Shorted Control Grid to Cathode — Shorted Cathode to Filament — Open Control Grid — and is a superior boost for low emission or slow heating — Any Combination of Defects Combined with Extremely Low Emission — Any Combination of Defects Combined with Slow Heating — Open Cathode Combined with Shorted Control Grid to Cathode — Open Cathode Combined with Shorted Cathode to Filament. Overcomes a total of 33 different combinations of shorts and opens involving various combinations of tube defects.

READ THIS UNUSUAL GUARANTEE

The "Nu Life" Kinecure must do everything we say it will — or your money back — provided it is installed by any recognized television technician anywhere in the U.S., according to installation instructions. The "Nu Life" Kinecure can be used on series or parallel or electro-static focus CRT's. No harm is done to either CRT or receiver if "Nu Life" is erroneously wired in installation.

FREE! GET FULL ILLUSTRATED DETAILS

CIRCUIT MANUFACTURING CO., INC.
26 Rittenhouse Place, Ardmore, Pa. A

Gentlemen: Please send me full illustrated details about the "Nu Life" Kinecure.

YOUR NAME_____

COMPANY NAME_____

ADDRESS_____

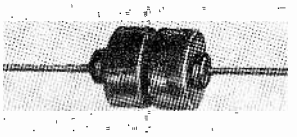
CITY_____ ZONE____ STATE_____

NEW DEVICES

(Continued)

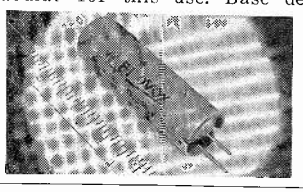
Can be used with vom scales in various ranges to test transistors in or out of set for current gain, leakage, opens or shorts and check crystal diodes for front-to-back current. Test leads, long-life batteries and detailed manual on transistor theory and testing. — **Century Electronics Co., Inc.,** 111 Roosevelt Ave., Mineola, N. Y.

HIGH-Q FERRITE-CORE CHOKES. For networks and filters at frequencies from 50–1500 kc and resonant elements in if and rf circuits. 14 inductances from 150 to 1 mh. Q values 142



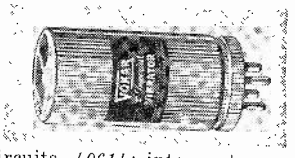
at 240 kc and 182 at 460 kc for a 1-μh choke. Coil form length ⅝ inch with 1½-inch pigtail leads. Diameters: 9/16 inch for 10-mh to 7/32 inch for 150-mh choke. Fungus-proof varnish. Temperature-stable chokes with less than 600 PPM/°C maximum drift.—**National Co.,** 61 Sherman St., Malden 48, Mass.

UPRIGHT-MOUNTING CAPACITOR, *Type P-156.* Outer insulating sleeve adapts paper tubular for this use. Base de-



signed to permit air circulation. Outside foil indicated by outer lead. Packaging includes Styrofoam pad.—**Aerovox Corp.,** 740 Belleville Ave., New Bedford, Mass.

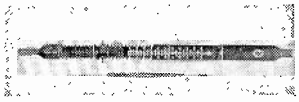
COMMUNICATIONS VIBRATOR, *Imperial.* For ambulances, taxicabs, police cars, fire and emergency equipment. *71210:* self-rectifying, reversible synchronous mobile communications power supply. *70611:* self-rectifying, reversible synchronous commercial–general-mobile communications power supply. *70612:* self-rectifying, reversible synchronous and for continuous-reception use in police cars and taxicabs. *70613: synchronous* with continuous transmitters; split reed; dual interrupter for police, ambulance, fire truck and taxicab receivers and 12-volt



circuits. *40614:* interrupter parallel-contact type power supply for mobile equipment. — **Vokar Corp.,** 7300 Huron River Dr., Dexter, Mich.

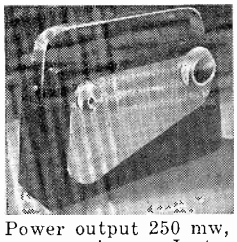
ALIGNMENT TOOLS, *Tele-A-Turn.* Automatically count and indicate turns made when resetting slugs, trimmers, screws, etc. *Tel-A-Turn No. 2586* is if aligner with one end fitting a No. 4 stud, the other a No. 6. *Tel-A-Turn No. 2587* an alignment screwdriver with standard metal tip at one end and extra-

narrow metal blade at other for small man openings. *Tel-A-Turn No. 2588* (illustrated) double-ended hex aligner turns top



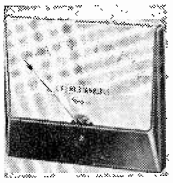
and bottom slugs with one side for 0.100-inch hex slugs and the other for 0.125-inch slugs.—**Walsco Electronics Mfg. Co.** 3602 Crenshaw Blvd., Los Angeles 16, Calif.

ALL-TRANSISTOR RADIO KIT, *TR-6.* 6 transistors. Diode detector. Push-pull output. 4-inch speaker. 9-volt battery with 250-hour life in normal



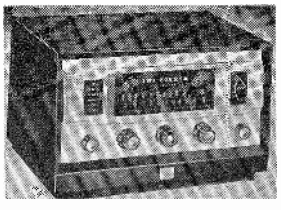
use. Power output 250 mw, with 300 mw maximum. Instruction book contains step-by-step wiring instructions, 4 pictorial wiring diagrams and schematic.—**Arkay Radio Kits, Inc.,** 120 Cedar St., New York, N. Y.

RECTANGULAR PANEL INSTRUMENTS, *Wide-Vue Line.* Open face design. Longer scale lengths. Custom-built 2½-, 3½- and 4½-inch models with any practical ac or dc range. Special



scales available. Standard magnet type or self-shielded core-magnet meter movements.—**Simpson Electric Co.,** 5200 W. Kinzie St., Chicago 44, Ill.

ONE-CHASSIS RECEIVER, *500.* Extreme sensitivity FM–AM tuner, audio control center and 30-watt amplifier. Micro-accurate tuning meter. Full, wide-



band FM detector. Amplifier has 16–32,000-cycle response, handles up to 60-watt peaks. 4 inputs including a separate tape playback preamplifier–equalizer. 4-, 8-, 16-ohm and recorder outputs. 7 controls. **Fisher Radio Corp.,** 21-21 44th Dr., Long Island City 1, N. Y.

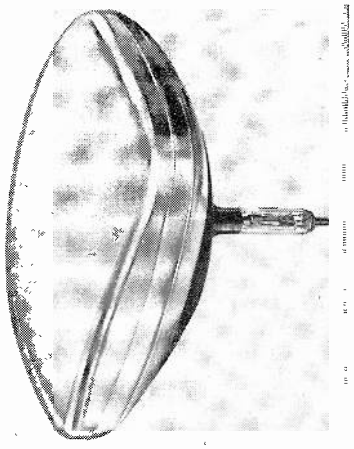
All specifications given on these pages are from manufacturers' data.

New Tubes & Semiconductors

This month's new tubes of particular interest to the radio–TV service technician are two new 110° magnetically deflected kinescopes and several tubes with controlled-warmup heaters.

110° picture tubes

The RCA 17BZP4 is a glass rectangular type with a 16 9/16-inch diagonal; overall length is 12 9/16 inches and weight 10 pounds. Thus, this 110° tube is approximately 3 inches shorter and 5 pounds lighter than comparative 17-inch 90° types. It has a 1⅛-inch diameter neck and features the new gun structure used in the 21CEP4 announced in the January issue.



The 17BZP4 is a low-voltage electrostatic-focus and magnetic-deflection type. It has a spherical filterglass faceplate, an aluminized screen 14¾ x 11-11/16 inches with slightly curved sides and rounded corners, and a minimum projected screen area of 154 square inches. In addition, the 17BZP4 has an external conductive bulb coating which with the internal conductive coating forms a supplementary filter capacitor.

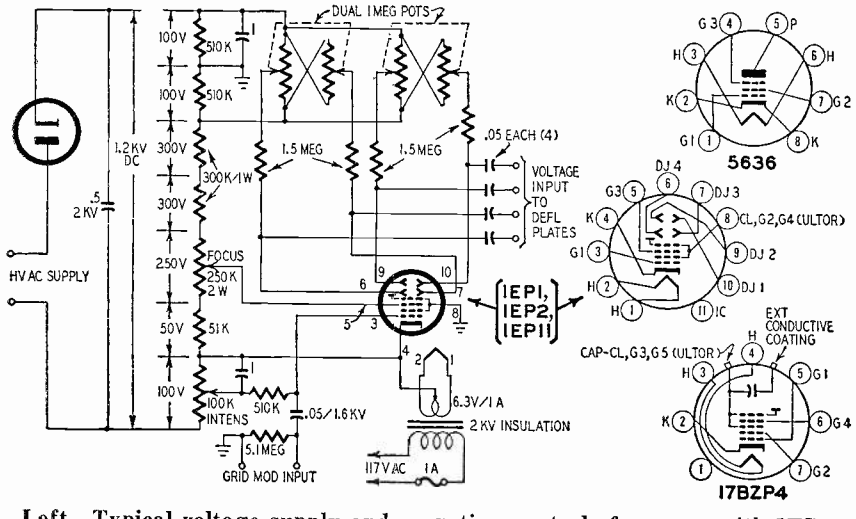
Sylvania's new 110° tube is the 17BVP4. It has a 1⅛-inch neck and electrostatic focus. It is a glass rectangular type with gray faceplate and 13¼-inch overall length. It uses a single-field ion-trap magnet and high voltage up to 17.6 kv.

1-inch scope tubes

The RCA 1EP2 and 1EP11 are companions to the 1EP1 flat-faced 1¼-inch-diameter cathode-ray tube announced in this column in the July, 1956, issue. The 1EP2 has a long-persistence screen, used where a temporary record of the trace is desired. The 1EP11 has a short-persistence screen intended for use where the trace is to be photographed. Except for the minimum ultor voltages, electrical characteristics are the same for the three types. Lowest usable ultor voltage is 750 for the 1EP2 and 1EP11 and 500 for the 1EP1.

Controlled-warmup tubes

This month's additions to the ever-growing list of tubes with heater characteristics designed for use in series-string circuits are the Sylvania 6AM8-A, 6AT8-A, 9CL8, 9U8-A, 6BY8 and the RCA 5CZ5. The 6AM8-A and 6AT8-A have 450-ma heaters and are series-string versions of the 6AM8 and 6AT8. The 9CL8 and 9U8 are 300-ma, series-string versions of the 6CL8—dis-



Left—Typical voltage supply and operating controls for scope with 1EP-type tube; right—base diagrams for 5636, 1EP1, –2, –3, 17BZP4.

OPPORTUNITY ADLETS

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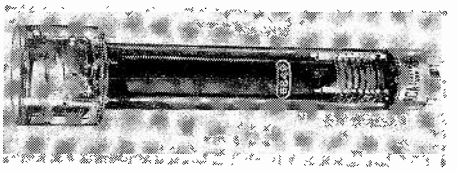
cussed in the October, 1956, issue—and 6U8, respectively. The 6BY8 is a miniature high-perveance diode and sharp-cutoff pentode designed for amplifier-limiter and detector service. The diode section is similar electrically to a 6AL5 and the pentode half resembles a 6AU6. The 5CZ5 is a 4.7-volt 600-ma equivalent of the 6CZ5 described in the January issue.

TV camera tube

The new RCA 6849 image orthicon is designed for TV cameras with industrial and scientific applications where light levels are extremely low. When used with a low-noise amplifier chain, it will produce usable video information with illumination on the photocathode as low as .00001 foot-candle.



The 6849 uses magnetic deflection and focus. Maximum bulb diameter is 3 inches and length is 15-3/16 inches.

Special-application types

The RCA 6887 is the first seven-pin miniature twin diode designed especially for switching circuits in compact, medium-speed electronic computers. Featuring a pure-tungsten 6.3-volt 200-ma heater, small size—only 1⅝ inches overall length—and high dependability, this type operates with about one-third less heater power than conventional twin diodes.

Other design features include a cathode made of a special alloy to minimize cathode interface and interlectrode leakage to maintain emission capabilities even after long standby periods, separate cathodes with individual pin connections and an internal shield to minimize coupling between stages. Base-pin connections and envelope size and shape are the same as they are for the 6AL5.

RCA 5636

A premium subminiature sharp-cutoff pentode intended for military and critical industrial service in gated and gain-controlled amplifiers, delay circuits and as mixers at frequencies up to 400 mc, the 5636 is rated for service at altitudes to 60,000 feet without pressurized equipment. It uses 1½–1¾-inch flexible leads. Base diagram appears on page 116.

The 5636 features two separate control grids each with a sharp-cutoff characteristic. Its cathode has two lead terminals to facilitate isolation of input and output circuits. Heater voltage is 6.3 at 150 ma. Absolute maximum operating voltages and currents (up to 60,000 feet) are: plate 165 volts at 11 ma, screen 155 volts at 7 ma, control grid 0 to −55 volts; suppressor grid −1 to +55 volts, plate dissipation 1.1 watts. END

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Technicians' News

MIDWEST ELECTRONICS FAIR

The first Midwest Electronic Service Fair will be held in Indianapolis, Indiana, April 12, 13 and 14, 1957, at the Antlers Hotel.

Service technicians from the five Midwestern states will attend the three-day show which will include exhibits, clinic lectures and a panel discussion by leaders in the industry. Acceptances for clinic discussions and speaking assignments have already been received from Westinghouse, Sylvania, Magnavox, Technical Appliance Corp., Howard Sams Co. and several other nationally recognized organizations.

The fair is sponsored by the Indiana Electronic Service Association whose membership includes service technicians from throughout Indiana. More than 1,000 technicians are expected to attend. Similar fairs have been held in New York and Texas; this is the first of its kind in the Midwest.

OPPOSE ILLINOIS LICENSING

Proposed legislation to license radio and television service technicians was discussed at a special meeting of the Associated Radio & Television servicemen, Illinois. (ARTS)

The ARTS membership decided to set up a committee that would handle all details of actively and aggressively opposing this legislation when it is brought before the public. Members of the committee are Harold Mueschen, chairman, Clifford Anderson, Anthony Bauman and Anthony Mallin.

STAN MYERS PASSES

Stanley W. Myers, veteran radio and television technician of the Philadelphia area, died recently after a brief illness. Mr. Myers established his first business in Philadelphia in 1926 and up to the time of his death continued to operate the repair shop that bore his name. He was the treasurer of the Philadelphia Radio Servicemen's Association (PRSMA) as well as editor and business manager of the PRSMA paper, and had been active in the affairs of the organization for many years.

CAPTIVE TECHNICIANS?

Independent service shops are losing trained and skilled help as a result of raids by factory service shops set up by General Electric, RCA and others, according to reports from a recent meeting of the Lackawanna Radio & TV Service Association. Commenting on these "talent raids," Dave Krantz, vice president of the Pennsylvania State Federation, called for action to combat loss of technicians and business to the captive service organizations and for increased support for the smaller service technicians and shop owners.

The meeting, called mainly to discuss captive service, is the first of a series of local meetings in which the Federation of Radio–TV Service Men's Associations of Pennsylvania will take part.

REWASHES SOLD WIDELY?

Testimony before the Bronx County, N.Y., Grand Jury indicates that "rejuvenated" and rebranded tubes may have a national distribution. Whether a system by which fake tubes were distributed to a network of dealers, was meant or whether national retail distribution from disreputable mail-order houses chiefly in the New York metropolitan area was implied, was not entirely clear from the testimony.

The investigation began with the arrest of Stanley Seltzer of the Bronx some time ago. He was charged with selling reprocessed tubes on which new warranty dates had been stamped. It was suspected that the tubes were factory rejects or worn-out ones collected from the junkboxes of TV service shops.

UTICA HAS NEW OFFICERS

The Mohawk Valley Radio–Television Technicians Guild (Utica, N.Y.) elected Frank Kurowski president; John Duga, vice president; Thomas Salisbury, secretary, and Edwin Buck treasurer at a recent meeting. John DeFrees, Frank Peters and Robert Weber were elected directors for one year.

SERVICE INDUSTRY TELERAMA

The council of Radio & Television Service Associations of Philadelphia and the Delaware Valley is sponsoring a weekend at the Ritz Carlton Hotel, in Atlantic City on April 12, 13 and 14.

H. Gordon Delaney, president of Allied Technicians of New Jersey and chairman of the reservations committee, reports considerable interest in the program has been aroused in many service associations throughout the country.

Plans for Telerama include presentations of new electronic products

(Continued)

the service industry will maintain, an arcade of manufacturers' exhibits, business and technical discussions, conferences between association leaders, a floor show and an industry dinner.

The council has five active associations and another New Jersey group is expected as a new member. The present active members are: Allied Technicians, New Jersey; TV Service Dealers Association and Northeast TV Service Dealers, Philadelphia; TV Service Dealers Association Delaware County, Pa., and Philadelphia Radio Servicemen's Association.

Reservations can be made by writing to Electronic Service Industry Telerama, 628 Lewis Tower, Philadelphia 2, Pa.

LICENSING ENDORSED

Licensing of Television repairmen has been endorsed in principle by the Radio & Television Guild of Long Island, New York, at a regularly scheduled meeting.

The guild, however, is withholding full support pending approval of three points TV repairmen consider essential for effective licensing. These are: First, that the television service industry be assured of full representation in the preparation of any licensing bill within the state of New York. Second, that an active member of the television service

Chris Stratigos (left), president of the Long Island Radio & TV Guild, confers with vice president and *Guild News* editor Ralph Milne, and last year's president Murray Barlowe on plans for the coming year, including a bigger and better Long Island Electronics Fair.

industry be a part of any permanent commission that might be established to supervise licensing. Last, that, before any local licensing bill is passed, an attempt be made to obtain state- or at least county-wide licensing.

Christopher Stratigos, president of the guild, expressed his confidence in the vast majority of Television repairmen. He stated, "Members of the guild already abide by a strict code of ethics and most nonmember technicians in the service field have their own high standards."

Stratigos and the guild feel the purpose of licensing is to eliminate the repairman with marginal qualifications and equipment who practices his trade at the expense of the public.

NEW ARTSD PESIDENT

The Associated Radio–Television Dealers of Columbus, Ohio, elected Jack Voigt as their new president. Following up a long-standing custom, the new president was presented with a birthday cake, in celebration of the 13th birthday of ARTSD, by the retiring president Jim Cumbow.

The association is preparing to discuss what should be done about the "test-it-yourself" tube testers which are causing losses in sales to many members of the association.

SECOND-HAND DEALERS?

Summonses were issued to a number of Bronx, N.Y., television dealers, charging that they were accepting TV trade-ins without first obtaining second-hand dealer licenses. At least one of the merchants stated that he had been accepting trade-ins for the last 25 years, first radios and later TV's, and had never been asked for a license before.

The reaction of another was "What do they think we are? Hockshops or something?"

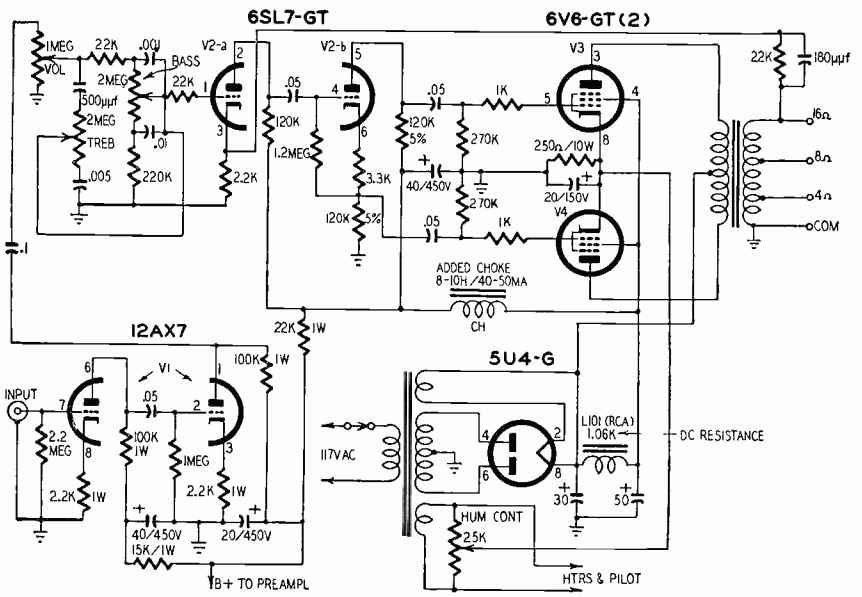
END

Question Box

AMPLIFIER CONVERSION

I have an RCA 648PTK projection TV set with AM and FM radio. I've discarded the TV circuits and kept the tuner and audio amplifier. Please show how the amplifier can be made a high-quality unit.—L.M., Lynbrook, N. Y.

Here is the diagram of your amplifier



as redesigned for high-fidelity performance. The 6J5 phase splitter in the original circuit has been replaced by half a 6SL7-GT (V2-b) and the 6F6's have been replaced by 6V6-GT's. V1 and V2-a compensate for losses in the tone control circuits and provide sufficient gain to permit most high-quality ceramic and crystal cartridges to drive the amplifier to full output.

V1 is shown as a 12AX7. It may be mounted in a convenient spot on or under the chassis. A shielded turret type socket (Vector or equivalent) will simplify wiring and placement of components. Keep all grid leads short and out of the fields of the chokes and power transformer, and shield if necessary to minimize hum pickup.

If you can do away with the power plug socket and wire the power cable directly to the power supply chassis, you can use this socket and substitute a 6SL7-GT for the 12AX7 without any changes in the circuit.

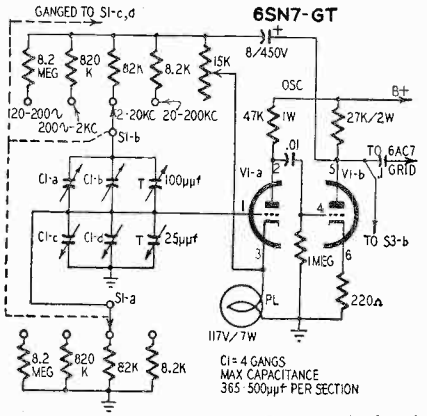
We suggest replacing the present output transformer with a wide-range type such as the Acrosound TO-270. If you want to go further, then convert it to an Ultra-Linear type using a TO-310 transformer and changing V2 to correspond to the phase inverter and driver circuit in the 6V6 amplifier in the Acrosound catalog.

If you plan to use a variable-reluctance cartridge, you can use a pre-amplifier recommended or supplied by the cartridge manufacturer.

MODIFYING AF GENERATOR

Can the waveform generator in the July, 1956, issue be modified to provide continuous tuning and a wider frequency range.—D. DeW., Menlo Park, Calif.

The diagram shows how continuous tuning can be provided by substituting for the fixed values in the original oscillator a set of ganged variables with a range of approximately 20 μμf to .001 μf. The tuning range is approximately 20 cycles to 200 kc in four bands. The main tuning capacitor (C1) should have a maximum capacitance of around 500 μμf per section. Such units are seldom available commercially except from surplus stocks. You can probably salvage a suitable substitute from an old radio made around 1932 or so. Otherwise, you can use a 4-gang 365-μμf unit with a slight reduction in tuning range.



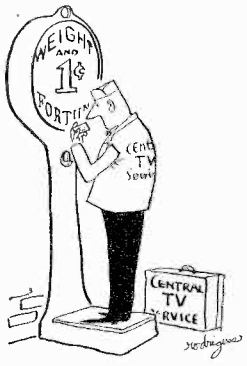
Note well that the frame of C1 is the common connection between all sections and the grid of V1-a so it *must* be insulated from the chassis with standoff insulators and from the dial and panel with flexible coupling.

The purity (freedom from harmonics) in the sine-wave output of the oscillator depends on matching resistors and sections of the variable capacitor in the frequency-determining network. The 25- and 100-$\mu\mu$f trimmers across the sections of the main tuning capacitor should be adjusted so the sine-wave out-put level (as measured with a scope or vtvm) remains constant as the tuning control is varied from 200 cycles to 2 kc. Use matched pairs of 1% precision resistors in the frequency-determining network and you will need to calibrate only one scale on the instrument. You will have to experiment with the values of the shaping capacitors and their connections to S1-c and S1-d to get the required performance on each range.

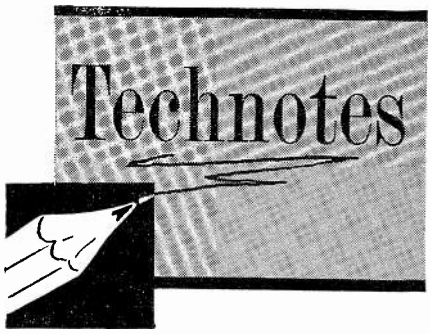
AFC FOR HEATHKIT FM-3A

In the January issue Mr. Montgomery explains how afc can be added to the Heathkit FM-3 tuner. I have a FM-3A whose circuit differs slightly from that of the earlier model and I'm not sure just what changes are required. Can you show how I can add this type of afc to my set?— H. C., Jr., La Grange Park, Ill.

Modifying the FM-3A for afc is simple. Just replace the 47,000-ohm 6C4 plate load resistor with a 15,000-ohm unit and proceed with the rest of the modification as outlined in the article.



"Weight 153 . . . be careful with high voltage."



NOISY TUNING CAPACITORS

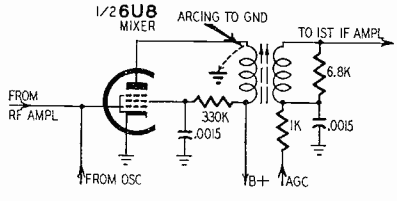
With the trend toward miniaturization in radios, smaller tuning capacitors are being used. When scratching noise is associated with tuning, the cause is usually shorting plates. Using a high voltage across the capacitor to burn out parts of the blades or to indicate the exact location of the offending parts is at best dangerous and requires unusual caution. Therefore, the following method appears more desirable:

1. Unsolder the antenna and oscillator leads from the respective sections of the capacitor.
2. Clip one lead of an ohmmeter to the stator and the other lead to the rotor of a section. Turn the capacitor the full arc until the meter shows which section is shorting. Often one or more portions of a section may be shorting.
3. When a short is found in either the antenna or oscillator section, observe at which part of the arc each section is shorting. Then, turn the rotor to minimum capicitance to expose the full plates of the rotor. With a magnifying glass the irregular spacing can easily be detected. A thin blade such as a razor blade can be used with little pressure to correct any irregular position of a rotor plate. Each time a plate is corrected, turn the rotor the complete arc and observe the ohmmeter for possible shorts.
4. A few drops of anti-noise lubricant on the ball bearings and on all moving contact portions of the rotor shaft will then insure smooth, noise-free motion of the variable capacitor.

—Jack Lipiner

INTERMITTENT STREAKS

On a Motorola model 14T4 the fault looked like a noisy tuner or tubes. The noise would sometimes affect vertical hold, mostly on the weaker channels. The 6U8 converter tube was microphonic. However, replacing the tube did not eliminate the intermittent condition.



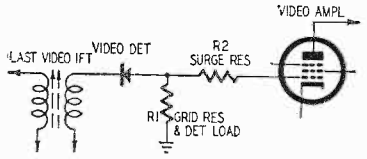
Unplugging the first if tube made the noise disappear, so it had to be somewhere in the front end. It was finally pinpointed to the 6U8 mixer section. By applying 350 volts and disconnecting leads, I found the trouble in the first if

transformer T1. Replacing this cured the trouble. The B-plus section was arcing to ground, causing the intermittent static.—*G. P. Oberto*

PIX DETECTOR FAILURE

Repeated failure of crystal video detectors in the same make and model is usually due to damage by a surge voltage.

Adequate resistance between detector circuit and the grid of the following video amplifier prevents such surges from overheating the crystal detector.



After servicing a set for a defective crystal detector, check to see if there is a surge resistor in the line to the grid. Resistor R2 should be connected as shown in the diagram. The value is not critical, neither is the wattage. Use between 220 and 1,000 ohms, ¼ watt, or better.

If there is no resistor between grid resistor R1 and the grid, insert one! It is cheaper than a return trip for free.—*James A. McRoberts*

RECENTERING PICTURE

Recently I had a Philco Model 51T1601 in the shop. The picture had shifted to the right, leaving about 3 inches of black area on the left-hand side of the screen, and the picture was way out of focus. I tried to focus the picture but with very little success.

I then tried to recenter the picture with the centering device, but with no results. I noticed the ion trap could be moved more than usual without changing the picture brilliance and the brightest position was near the focusing magnet. I finally removed the PM focusing magnet and tried a new one. The picture centers correctly now and can also be focused normally now.—*Clare E. Ernst*

RCA KCS47

Reduced sound with excessive high-frequency hiss can result from poor grounding of the angle shield underneath the chassis. Two bolts (Parker screws) hold this shield, plus a soldered connection to a center post of a miniature tube socket. Poor shielding due to improper grounding results in feedback and oscillation. Tighten the screws and resolder the contact. The shield, by the way, is around the fourth if coil!—*L. A. Williams*

MAJESTIC 2C6OP RADIO

A sudden decrease in volume was due to an open capacitor between the plate and cathode of the 6AC5-GT. Replacing the defective unit with a good .01-μf capacitor cleared up the trouble.—*John Flint*

3.58-MC HARMONIC RADIATION

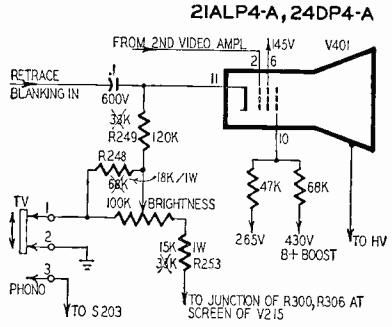
Interference on all channels, generated within color TV receivers, can be caused by the 13th harmonic of the 3.58-mc oscillator. This frequency—46.54 mc—beats with the picture carrier and creates interference in the picture on all channels.

In the model 21-CT-660U series receivers the 3.58-mc harmonic is coupled to the picture if amplifier by a shielded cable running from C175, at the plate of the vertical output tube, to R219 at the picture-tube terminal board. The shield of this cable is grounded to the chassis at one side of the 3.58-mc socket.

The remedy for this interference is to unground the shield at the 3.58-mc oscillator socket and ground it at the other end of the cable near the picture-tube terminal board. This modification has been made in all late-production receivers. — *RCA Television Service Tips*

DU MONT RA-340/341, 342/343

To improve the high-voltage regulation and thereby eliminate the possibility of a vertical size change and/or pulling at the left side of the picture when the brightness control is set to its maximum position, the following changes are made:



The picture-tube cathode brightness control circuit (see diagram) is revised by lowering the value of R248 from 68,000 ohms, 1 watt to 18,000 ohms; R249 from 33,000 ohms to 120,000; R253 from 33,000 ohms, 1 watt to 15,000.—*Du Mont Service News*

PICTURE-TUBE ARCING

Increases in high voltages used to illuminate picture tubes may cause tube failure. Arc-over can occur in the gun structure, resulting in burning open filaments and damaging cathodes.

A 100,000-ohm ½-watt resistor placed in series with grid 2 (pin 10) of the 21ALP4, -A, 21YP4, -B, 17HP4, -B or 24DP4A will help prevent arc-over from grid 2 to filament.

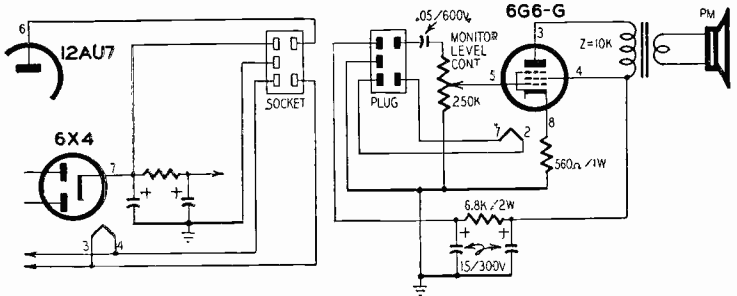
To insert the resistor, simply break the lead close to the picture-tube socket, put the resistor in series and then insulate the connections. Be sure to place this resistor physically close to the tube socket or there will be a possibility of shading occurring.—*Motorola Service News*

END

radio-electronic Circuits

RECORDER MONITOR

Many tape recorders on the market do not have a monitoring amplifier and speaker. This is a disadvantage because the operator must wear phones when monitoring a recording or editing a playback. The circuit in the diagram shows how I solved the problem of monitoring my Magnecord PT6-VAH without phones and without laying out



a bundle of cash. Although this circuit was designed with the Magnecord primarily in mind, it should work equally well with other tape recorders The monitor amplifier is a 6G6-G driven by the recorder's output stage. You can use a miniature 6AK6 without changing any circuit constants.

Heater voltage for the 6G6-G power amplifier was taken from the 6X4 (high-voltage rectifier) filament winding of the power transformer because the other tube heaters are supplied by a 12.6-volt selenium rectifier circuit. There was no objectionable hum pickup with this setup. Voltage for the plate and screen of the 6G6-G was taken from the cathode of the 6X4 rectifier. That prevented additional current from flowing through the R-C filter and increasing the voltage drop across it, which would have lowered the normal voltages applied to the other stages of the recorder. The small amount of filtering necessary for the plate and screen of the 6G6-G is supplied by a dual-section, 15-μf 300-volt electrolytic and the 6,800-ohm 2-watt resistor. Signal voltage is taken from the plate of the tape recorder output stage (12AU7) and R-C-coupled to the grid of the 6G6. The potentiometer arrangement permits the monitoring of recordings as well as playback.

The monitoring amplifier was constructed in a miniature utility cabinet but any small chassis or housing may be used since circuit layout and wiring are not critical. If there is space enough inside the carrying case, the monitor could be built in, a real convenience when the recorder must be carried.

The only change made within the tape recorder itself was the addition of five leads brought out to a miniature five-contact polarized socket mounted on the carrying-case side.

Power output of the monitor is approximately 0.9 watt maximum at average recording and playback levels. This is more than adequate output for most monitoring requirements. Total harmonic distortion at the maximum rated output is approximately 5% at 2,000 cycles, which would hardly put it in the hi-fi class. However, the monitor was intended to alleviate a condition of "earphonis" and it fills the bill admirably.—*Warren J. Smith*

THE "LOW-VOLTER"

While the "low-volter" (Fig. 1) consists of no more than a 12.6-volt center-tapped 2-ampere filament transformer mounted in a little 3 x 4 x 5-inch aluminum box along with an inexpensive ac voltmeter, a power cord and three output terminals, it is a unit of an almost limitless number of uses.

First, it may be plugged into any ac outlet to supply either 6.3 or 12.6 volts, up to 2 amperes, to the heaters of tubes in an experimental setup. Second, plugged into a variable autotransformer of the Powerstat or Variac type, it's especially useful for checking the effect of heater-voltage variation in tubes to be used in push-pull or in sensitive circuits where an unbalance or a relatively wide variation in emission can be important. With the same connections, it will supply ac voltages

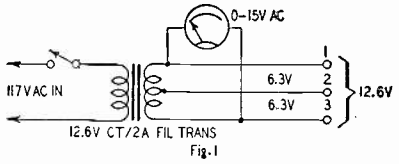
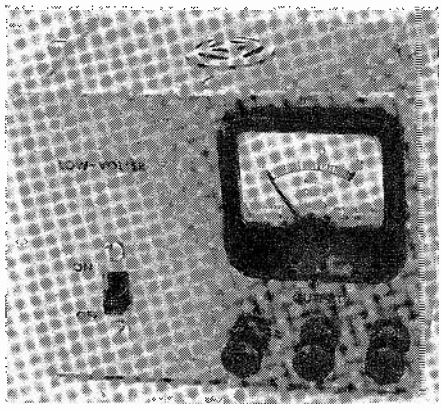


Fig. 1



from 0 to at least 12.6 volts. Thus it will deliver heater power to tubes for which a transformer may not be immediately at hand.

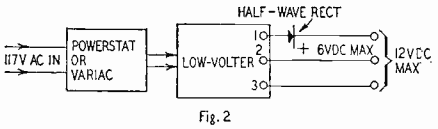


Fig. 2

Again with the Powerstat or Variac and with a half-wave rectifier connected in series, as in Fig. 2, the instrument becomes a battery booster or trickle charger to charge or maintain the charge of any 2- or 6-volt wet-cell battery. It will supply power for simple electroplating. With or without the rectifier, as the case may require, it will operate model trains or drive small electric motors. It can be connected in series with the 117-volt ac line (see Fig. 3) to act as a 6- or 12-volt line-voltage booster for devices or appliances requiring up to 200 watts of power. And, because it will deliver up to 25 watts of power on its own, its applications in experimental setups are almost limitless.

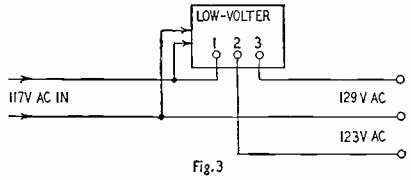


Fig. 3

The low-volter is shown in the photo. Either this layout or one of the builder's choice may be used, since parts placement is entirely noncritical. In this version, a 1-inch diameter hole was punched in the top and underside of the box for ventilation. A 1-inch ventilating plug was pressed into the hole in the top to improve the appearance. The underside of the box has circular pieces of sponge rubber cemented in the four corners as feet and a 4½ inch rope cleat, of the type generally used for awnings, is fastened to the back to store the power cord when the unit is not in use.—*Frank J. Tooker*

(Had the constructor connected the rectifier inside the equipment, with a switch, its usefulness would have been increased greatly.—*Editor*) END

Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

PROKOFIEFF: *Scythian Suite*
Lieutenant Kije Suite
Scherchen conducting Vienna Symphony Orchestra
Westminster XWN-18266

GLIERE: *Red Poppy Ballet Suite*
Symphony No. 3
Scherchen conducting Vienna State Opera Orchestra
Westminster XWN-2212
(Two 12-inch LP's)

Westminster is re-issuing portions of its catalog in remastered and improved pressings. The nature of the improvements is not stated but I gather that, principally, they consist of the use of the RIAA curve instead of the previous NAB, and mastering at a somewhat reduced level to reduce overload distortion. The reissues benefit also from the use of the improved techniques and equipment for cutting masters and pressing developed in the 4 or 5 years since some of these were first released. The reissues include some of the recordings which made such a spectacular impact on the high-fidelity world and catapulted the label from obscurity into the forefront of the business.

In their new form they provide even more spectacular demonstration material. The drums and basses are just as big but cleaner and better defined; the high highs tinkle as prominently but are also brighter and cleaner. Some may find the prominence of bass and high highs a little artificial compared with the more natural balance in vogue today. But it would be difficult to find recordings which yield a more spectacular and more convincing demonstration of how good hi fi can be. They are especially notable for the exceedingly good definition of the bass which is now not only bigger than life but, on first-class systems, as distinctly identifiable and separable as in real life.

The *Lieutenant Kije Suite* is one of the most engaging modern compositions in musical catalogs and the prominence of bass and high ends is thoroughly appropriate and satisfying. The *Wedding* section is still a superb demonstration piece. The drums are terrifically big but nicely damped. The *Troika* has some beautifully clear high highs. The brasses are bright and free of unpleasant stridency. The solo instruments throughout are outstanding and the definition is admirably fine. The whole work pleases both the hi-fi ear and, as far as I'm concerned, musical sensibilities.

The *Scythian Suite* is even more spectacular as to sound and tonal qualities and presents more demanding tests of definition. However, it is more frenetically and dissonantly modern and will have less appeal to those who have not yet developed a taste for this kind of music. There are some exceedingly delicate effects, among them some musical sounds which sound almost exactly like low-level intermodulation in the region above 5,000 cycles.

Gliere's music is far less modern in flavor but equally suited for the prominent bass and high highs. The *Sailor's Dance* from the *Red Poppy* is another top demonstration piece with lovely string bass as well as big drums plus plenty of high highs. Especially notable is the very distinct difference between the tapped and the rolled tambourine. There is a terrific but clean and well-defined peak. The rest of the ballet is delightful music brilliantly played and reproduced.

The Third Symphony is a programmatic and very literal musical telling of the legends about the Russian hero, Ilya Mourometz, written with plenty of thunder, gunfire, etc., which Scherchen has appropriately emphasized and the recording reproduces brilliantly.

LAMBERT, Constant: *Concerto for Pianoforte and Nine Players*
Eight Poems by Li-Po
Gordon Watson, piano, and the Argo Chamber Ensemble
Westminster XWN-18254

This, I gather, is a new recording and possibly the only available one of these works of this late contemporary British composer. The *Concerto* is dated 1931 and was an attempt to use jazz idioms. The songs of Li-Po are even earlier. The songs as sung are little more than sing-song recitative but the accompanying musical background has real charm. The concerto has plenty of excellent percussion. There is an exemplary single double bass. Though musically its appeal is probably limited, those who have an interest in it will find this rewarding in sound and with a high degree of presence.

***Pilar Lopez* and Her Dancers,**
ALBENIZ: *Six Spanish Dances*
TEJERA: *Andalucian Dances*
Capitol P-18020

Spanish dancing with its heel stomping, finger snapping, hand clapping, hip slapping, castanets, etc., contains the widest variety of more or less musical transients the world of music provides. In his *Fiesta Flamenca* Emory Cook provided a brilliant recording of the high-frequency spectrum of these. In her previous Capitol recording, Pilar Lopez and her troupe provided possibly the best samples of the low-frequency types. In this recording we now have a representative collection of just about all types and the recording is good enough to take its place alongside the Cook. The *Six Spanish Dances* has an orchestral accompaniment and provides most of the heel stomping but also examples of the rapid-fire transient like sounds of the castanets. The *Andalucian Dances* is a flamenca with guitar accompaniment and sung narrative. No hi-fi library should be without at least one of these Spanish dances.

Afternoon in Amsterdam
Barrel Organ Music of the Kalverstraat
Capitol T-1003

We've had several recordings of the various mechanical precursors of the juke box, phono-

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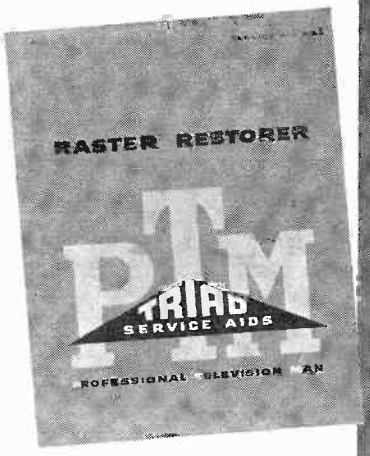

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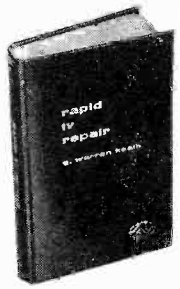

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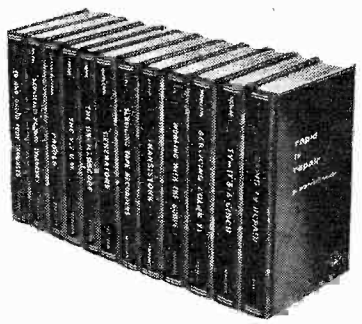

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graph and radio. But most of them reproduced wheezy old instruments badly restored, playing music of little enjoyment. Here, however, is not only a faithful reproduction of one of the most elaborate of the mechanical music makers, but one in perfect condition and playing music which has a folksy charm sure to please almost everybody, even the musical long-hair—if he has any tolerance at all. This large barrel organ has a very nice bass, very acceptable drums, and a variety of amusingly corny high-high effects which rival those of the theater organ. It offers some three-dozen selections ranging from love songs to tangos, marches and waltzes in excellent arrangements which belie their mechanical performance. These I suppose provide a pretty complete cross-section of the popular music of Amsterdam, and will, I'm sure, be as popular with your family as they no doubt are with Dutch families.

STRAUSS FAMILY: *Waltzes by* Arthur Fiedler and Boston Pops
RCA Victor LM-2028

The great preoccupation of recordists today is in trying to achieve in recordings reproduced in the home some approximation of the tonal balance of an orchestra in the concert hall. The early high-fidelity recordings overstressed the bass and treble. This was a natural tendency for it was these elements which had been most completely lost in pre-high-fidelity recordings. Sometimes this preoccupation with what became known as "hi-fi effects" led to such ludicrous extremes as the version of *Gâité Parisienne* recorded by the Boston Pops which was all high highs and no bass.

It is a little ironic that one of the best current examples of excellent tonal balance should be provided by this disc by the same orchestra. Here we have a half-dozen Strauss waltzes *(Where the Citrons Bloom, Secret Attractions, Thousand and One Nights, Doctrines, Music of the Spheres* and *Roses of the South)*. There is a fine dull drum just loud enough to give the beat but not overwhelm the music. The strings are sharp but clean; the trap drums and high highs impart the proper color but do not steal attention from either the melody or the beat. You'll like it to listen to, though there are more spectacular versions for demonstration.

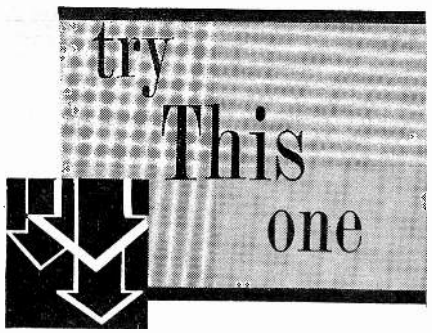
OOM PAH-PAH in Hi-Fi
Guckenheimer Sour Kraut Band
San Francisco Records M-33005

This is a band of another color entirely. If you remember the little German bands which 30 or 40 years ago used to serenade on street corners, this will really take you back. If you don't, it will take you aback, but charmingly. The Guckenheimer band is an eight-piece very amateur outfit manned by prominent San Francisco commuters residing in Sausalito, including Richard Gump of the famous gift shop of the same name and cartoonist George (Grin and Bear It) Lichty. On this record it plays the genuine sauerkraut-und-pigs-knuckles repertoire, including *Ach Du Liebe Augustine, Hile-hilo*, etc., with a charming tonal roughness, occasional clarinet squeaks and plenty of missed notes. But the drum is large as life and the whole thing is recorded with a faithfulness which will bring smiles to one and all.

L'Italia
Carmen Dragon conducting
Hollywood Bowl Orchestra
Capitol P-8351

Another in the series of Bowl potpourri which should please. Ten of the most familiar Italian airs, songs and dances, such as *Funiculi-Funicula, Santa Lucia, Come Back to Sorrento, Perpetual Motion, Dance of Camorristi*, excerpts from *Capriccio Italien*, the *Barcarolle* from *Tales of Hoffman*, etc., in big arrangements. Mostly gentle and romantic music with occasional snatches of more frenetic brilliance, with fair drums, occasional high highs of cymbals, tambourines and a nice sound throughout. Mostly background mood music but good demonstration material as well. END

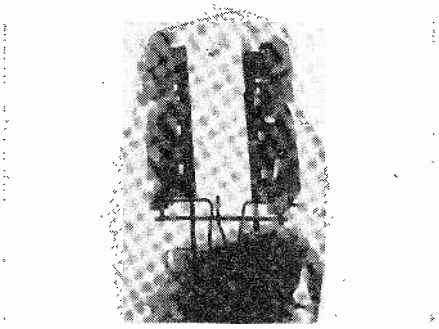
Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, *154 West 14th St., New York 11, N.Y.*



TUBE TYPE NUMBERS

On some tubes the type number is so faintly printed on the glass that it is very difficult and occasionally almost impossible to read. Unfortunately without the type number it is a tedious job to pick out the proper replacement. This frequently involves hunting for the set manufacturer's diagram just to identify the tube.

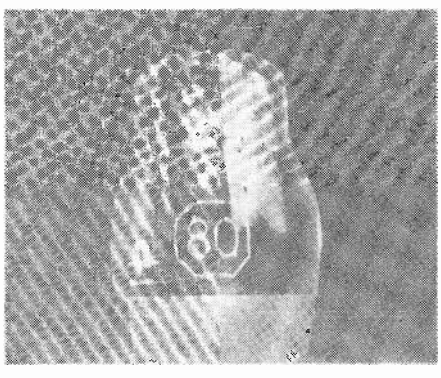
Here is a very simple trick that I use. I have been able to type numbers which were invisible in bright daylight, even when searching with a strong magnifying glass. See Fig. 1, where



no signs of the code number can be seen although it is right there on the surface facing the camera.

To read a faint number take the tube and a flashlight into a completely dark cellar or clothes closet, wait a few minutes until your eyes become accustomed to the dark and then hold the tube in your left hand, lean the glass part away from you and shine the beam almost parallel along the glass surface.

Next you carefully rotate the tube and you will find a position in which the slanting rays of light cross the spot where the type number has been stamped; the slight roughness on the smooth surface of the glass will cause the numbers and the design border to

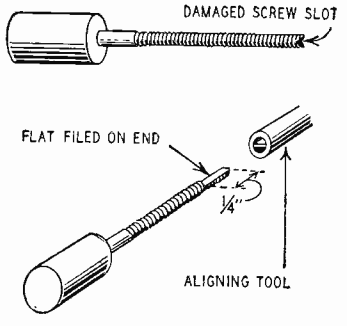


appear on the glass sharp and clear enough to be read. See Fig. 2. Neither camera nor tube have been moved from positions in Fig. 1 but the light has been changed so the beam is parallel with the glass surface. The code number is now clear and distinct.

Try this the next time you want to read the almost completely obliterated type number on a tube. Better hold the lens end of your flashlight in your hand so as to shade the side light from bothering you—it is the slanting beam of light crossing the tube that does the trick by sidelighting the nearly-obliterated numbers.—*George P. Pearce*

AUTO SPEAKER SWITCHING

While installing a rear-seat speaker in a car, I found that I didn't have a three-way switch of the type usually used in these setups. I did, however, have a spdt switch with a center off position that is less expensive and works better in the circuit that I devised. See diagram.



When the switch is in the center (off) position, the speakers are in series and the power divides between them. Throwing the switch in one direction shorts out the front speaker and full power is applied to the one in the rear. In the opposite direction, the rear speaker is shorted and the front speaker receives full power.—*Elgie P. Smith*

SOCKET TROUBLE

Many times, particularly in older television sets, certain intermittents can be traced to poor socket contacts. This trouble can usually be detected by rocking or twisting each tube while the set is in operation. Correction, usually rather simple, consists merely of bending or tightening the socket contacts while the tube is removed.

In the case of molded sockets, a sharp-pointed instrument or tool, forced from above between the metal contacts and the molded plastic, will usually bend the contacts sufficiently to restore the socket to normal operation. A well-pointed nail mounted on a stick or an old test prod (the kind that uses steel phono needles) will usually serve very adequately as the instrument or tool.

Contacts of wafer sockets must be adjusted or bent from underneath with either long-nose pliers or a screwdriver. —*Carleton A. Phillips* END

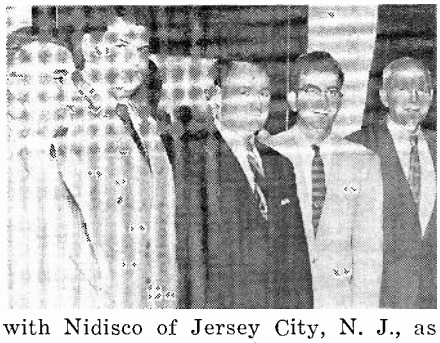
Business

Merchandising and Promotion

Pyramid Electric Co., North Bergen, N. J., is sponsoring a contest to promote its Twist Mount capacitors. Contestants must identify capacitors in schematics published in successive issues of RADIO-ELECTRONICS and other service technician magazines. Judges include M. Harvey Gernsback, editorial director of RADIO-ELECTRONICS, Howard W. Sams and Oliver Read.

Amphenol Electronics Corp., Chicago, is celebrating its 25th anniversary this year. The event will be marked by special issues of its house organ *The Amphenol Engineering News*, advertising and trade show exhibits. Arthur J. Schmitt, president and chairman of the board since its inception, founded the company in 1932.

Cornell-Dubilier, South Plainfield, N. J., recently held a question-and-answer session in Union City, N. J.,



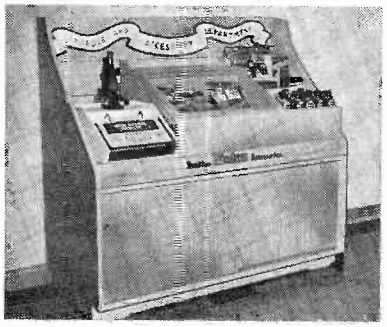
with Nidisco of Jersey City, N. J., as host. This is part of the company's long-range program to help service technicians and jobbers. Photo shows Ray Leary, sales manager of the Cornell-Dubilier Jobber Division (third from left), surrounded by executives and store managers of the Nidisco chain.

Simpson Electric Co., Chicago, which recently held a series of color TV meetings on the West Coast and Texas, will also include Denver, Salt Lake City and other cities to be announced later in the itinerary. Bob Middleton, of the Simpson field engineering staff and a well-known author and lecturer, is conducting the demonstrations. A slide-and-tape presentation is being prepared for areas which Middleton cannot personally visit.

Weller Electric Co., Easton, Pa., awarded prizes to four of its reps who were chosen winners in its nationwide Christmas display contest. The representatives set up displays in distributors' windows in their territories. Photo shows Frank Van Gilder, regional sales manager; Joseph F. Whitaker, vice

president—sales, both of Weller, and John Gruenberg, 2d, and Earle C. Thompson of Arndt, Preston, Chapin, Lamb & Keen, Weller's advertising agency (left to right), looking over some of the 675 photos entered in the contest.

Electrovox Co., Inc., East Orange, N.J., designed a new Perpetual Profit



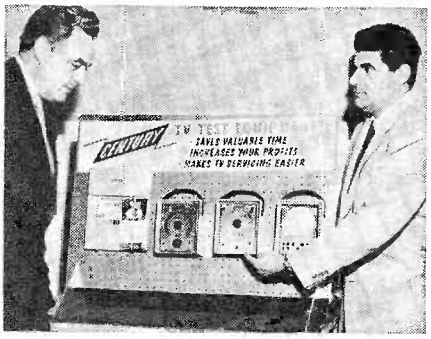
Builder store fixture as a display and sales center for its Walco needles. Display incorporates the needle clinic

(Continued)

which the company developed some time ago.

G-C Electronics Manufacturing Co., Rockford, Ill., is featuring a starter assortment of its Stackpole resistors to promote packaged carbon resistor sales. The assortment includes 30 boxes of the most-used resistors in an all-metal bench or wall rack.

Century Electronics Co., Mineola, N.Y., designed a new display board which holds three of its basic instruments together with catalog sheets describing the entire line. Photo shows Phil Horowitz, president of Century (right), explaining the display to Douglas H. Carpenter, recently appointed national sales representative for Cen-



tury. Carpenter announced that representation has been arranged for most of the country with a few areas still open. This is the first time the Century line has been sold at the distributor level.

END

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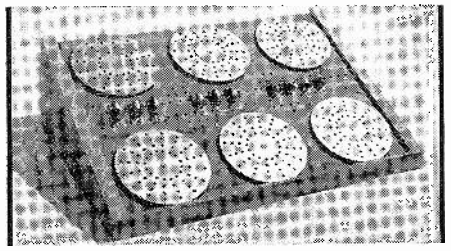

Control Panel of **GENIAC** set up to do a problem in check valve research.

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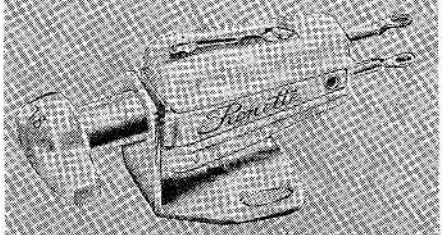

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People

Arthur L. Chapman is the new president of CBS-Hytron, Danvers, Mass. Succeeding Charles F. Stromeyer who resigned, he comes to CBS-Hytron from Sylvania where he had been vice president of manufacturing.

Arthur E. Davis (right), **Alfred W. Preskill** and **Alex Brodsky** (lower right) were elected vice presidents of Allied Radio Corp., Chicago. The promotion of the three executives who have been with the company for many years is in line with Allied's current expansion program and decentralization to develop sales and customer service by specialized product lines.

Irving I. Ser (left), and **Mario DeMatteo** were appointed general sales manager and assistant sales manager, respectively, of Astron Corp., East Newark, N.J. Ser had been industrial sales manager and DeMatteo jobber sales manager. **Herman C. Bloom**, former assistant jobber sales manager now becomes distributor sales manager.

Merle W. Kremer was appointed general manager of the Parts Division of Sylvania Electronic Products, Warren, Pa. He had been spe-

cial assistant to Marion E. Pettegrew, vice president in charge of the Radio & Television, Parts and Tungsten & Chemical Divisions.

Obituaries

Robert E. Burrows, general sales and advertising manager of Thomas Electronics, Inc., Passaic, N. J., at his home in Livingston, N. J.

Joseph F. Moscato plant superintendent of Quam-Nichols, Chicago, of a heart attack at the age of 44.

Personnel Notes

. . . **John L. Burns** was elected president and a director of RCA. He succeeds **Frank A. Folsom** who becomes chairman of the Executive Committee of the board. The move was made to permit an orderly transition of management when Folsom retires in two years in accordance with his announced intention. At that time he will continue for five years with RCA in a counseling capacity. Mr. Burns was formerly a senior partner and vice chairman of the executive Committee of the management consultant firm of Booz, Allen & Hamilton, which includes RCA among its clients. **Brig. Gen. Daniel Sarnoff** continues as chairman of the board and chief executive officer.

. . . **Frank Van Gilder** and **C. R. Robertson** were named regional sales managers for Weller Electric Corp., Easton, Pa. They were previously assistant sales managers. Both will maintain headquarters in Easton.

. . . **Edward Bishop** joined Hallicrafters Co., Chicago, as controller, from Johnson & Johnson Co. **John R. Halligan**, acting budget director and assistant to the manager of accounting, was advanced to assistant treasurer.

. . . **G. A. Godwin** and **Edward L. Nung** were elected vice presidents of P. R. Mallory & Co., Inc. Indianapolis, Ind. Godwin is general manager of the Mallory Metallurgical Divisions; president, P. R. Mallory Plastics Co., and chairman of the board, Electronic Timers Co., all Mallory divisions. Nung is general manager of the Mallory Electronic Divisions.

. . . **R. T. Leitner**, chief engineer of Technical Appliance Corp., Sherburne, N. Y. was named vice president and director of engineering.

. . . **Dr. Frank Jaumont**, joined the Delco Radio Division of General Motors Corp., Kokomo, Ind., as director of research and engineering–semiconductors. He comes from Franklin Institute, Philadelphia, where he was chief of physics and metals section. END

CORRECTION

Mr. Becker has called our attention to a typographical error in the parts list for Fig. 1 of his article "TV Tube for High Fidelity" in the February issue. The power transformer should be a Triad R-12A instead of an R-1ZA as listed.

technical Literature

HI-FI SUPPLIES

A new catalog presents the complete specifications of components along with explanations of their engineering features. Color photos show applications in the home. Additional features include a question-and-answer section in non-technical language and also a high-fidelity planning guide.

H. H. Scott, Inc., Dept. NR 12, 385 Putnam Ave., Cambridge, Mass.

TV SERVICE SHOP PLANS

In *TV Service Shop Plans*, the service technician will find black-and-white drawings that completely plan a TV service operation. Sketches include a floor plan designed for two technicians but flexible enough for adaptation to individual requirements. Sales area and office, shop, storage room, lavatory and lighting are provided for, too. Further diagrams outline construction of the sales counter, small parts inventory, duplex workbench, operational-test and storage rack, technical data and records. They are accompanied by lists of necessary materials. A planning page of cutouts is included.

General Electric Tube Distributors.

SWITCHES

An assortment of switches, including phenolic, ceramic, lever action, spring-return, power, subminiature, slide and those with H-type indexes is offered in this catalog. Pages 6 through 25 of its 33 pages describe special designs not found among stock items. Considerable attention is given, also, to the hardware and accessories for mounting and shielding switches.

Centralab, 900 E. Keefe Ave., Milwaukee 1, Wis.

CLOSED CIRCUIT INDUSTRIAL TV

The latest descriptive literature on the Blonder-Tongue Observer line of closed-circuit TV equipment features its TVC-1 camera and is accompanied by an applications checklist designed to assist both the potential user and distributor in planning integrated closed-circuit systems.

Blonder-Tongue Laboratories, Inc., 526–36 North Ave., Westfield, N. J.

INDUSTRIAL TELEVISION EQUIPMENT

A new 8-page descriptive brochure of industrial TV equipment contains many illustrations of the latest developments in cameras, monitors, controls, lenses and the other accessories for a camera chain of any kind. Included are cameras

with full remote control for adjustment of focus and iris apertures and for both high- and low-speed tilt and pan. Also listed are special weatherproof and explosion-resistant housings, and various lenses and turret heads.

Philco Corp., Government and Industrial Div., 4700 Wissahickon Ave., Philadelphia, Pa.

SILICON RECTIFIERS

Handbook No. 669 has two purposes. It catalogs the maker's silicon rectifiers and lists RETMA's 1N numbers alongside regular part numbers.

Sarkes Tarzian, Inc., Rectifier Div., 415 N. College Ave., Bloomington, Ind.

ARMS

How Good Is Your Arm covers such important aspects of transcription arms as resonance, tracking, tracking error, torsional resonance and pivot design. Numerous charts illustrate its text.

Fairchild Recording Equipment Co., 10-40 45th Ave., Long Island City, N. Y.

HI-FI SYSTEMS AND ACCESSORIES

The high-fidelity products of the leading manufacturers can be found in this *1957 High-Fidelity Catalog*. It is divided into amplifier, tuner, record changer and speaker sections, each with a preliminary explanation of that component's role in a hi-fi system.

Hudson, 48 W. 48th St., New York.

LOW-VOLTAGE POWER SUPPLY

A new low-voltage power supply catalog, 16 pages in length, contains a *Power Equipment Questionnaire* form for requesting information on special and custom-built power supplies.

Opad Electric Co., 69 Murray St., New York 7, N. Y.

ELECTRONIC SUPPLIES

This 1957 catalog of electronic products covers a wide range of equipment, components and supplies for television, communications, industry and defense. It has complete manufacturers' new products and catalog indexes.

Federated Purchaser, Inc., 1021 U. S. Route 22, Mountainside, N. J.

CHOPPERS

A complete new chopper catalog with electrical and mechanical specifications is presently available. Included, also, are new flange-mount wire-in models for high-frequency operation.

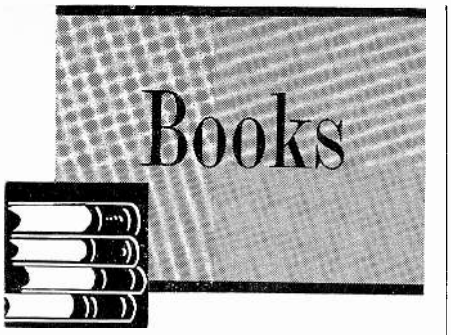
James Vibrapowr Co., 4050 N. Rockwell, Chicago 18, Ill.

Correction

There is 50c charge for *Tuned to Tomorrow* (February Technical Literature).

National Co., Inc., 61 Sherman St., Malden, Mass.

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.



TRANSISTOR TECHNIQUES, Gernsback Library, Inc., New York 11, N. Y. 5½ x 8½ inches, 96 pages. $1.50.

Progress in transistors and circuitry continues rapidly, but fundamental principles remain unchanged. This collection of RADIO-ELECTRONICS articles on basic techniques and special devices should go a long way in helping the experimenter and technician to understand and construct more complicated circuits and instruments.

The booklet starts with important information for the transistor user. It shows how to identify and test transistors, how to protect them against damage, and how to build an experimental layout. This is followed by various measurement techniques, design of oscillators and triggers, stabilization of amplifiers. A particularly interesting feature is material on tetrodes (now making their appearance commercially).

The many construction articles include photos, diagrams and parts lists. Among the special projects are devices for voltage multiplication, headlight control and Geiger counting.—*IQ*

SCIENTIFIC USES OF EARTH SATELLITES, edited by James A. Van Allen. University of Michigan Press, Ann Arbor, Mich. 7 x 10 inches, 316 pages. $10.

The importance of electronics in the satellite program is made apparent by the fact that 14 of the 18 chapters refer to (or take for granted) the use of electronics in measurements or transmission of information. The book is a collection of papers presented at the 1956 meeting of the Upper Atmosphere Rocket Research Panel and contains the contributions of 40 leading scientists, technicians and military experts. —FS

COMPUTERS, Their Operation and Applications, by Edmund C. Berkeley and Lawrence Wainwright. Reinhold Publishing Co., 430 Park Ave., New York, N. Y. 366 pages. $8.

Opening with a definition of an automatic computer and the type of work it can do, Section I lists 170 types of computers now in use. Section II describes digital and Section III analog computers. Other types of computing machines, ranging from dial telephone systems to war strategy machines, are then described. A discussion of minature computers and their use in training follows, considerable reference being made to Simple Simon and the material appearing in the 13 articles on

computer principles by Berkeley in RADIO-ELECTRONICS. Jumping from the minature to the gigantic, Univac, the IBM types 701, 702, 705 and 704, and ERA type 1103 are described. The final chapter is on applications of automatic digital computers and the attitudes of prospective buyers toward them. An excellent appendix, including references to books and other sources of information, a roster of computer manufacturers and a glossary of computer terms and expressions closes the book.—*FS*

TV TUBE LOCATION AND TROUBLE GUIDE (RCA), edited by John F. Rider Laboratories Staff. John F. Rider Publisher, Inc., New York. 46 pages. $1.25.

Top-view tube layout diagrams show the exact location of all tubes, the if and detector alignment points, and video, audio and sync signal paths in all RCA TV receivers produced between 1947 and 1956. A trouble chart lists common faults and indicates which tubes may cause them. Voltages on the damper and various key points in the deflection circuits are listed to aid in trouble shooting. Dial-stringing charts and series-string heater wiring diagrams are provided where necessary.

HANDBOOK OF SEMICONDUCTOR ELECTRONICS, edited by Lloyd P. Hunter. McGraw-Hill Book Co., New York. 605 pages. $12.00.

A comprehensive guide and reference prepared by 13 specialists covering the design, construction and applications of semiconductor devices. The first of four sections is devoted to the physics of transistor and diode action. Part II deals with transistor, diode and photocell manufacturing processes. Circuit design and applications are covered in Part III and the last part provides background material that may be needed to understand the theories and methods of measurement referred to in previous parts. Part IV concludes with a 68-page exhaustive bibliography of material on semiconductors published between 1936 and 1955.

REFERENCE DATA FOR RADIO ENGINEERS, 4th Edition. Compiled for and published by International Telephone & Telegraph Corp., New York. 1150 pages. $6.

This work is basically the popular 3rd Edition (1949) brought up to date, expanded where developments warrant further treatment and with new material added on such subjects as network design of filters, magnetic amplifiers, Feedback control systems, semiconductors and transistors, digital computors, nuclear physics, information theory and probability and statistics. The new work with its 38 chapters and approximately 1,000 tables and illustrations is nearly twice the size of the 3rd Edition. END

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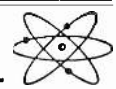

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New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13½" x 14" and requires 2¾" clearance above and 3¾" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-100-A ..... Net **49.50**

PK-90 VISCOUS-DAMPED TONE ARM

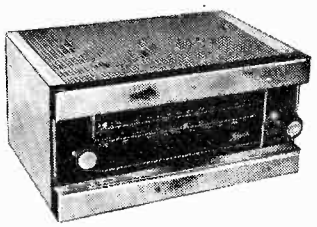
This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball 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.

PK-90 ..... Net **15.95**

LAFAYETTE'S FM-AM TUNER KIT

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL



The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output: **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 μv for 30 db quieting; AM, Loop sensitivity 80 μv/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwith, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V, 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 kit, less cage ..... Net **34.95**

ML-100—Metal cage for above, shpg. wt., 3 lbs. ..... Net **5.00**

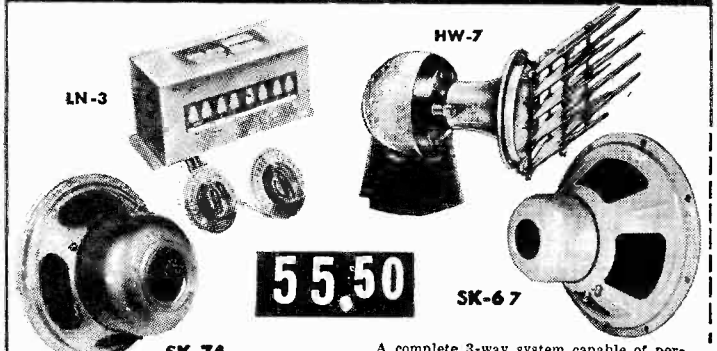
LAFAYETTE MATCHED HIGH FIDELITY PHONO SYSTEM

Nothing Finer At This Price

NEVER—in the annals of HIGH-FIDELITY has a phono system of this quality—at this price—been offered. A Lafayette "best buy" system designed around the new Lafayette LA-59 amplifier. The performance of this Phono system surpasses the most critical requirements of music lovers. Twenty-four combinations of record equalization provide an almost endless variety of tone compensation to match varying recording characteristics. This system includes the famous **Garrard RC-121 "Renown" 4 speed automatic and manual record changer, LAFAYETTE LA-59 18 watt amplifier** with features found only in the most expensive amplifiers. G.E. triple-play—turnover cartridges with **genuine G.E. DIAMOND SAPPHIRE STYLI,** AND **LAFAYETTE SK-58 12" coaxial HI-FI speaker.** All units are supplied with plugs, jacks and prepared color-coded interconnecting cables for quick easy installation. For 110-125 volt, 60 cycle AC. Shpg. wt. 50 lbs

HF-154—Complete Phono System ..... Net **119.50**

3 WAY HI-FI SPEAKER SYSTEM



- 15" Woofer with 31.5 oz Magnet
- 8" Mid-range speaker
- Acoustical Lens Tweeter
- 3-Way Crossover Network

A complete 3-way system capable of performance heretofore found only in systems at many times this price. The components were specially selected by Lafayette sound engineers to offer the maximum in audio fidelity at the lowest price possible. Includes continuously variable presence and brilliance controls. Offers superb reproduction across the entire audio spectrum. Shpg. wt., 25 lbs.

SY93 ..... Net **55.50**

HW-7 Hi-Fi Tweeter w/Acoustic Lens **14.95**
LN-3 3-way Crossover Network with Controls **14.95**
LN-2 2-Way Crossover Network with Control **8.75**

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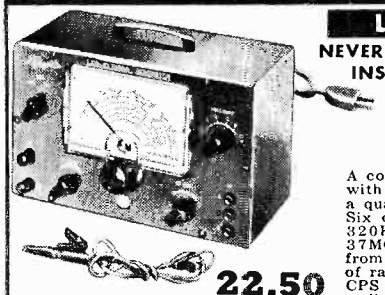
NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 130 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY



22.50

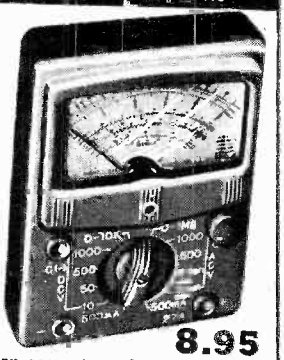
A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC—1000KC, 1MC—3.2MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts, AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR **22.50**

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH



FULL SCALE RANGES

DC Volts: **0-10; 0-50; 0-500; 0-1000 Volts — *AC Volts:*** **0-10; 0-50; 0-500; 0-1000 Volts—*DC Current:*** **500 ua and 500 ma — *Resistance:*** **0-10K; 0-1 Meg — *Decibels:*** **—20 to +22; +20 to 36 db (0 db — 0.775 V)—*Capacity:*** **250 mmfd to .2 mfd—.005 mfd to 1 mfd—*Output Ranges:*** **0-10; 0-50; 0-500; 0-1000 volts**

8.95

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼"x3½"x1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A ..... Complete **8.95**

NEW! LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED

34.50

- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS
- 4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001 -.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14½"L x 8¾"H x 5"D. Shpg wt. 19 lbs.

MODEL LC-4 ..... NET **34.50**

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER

19.95

LOOK AT THESE FULL SCALE RANGES!

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts — A.C. VOLTS: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts — RESISTANCE: 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms—D.C. CURRENT: 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps — DECIBEL: —20 to +17 db (0 db—0.774V) — CAPACITY: .0001-.01; .005-.15 mfd — INDUCTANCE: 20-2000 millihenry —OUTPUT RANGES: 0-6; 0-30; 0-120; 0-600; 0-1200 Volts

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V A.C., for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6¼"x4¼"x2½". Complete with batteries and leads. Shipping weight 4½ lbs.

RW-30A ..... Singly, Each **19.95**
In lots of 3, Each **19.25**

NEW! LAFAYETTE CAPACITOR-RESISTANCE TESTER

COMPLETELY WIRED AND TESTED

21.50

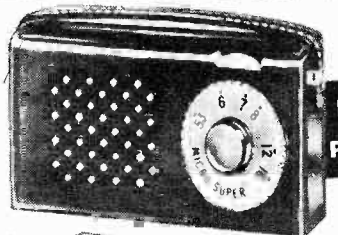
COMPLETELY WIRED AND TESTED

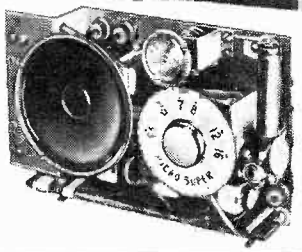
- CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION
- DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS

A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9⅜"L x 7⅛"H x 5¼"D. Shpg. wt. 10 lbs.

MODEL LC-15 ..... NET **21.50**

BUILD A 6 TRANSISTOR SUPERHET RECEIVER





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- CLASS B PUSH-PULL AMPLIFICATION—PLENTY OF POWER!

Superb Performance! Incomparable Value!

Transistor-wise Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-119. An outstanding achievement of constant research and design, this kit represents the optimum in sensitivity, selectivity and stability! You'll be amazed at its superior commercial quality! You'll be elated with its surprising performance! The circuit, using 3 high frequency RF Transistors, 3 dependable audio Transistors and Crystal Diode, features a specially matched set of 3 I.F.'s, Oscillator, High-Q Loop, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to effect maximum transfer of power. Has efficient 2¾" speaker for exemplary reproduction, and earphone jack for private listening. Complete with all parts, transistors, pre-punched chassis, battery and easy-to-follow step-by-step instructions. 6" x 3½" x 1½". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case ..... Net **33.50**

MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119. 6" x 3½" x 1½". Shpg. wt., 1 lb. ..... Net **2.95**

MS-279—Sensitive matching earphone ..... Net 2.39

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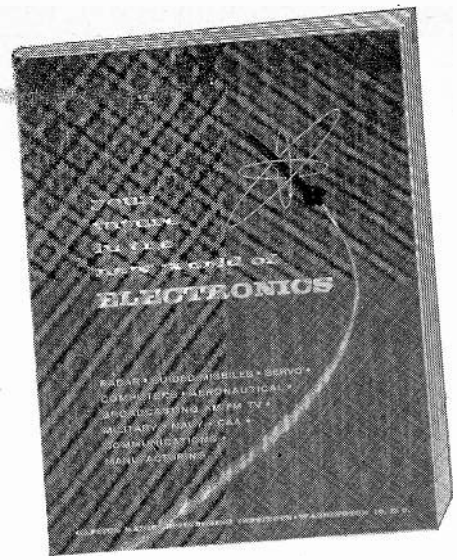

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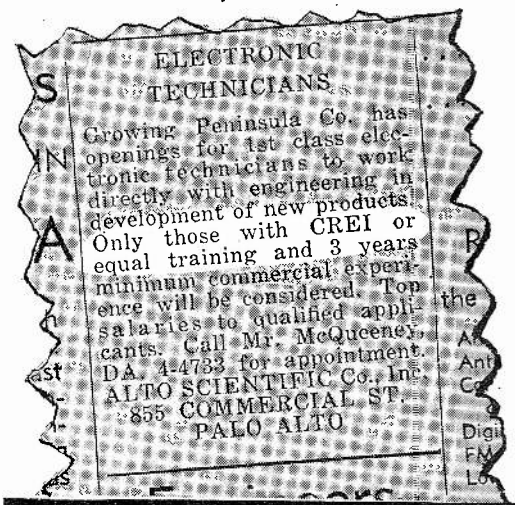

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- ☐ Practical Television Engineering
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Street .....

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

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ELECTRONICS EXPERIENCE.....

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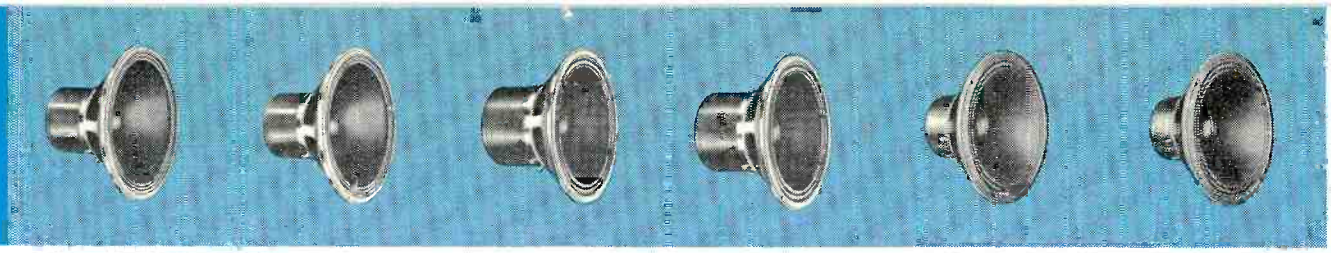
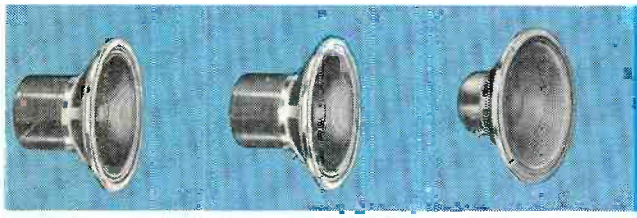
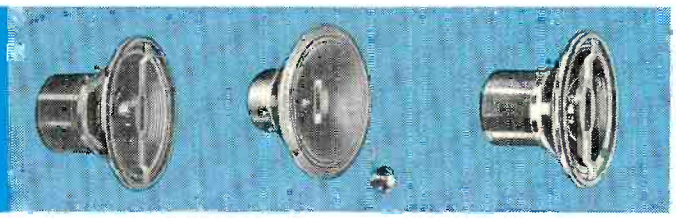
ELECTRO-VOICE Low-Frequency Drivers



Model 18WK, Net $115 | Model 18 W, Net $115 | Model 15WK, Net $85 | Model 15W, Net $85 | Model 15BWK, Net $43 | Model 15BW, Net $43

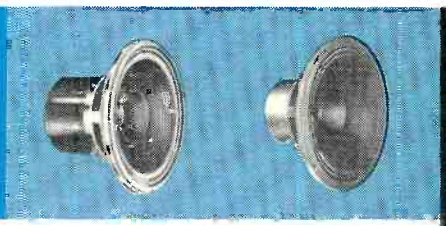


ELECTRO-VOICE TRX Extended-Range Integrated 3-Way Loudspeaker Systems

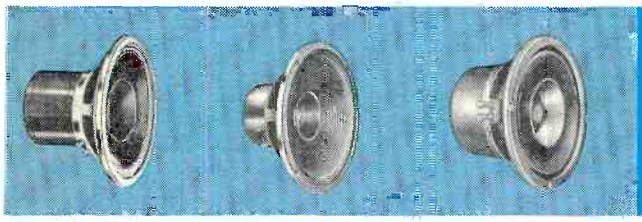


Model 12WK, Net $65 | Model 12W, Net $65 | Model 12BW, Net $33 | Model 15TRX, Net $145 | Model 15TRXB, Net $79 | Model 12TRX, Net $120

ELECTRO-VOICE Radax Coaxial Integrated Full-Range 2-Way Loudspeaker Systems



Model 12TRXB, Net $64 | Model SP15, Net $85 | Model SP15B, Net $43



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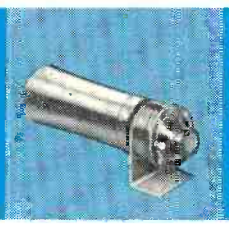
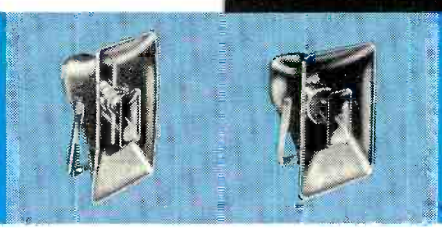
ELECTRO-VOICE Mid-Bass Driver-Horn Assembly



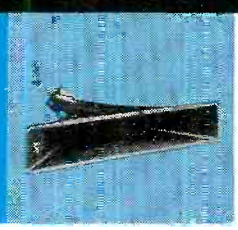
Model 828HF with A8419, Net $28

ELECTRO-VOICE Coaxial Mid-Range Drivers



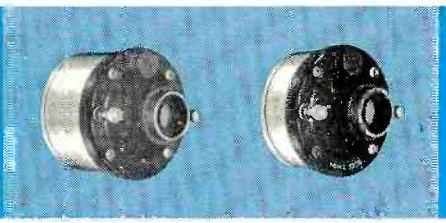
Model 848HF, Net $52 | Model 847HF, Net $33

ELECTRO-VOICE Diffraction Horns



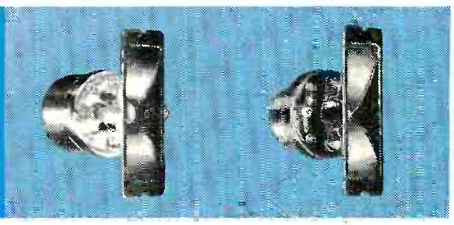
Model 6HD, Net $22

ELECTRO-VOICE H-F Drivers



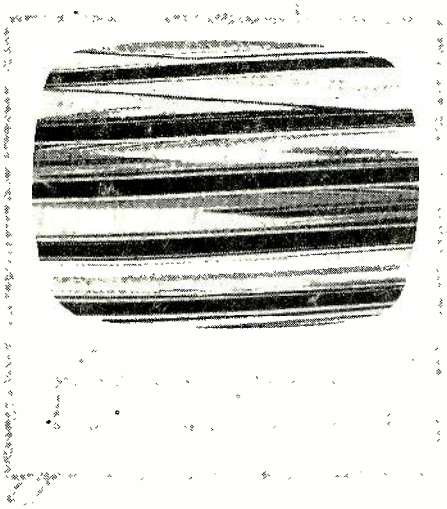
Model 8HD, Net $18 | Model T25A, Net $58 | Model T10A, Net $42.50

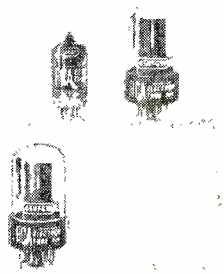
ELECTRO-VOICE Super-Sonax Very-High-Frequency Drivers



Model T35, Net $33 | Model T35B, Net $21

for
WEAK
"SYNC"





give that set a "shot" with

RCA TUBES

When the picture symptom is "unstable sync"—check into that sync separator, sync amplifier, video if, and video amplifier, *and use RCA Tubes when you replace.*

Designed and built to some of the tightest electrical tolerances in the tube business, RCA Tubes are the answer for replacement types that *fit the circuit.* Take the RCA-12AU7 and 6SN7-GTB, as examples. In these types, plate current cutoff characteristic is extremely uniform from tube to tube. And stability is excellent—even under wide variations in heater voltages. When you replace—go 100 per cent with "RCA's", and watch your bench-time drop. When you order—tell your distributor "RCA only" and watch your profits grow.

RCA **RECEIVING TUBES**

Radio Corporation of America

® Tube Division Harrison, N. J.