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FEBRUARY 1957

Radio-Electronics

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HUGO GERNSBACK, Editor

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(See page 4)

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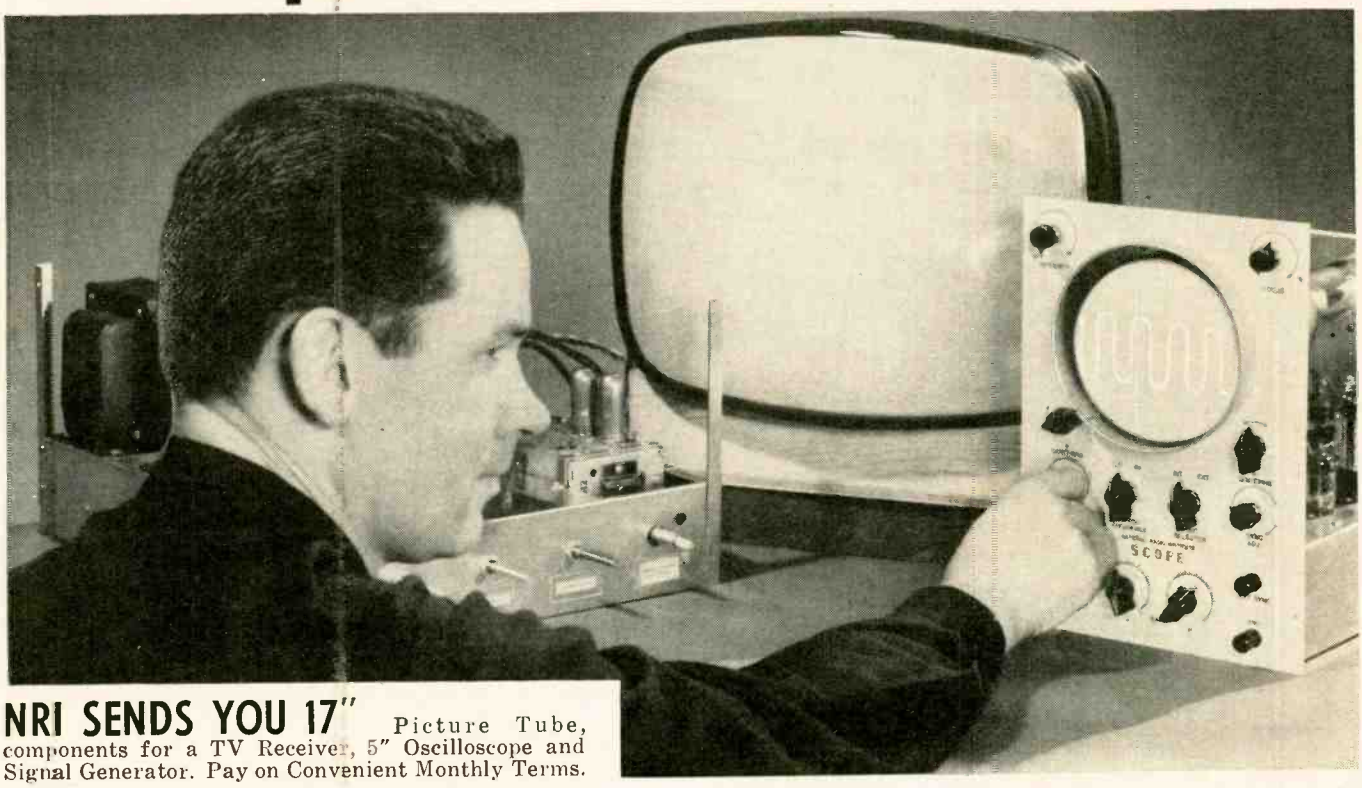

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FEBRUARY, 1957

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AUDIO—HIGH FIDELITY

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ON THE COVER

(Story on page 78)

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SUBSCRIPTION RATES: U. S., U. S. possessions and Canada, $4.00 for one year; $7.00 for two years; $9.00 for three years; single copies 35c, Pan-American countries $4.50 for one year; $8.00 for two years; $10.50 for three years. All other countries $5.00 a year; $9.00 for two years; $12.00 for three years.
SUBSCRIPTIONS: Address correspondence to Radio-Electronics, Subscription Dept., 404 N. Wesley Ave., Mt. Morris, Ill., or 154 West 14th St., New York 11, N. Y. When ordering a change please furnish an address stencil impression from a recent wrapper. Allow one month for change of address.
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News Briefs

SEAGOING OBSERVATORIES will permit the Navy's experimental ship Compass Island to know its exact position at any time without any help whatever from shore-based installations. The special *ships inertial navigational system* (SINS) which the Compass Island is testing determines latitude and longitude, true north and the ship's speed over the bottom. The Navy's chief interest in such a system is for use in missile ships, whose location must be known very exactly to permit them to launch a ballistic missile at a target whose coordinates are known, but it may also prove of value to all shipping.

The miniature observatories, or celestial trackers, once pointed toward heavenly bodies, will automatically track them, giving information for use in checking and correcting the SINS. The trackers are mounted on a rigid tower isolated from ship flexures to give fixed reference planes for celestial computations. For further stabilization, special activated fins counteract roll so that the ship rolls only about 1.5° where without the automatic fins the roll would be 10 times as great. Both the servo-operated fins (which, incidentally, make the Compass Island the most comfortable ship in the Navy) and the inertial navigational system were developed by branches of the Sperry Gyroscope Co.

Ship's speed is indicated by a special sonar system in a large streamlined dome attached to the ship's hull. This system was developed by the Navy's Bureau of Ships and General Electric. The sonar dome earned the Compass Island the shipyard title of "ship with the droop snoot."

TV TUBE FRAUDS are the subject of intensive investigation by the tube division of the Radio-Electronics–Television Manufacturers Association. Faced with the threat of the growing counterfeit racket in radio and television receiving tubes, a committee has been established to compile facts and survey the entire situation. RETMA has emphasized the necessity of cooperation between industry and law enforcement representatives and the importance of vigorous prosecution.

RETMA's general counsel, Glen McDaniel, was invited to appear before the Bronx County, N. Y., grand jury which is investigating the problem in that area. The grand jury had its regular term extended to continue its investigation of the alleged electronic-tube racket which has caused heavy losses to manufacturers and others.

Stanley Seltzer, Bronx service technician, whose arrest and indictment on a charge of grand larceny in connection with the alleged racket had triggered the investigation, had his bail increased to $20,000. He was charged with forging code numbers and trademarks on electronic tubes. The reprocessed tubes, it was said, were sold at a discount, with a fake 1-year guaranty, to dealers who believed them to be direct from the manufacturer.

Because of the counterfeiting, it is believed that G-E has lost about $1 million yearly and that RCA has been swindled out of nearly as much. More than 30,000 phony tubes have been seized by the Bronx District Attorney's office.

FIRST ALL-COLOR TV CLINIC to be held in the Midwest was sponsored by the Television Service Association of Michigan. The meeting was open to all Michigan radio and TV service dealers and technicians. Scheduled at the Ft. Shelby Hotel, Detroit, Jan. 27-28, Michigan's Colorama" was publicized as a service and dealer clinic on color TV.

Calendar of Events

Detroit High-Fidelity Music Show, Feb. 1–3, Statler Hotel, Detroit, Mich.

Los Angeles High-Fidelity Show, Feb. 6–9, Ambassador Hotel, Los Angeles. The West Coast Convention of the Audio Engineering Society will be held in conjunction with the show, Feb. 7–8.

1957 Transistor and Solid State Circuits Conference, Feb. 14–15, University of Pennsylvania, Philadelphia, Pa.

San Francisco High-Fidelity Show, Feb. 15–18, Hotel Whitcomb, San Francisco, Calif.

Cleveland High-Fidelity Music Show, Feb. 22–24, Hotel Hollenden, Cleveland.

Pittsburgh High-Fidelity Music Show, March 8–10, Sheraton Penn Hotel, Pittsburgh, Pa.

1957 Nuclear Congress and International Atomic Exposition, March 11–15, Convention Hall, Philadelphia, Pa.

IRE National Convention and Radio Engineering Show, March 18–21, New York Coliseum, New York, N. Y. RADIO-ELECTRONICS will exhibit in Booth 4103.)

WALDEMAR B. KAEMPFFERT, science editor of *The New York Times* for 26 years, died on Nov. 27 at the age of 79. One of the early science editors in journalism, Mr. Kaempffert was outstanding in his ability to explain technical discoveries and principles to the laymen in popular language.

He was born in New York City and majored in science at City College

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where he was elected to Phi Beta Kappa. His writing career started in 1897 as assistant editor of *The Scientific American*. In 1911 Mr. Kaempffert was named managing editor of the magazine. Four years later he joined *Popular Science Monthly* as editor, holding that position until 1920. After freelancing in science for several years he became science editor of *The Times* in 1927.

In 1954 he became the first science writer to receive the Kalinga Prize, worth $2,800. He was nominated for the award by the British Association of Science Writers, which cited him for contributions to the public understanding of science.

"It is the business of the journalist," he wrote in 1935, "to present the discoveries of the laboratory so that the many will understand . . ."

AIR TRAFFIC CONTROL made significant progress with an announcement by the Civil Aeronautics Administration that it had placed an order with Raytheon for 23 long-range radar units. The equipment is part of a plan, announced last April by Secretary of Commerce Sinclair Weeks, designed to handle a fourfold increase in U. S. air traffic with minimum delay and maximum safety.

The 23 radar units will be part of an expanding coast-to-coast traffic control network of more than 70 civil and military radar installations which will give controllers a picture of aircraft from 15,000 to 70,000 feet in virtually all the U. S. airspace, and of aircraft at lower altitudes on densely traveled routes.

Each radar unit uses a giant 40-foot antenna and covers effectively more than 125,000 square miles. A single set can feed 15 monitor screens simultaneously so that each controller on duty in a CAA center can have a picture of traffic movement. At present CAA controllers depend on position reports radioed in by pilots en route.

Planes appear as light spots or pips on the radar scope (see photo). An electronically projected map overlay on the scope permits the operator to pinpoint instantly a plane's position along intercity airlanes shown on the scope. Plane detection is simplified because of the radar system's ability to select and reflect only moving objects.

WORLD-WIDE TV will be possible with the advent of man-made space satellites. R. P. Haviland, G-E rocket expert, stated that the satellites can serve as relay stations in the world-wide system. The principle would be the same as that used when an airplane recently relayed several live TV programs from Cuba to the U. S. With a satellite, the distances covered could be much greater because of the height of the relay station.

The basic plan calls for four satellite stations traveling 4,000 miles above the equatorial section of the Earth. The satellites would be spaced equally around the Earth so that one would be visible at any instant from any point in the equatorial region. A TV signal could then be transmitted from any ground location in this region to the nearest satellite and be relayed from satellite to satellite. At the proper location, the signal would be retransmitted to a receiving station on Earth.

Each satellite would have to carry a receiver and transmitter. The major ground equipment would be a large directional antenna pointed toward the satellite.

FM DEVELOPMENT ASSOCIATION has been formed recently with an aim toward developing and expanding the art and science of the FM industry. It will attempt to provide overall better programming and service to the listening public, to find new means of revenue for the FM operator and to centralize the purchase of all basic components. President of the group is Robert L. Brazy of the Pan American Broadcasting Co.

Among the various groups formed within the association is the multiplexing committee. It is their duty to cooperate with various manufacturers of this type equipment and to report on the performance of various systems when the completed installations have been made.

THREE NEW TV STATIONS have gone on the air since our last report:

WRAL-TV, Raleigh, N.C.....5
KNAC-TV, Ft. Smith, Ark.....5
KICA-TV, Clovis, N.M.....12

WHYY-TV, Philadelphia, Pa., channel 35, has temporarily suspended its activity.

KGVO-TV, Missoula, Mont., channel 13, changed call letters to KSMO-TV.

KXLF-TV, Butte, Mont., switched to channel 4 from 6.

The total of TV stations now operating in the U. S. and its territories is 494 (398 vhf, 96 uhf), including 22 noncommercial, of which 5 are uhf.

Canada now has 38 TV stations, its 2 new stations being:

CHEK-TV, Victoria, B. C.....6
CFLA-TV, Goose Bay, Labrador....8

END

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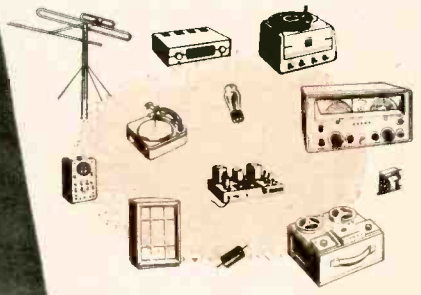

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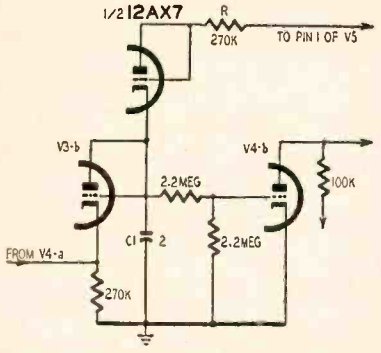
"SPEECH–MUSIC" IMPROVEMENT

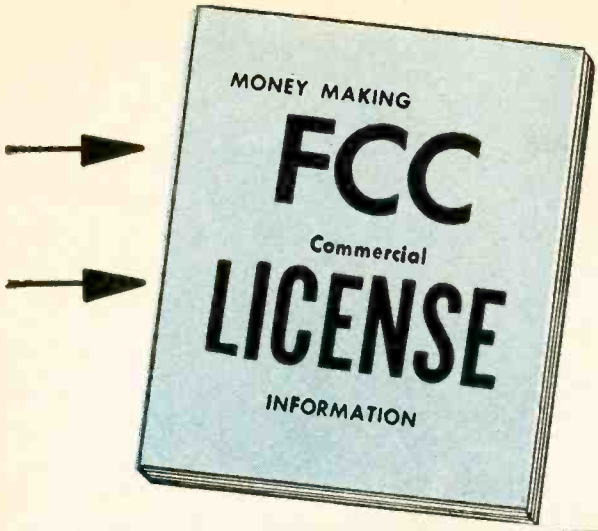
Dear Editor:

Thank you for Mr. Predmore's Speech–Music Discriminator. (September, page 62). It is excellently presented and the little gadget is a real wonder and a boon to suffering humanity.

The discriminator was having a rough time with the more violent forms of pop music followed by mealy-mouthed announcers. I tried some experimenting to improve this condition. One of the things I noticed was that the singers have an unfair advantage over the announcer. He has to start from zero to reach a fixed flip voltage while the singer stands on a voltage platform erected under him by the orchestra. This makes it much easier for the singer to be cut off. I noticed also, by watching the vtvm, people generally speak more rapidly than they sing. Therefore, speech pulses are delivered to the memory capacitor at a faster rate than pulses from the vocalist. However, due to the long time constant, the voltages do not have much chance to decay before the next pulse arrives.



Essentially therefore, the gadget reacts mostly to magnitudes and not to frequency. By shortening the time constant I find it much easier to differentiate between pop music and the announcers. But shortening the time constant makes it harder to keep the talkers above the threshold. I thus added a little circuit which makes it possible to get two time constants—a short one below threshold and the normal 8.8-second constant above (see diagram). The 270,000-ohm resistor R was arrived at experimentally, providing a time constant of about ⅔ second. Anything much shorter than this keeps the announcer from being cut off; longer obliterates any difference between speech and music due to the rate of pulses. Since both the announcer and singer now have a tougher time getting over, I thought it wiser to reduce



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James Faint, Johnstown, Pa.	1st	26 weeks

Bob Thompson:

In a year and a half, he received his first class FCC license. He isn't through yet. He is continuing his training with Cleveland Institute. His goal is much higher than his present position with Eastern Airlines, so, he is adding technical "know-how" to his practical experience. You can be sure he will go far.

Bob Thompson
2935 Ironwood Drive
Nashville 14, Tennessee

James Glen:

When Jim enrolled, he was a temporary employee of the City of Tacoma, Washington. He was helping wire and install an interoffice phone system. In the space of 14 months, he completed the Master Course and received his first class license. He is now installing and maintaining mobile and microwave equipment.

James S. Glen, Jr.
2920 Knob Hill Road
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CORRESPONDENCE *(Continued)*

threshold down to about −2 volts.

There is a price to pay for everything and in this case the price is that the announcer gets off a few more words than formerly. This brings me to Theilheimer's empirical law—better let an announcer talk than kill the music in mid-flight.

The control settings must be made on speech, not on music. If the setting is made on music, particularly on a smooth passage, it is then possible for the gadget to flip on a rougher passage after which it never falls below threshold again. In short, the threshold must not be made into a sort of one-way valve.

WERNER THEILHEIMER
New York, N. Y.

3-WIRE LINE PLUGS

Dear Editor:

The article "The 3-Wire Line Plug" on page 112 of the November issue amused me. Those grounding pigtails are a laugh. You are supposed to remove a screw and insert the pigtail and imagine your equipment is grounded. If you are in a public or other building where the wiring is in conduit or armored cable, then the equipment is grounded. But, 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 a dry wall and nothing more. There are also plastic boxes in use.

Installing an adapter into an outlet like this is a huge joke and gives the user a false sense of security. The user has to be working on a grounded machine and have his body grounded to the machine or other ground to feel any leakage. In these cases, if the operator feels a nip, it is simpler and surer to reverse the wall plug and work in comfort.

C. L. VAN LIEW
Raymond, Wash.

(In many cases portable electric tools are used around grounded machinery, on damp ground or in cellars with concrete floors so we sincerely hope that no reader will wait for a nip to tell him that his tool is hot. Never use a tool that requires proper line-plug polarity to prevent a shock. Have it repaired at once by a qualified technician. Your first little nip may be a lethal nightcap.

The article on the 3-wire parallel-blade grounding plug was prepared mainly to show readers how they could use equipment fitted with these connectors and explain why this fitting was adopted. We did not intend to imply that this fitting with its adapter invariably insures a positive ground. It is simply a more convenient means of making a ground connection *when one is available* at the oulet being used.

After reading your letter and a similar one from another reader, we feel that we—like most equipment manu-

(Continued on page 16)

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Tube Placement Charts: Top and bottom views are shown. Top view is positioned as seen from back of cabinet. Blank pin or locating key on each tube is shown. Charts include fuse location for quick service reference.

Tube Failure Check Charts: Shows common trouble symptoms and tubes generally responsible for such troubles. Series filament strings are schematically presented for quick reference.

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☐ I am interested in receiving all new PHOTOFACT Sets regularly as published each month. Send full details (I understand there is no obligation on my part, and that I will receive without charge, the latest "Index to Photofact", along with Wall Holder).

☐ I am a Service Technician: ☐ full time; ☐ part time.

My Distributor is:_____

Name:_____

Address:_____

City_____ Zone____ State_____

"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

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

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 stroighteners 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**

See Your B&K Distributor or Write for Bulletin No. 500-E

Model 1000 DYNA-SCAN
Picture and Pattern Video Generator Complete Flying Spot Scanner. Net, $199.95

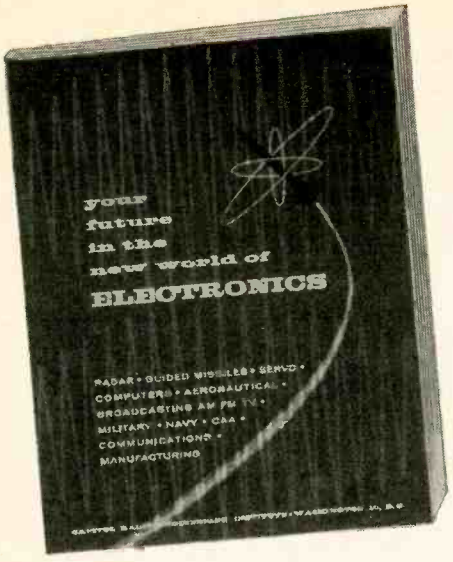
Model 400 CRT
Cathode Rejuvenator Tester. Tests and repairs TV picture tubes. Net, $54.95

Model 750 CALIBRATOR
Designed to check and adjust test instruments with laboratory accuracy Net, $54.95

B&K

Makers of Dyna-Quik, CRT, Dyna-Scan and Calibrator

B & K MANUFACTURING CO.
3726 N. Southport Ave. · Chicago 13, Illinois



The data that Launched Thousands of Careers is yours FREE

Tells how you can be successful in RADIO-TV-ELECTRONICS

Send for Your Free Copy Today!

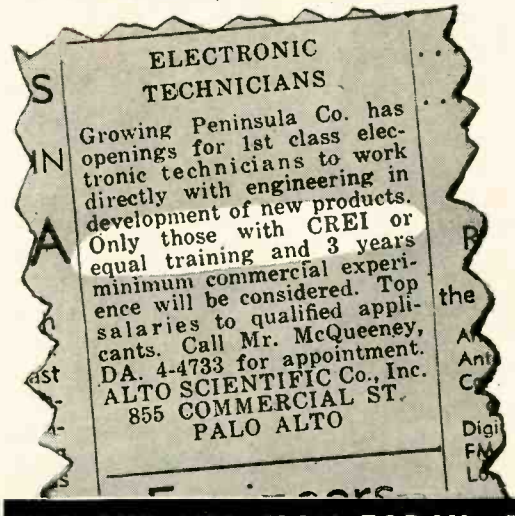
This is a brand new edition of the book which has launched thousands of men on good-paying careers in radio-tv-electronics.

It brings you completely up to date—answers important questions on newest career developments in electronics, including Radar, Guided Missiles, Servomechanisms, Computers, as well as Aeronautical Electronics, Broadcasting (AM, FM, TV), Military, Navy and CAA Electronics, Communications and Electronics Manufacturing.

This book, "Your Future in the New World of Electronics," also shows you how CREI Home Study leads the way to greater earnings in the booming electronics world.

However, CREI does not promise you a "snap." With an accredited technical school such as this you must study to convert your ambition into technical knowledge you can sell in the fabulous Electronics market.

Since its founding in 1927, CREI has provided thousands of professional electronics men with technical educations. During World War II, CREI trained thousands for the Armed Services. Leading firms choose CREI courses for group training in electronics, at company expense, among them United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Douglas Aircraft Co., Glenn L. Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp., and U. S. Information Agency. CREI courses are prepared by recognized experts, in a practical, easily understood manner. You get the benefit of time-tested study assignments under the personal supervision of a CREI staff instructor. This is accomplished on your own time, during hours selected by you, and controlled by your own will power. This complete training is the reason that graduates find their CREI diplomas keys-to-success in radio, TV and Electronics. CREI alumni hold top positions in America's leading firms. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply. Now is the time of decision for you. Luck will not propel you forward unless it finds you trained. Contacts won't budge you an inch unless you have the skill to back them up. The answer is: Technical Training . . . and willingness to learn. Together they will bring you increased earnings in this new Age of Electronics. Fill out the coupon below and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future—is up to you!



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

KOREAN WAR VETERANS: If eligible for training under the new G.I. Bill of Rights, check the coupon for full information.

Industry Calls for CREI training By Name . . . SO SHOULD YOU!

Here you see an actual help wanted ad from the *San Francisco Examiner*, April 1, 1956, one of many which specify "CREI or equal" training. This shows that industry approves CREI training, even insists on it.

FILL OUT AND MAIL TODAY—BEFORE YOU FORGET IT!

CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 142-W, 3224 16th St., N.W., Washington 10, D.C.
Accredited Technical Institute Curricula

Please send me your course outline and **FREE** Illustrated Booklet **"Your Future in the New World of Electronics"** . . . describing opportunities and CREI home study courses in Practical Electronics Engineering.

B

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

Name..... Age.....

Street .....

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

CHECK: ☐ Home Study ☐ Residence School ☐ Veteran

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

EMPLOYED BY.....

TYPE OF PRESENT WORK.....

SCHOOL BACKGROUND.....

ELECTRONICS EXPERIENCE.....

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED?

.....

facturers using these plugs—were remiss in not pointing out the danger in assuming that every outlet box and its cover plate mounting screw is grounded.

Before installing a grounding type receptacle, it is of course necessary to make sure that the outlet box is grounded and that the system ground is secure and in good condition. Generally, the system ground will be a heavy copper wire, bare or armored, running from the service entrance box to a cold-water pipe or a ground rod. If the outlet box you want to use is not grounded, have a qualified electrician check the installation and provide adequate grounding.

In the field, take every precaution when using electric tools. Provide a reliable connection from the adapter pigtail to a cold-water pipe or other approved ground. If you use alligator clips for convenience, anchor the ground line to the power cord and the pipe so the clips cannot be yanked off or the pigtail broken accidentally. *Avoid using electric tools on wet ground or in damp locations. The additional time required with hand tools may add years to your life.—Editor*)

TUBE JOCKEYS RIDE AGAIN

Dear Editor:

My letter is in reference to the one entitled "Tube Jockey's" sent in by Mr. H. A. Highstone (December, 1956).

I am sure Mr. Highstone began his career as a professional TV technician from his letter. It seems to me that a man who knows all the answers to TV defects should be president of some large electronic engineering firm instead of a small TV repair shop.

If electronic engineers knew all the answers, TV's would come off the line perfect.

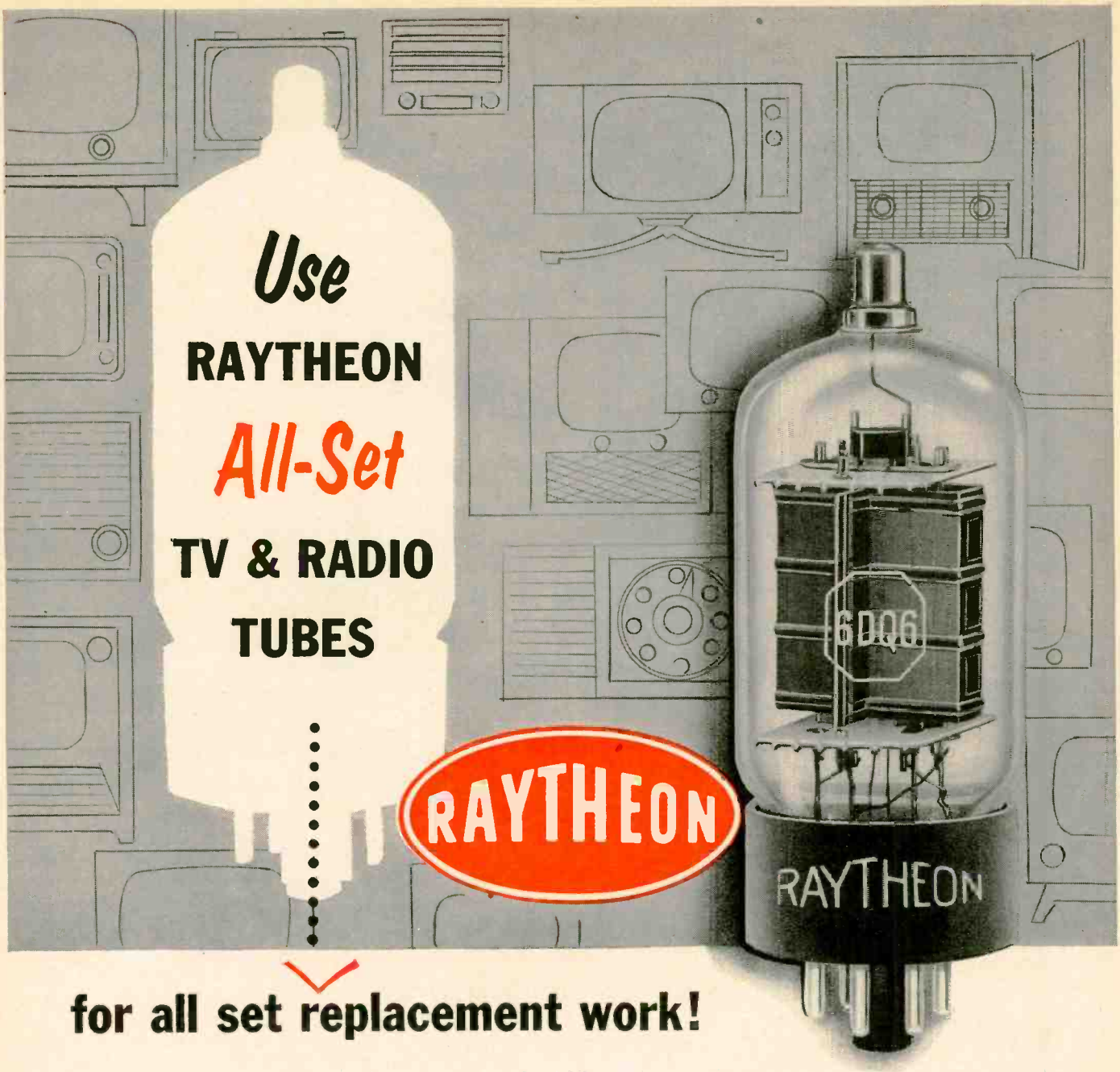
If the so-called jockeys are honest in their diagnosis of the troubles, more power to them; they won't make the same mistakes again. I firmly believe there is plenty of room in the TV and radio servicing field for those who are honest and sincere because you must be honest with yourself before you can sell yourself to the customer. You may fool some of them for a while, but eventually they will find you out.

My electronics schooling began with a home study course. The first lesson I learned was to be honest with your customers and they will do your advertising for you.

FLOYD COX

Cox TV Hospital
Los Angeles, Calif.

(If our correspondent will reread Mr. Highstone's letter carefully, he will note that it was not insisted that the "so-called jockeys" were honest in all their so-called findings. But if they were honest, the evidence indicates such fantastic ignorance that there can be no hope that "they won't make the same mistakes again."—*Editor*) END



for all set replacement work!

You'll save yourself trouble if you standardize on Raytheon "All-Set" Tubes for replacement work.

Here's why:

Raytheon "All-Set" Tubes are designed to give perfect service in many makes and models of receivers because Raytheon sells Tubes to almost every set manufacturer. To satisfy the many and varying needs of so many manufacturers, these tubes must combine top quality performance and dependability. This successful combination makes Raytheon "All-Set" Tubes tops for replacement.

Always use Raytheon "All-Set" Tubes to satisfy your "all-set" customers.

TV-Radio service is your business . . . serving you is ours

RAYTHEON MANUFACTURING COMPANY

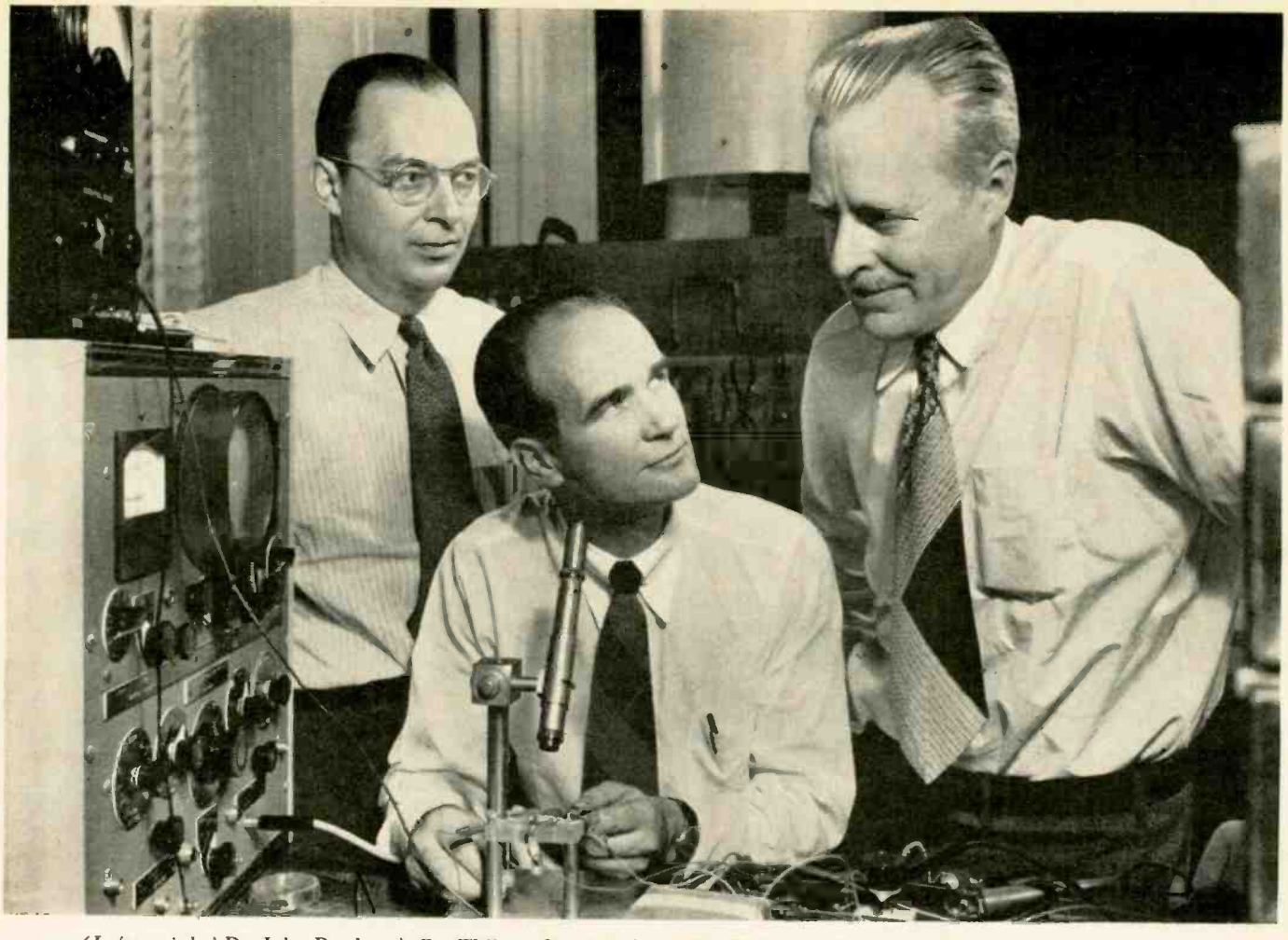
Receiving and Cathode Ray Tube Operations

Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

Raytheon makes all these { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

RAYTHEON®

Excellence in Electronics



(Left to right) Dr. John Bardeen*, Dr. William Shockley* and Dr. Walter H. Brattain, shown at Bell Telephone Laboratories in 1948 with apparatus used in the early investigations which led to the invention of the transistor.

Bell Telephone Laboratories Salutes Three New Nobel Prize Winners

Drs. John Bardeen, Walter H. Brattain and William Shockley are honored for accomplishments at the Laboratories

The 1956 Nobel Prize in Physics has been awarded to the three inventors of the transistor, for "investigations on semiconductors and the discovery of the transistor effect."

They made their revolutionary contribution to electronics while working at Bell Telephone Laboratories in Murray Hill, N. J. Discovery of the transistor was announced in 1948. Bell Laboratories is proud to have been able to provide the environment for this great achievement.

This is the second Nobel Prize awarded to Bell Telephone Laboratories scientists. In 1937 Dr. C. J. Davisson shared a Nobel Prize for his discovery of electron diffraction.

Such achievements reflect honor on all the scientists and engineers who work at Bell Telephone Laboratories. These men, doing research and development in a wide variety of fields, are contributing every day to the improvement of communications in America.

**Dr. Bardeen is now with the University of Illinois, and Dr. Shockley is with the Shockley Semiconductor Laboratory of Beckman Instruments, Inc., Calif.*

Bell Telephone Laboratories

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

You Can Train at Home for Good Pay Jobs in

RADIO-TELEVISION

Fast Growing Industry Offers Good Pay, Security, Bright Future

Training PLUS OPPORTUNITY is the ideal combination for success. Today's OPPORTUNITY field is Radio-Television. Over 125 million home Radios plus 30 million sets in cars and 40,000,000 Television sets mean big money, opportunity for trained Radio-Television Technicians. More than 4,000 Radio and TV Broadcasting stations offer interesting and important positions for technicians, operators. Color Television, portable TV sets, Hi-Fi, other developments assure future growth. Radio, Television are both growing. Need for trained technicians is increasing!

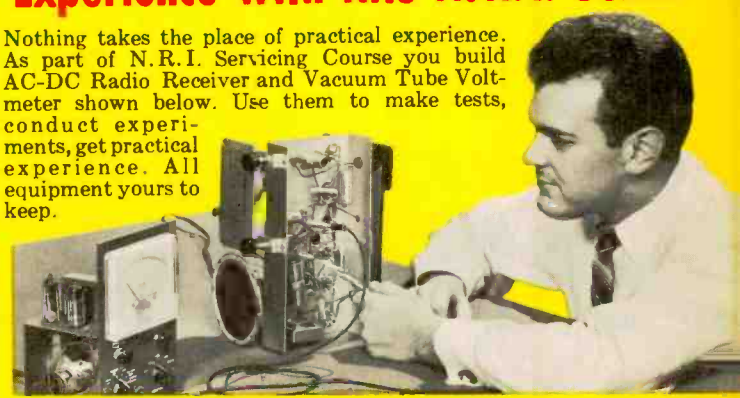
J. E. SMITH
Founder

Find Out What Oldest and Largest Home Study Radio-Television School Offers You

Since 1914—for more than 40 years—N.R.I. has been training ambitious men at home in spare time for Radio-TV. Thousands of successful graduates say N.R.I.'s 50-50 training method is a fast, easy, effective way to higher earnings, desirable jobs. Carefully planned experiments and practice with equipment supplied free of extra charge, bring basic principles, techniques to life right in your own home. Find out what dependable training can do for you.

You Learn by Doing—Get Practical Experience with Kits N.R.I. Sends

Nothing takes the place of practical experience. As part of N.R.I. Servicing Course you build AC-DC Radio Receiver and Vacuum Tube Voltmeter shown below. Use them to make tests, conduct experiments, get practical experience. All equipment yours to keep.



Add to Your Income Starting Soon

Make $10-$15 a Week Extra Fixing Sets in Your Spare Time

Soon after enrolling, many N.R.I. students start earning extra money fixing neighbors' radio sets. Many earn enough extra to pay entire cost of course and provide capital to start their own full time Radio-TV business after getting N.R.I. Diploma. If you want a job with a future, find out how you can train at home for Radio-Television. Mail Postage Free postcard for Sample Lesson. See how practical it is to learn at home. Get 64-Page Catalog, too. See equipment you get, outlines of courses, facts about opportunities in this growing field. Prices of N.R.I. Courses are low, terms easy.

See Other Side

N.R.I. Training leads to good pay jobs like these. BROADCASTING: Chief Technician, Chief Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P. A. Systems, Television Receivers, Electronic Controls, FM Radios, Hi-Fi. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician . . . **AND MANY OTHERS.**

N.R.I. TRAINED THESE MEN

Thanks N.R.I. for Good Start

"Right now I am doing spare-time repairs on Radios and Television. Going into full time servicing soon." C. HIGGINS, Waltham, Mass.

Quit Job to Start Business

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." W. F. KLINE, Cincinnati, Ohio

Engineer with Station WHPE

"I operated a successful Radio repair shop. Then I got a job with WPAQ and now I am an engineer for WHPE." VAN W. WORKMAN, High Point, N. C.

N.R.I. Started His Way up

"I was a cab driver earning $35 a week. Then I enrolled with N. R. I. Now tester with TV maker." J. H. SHEPHERD, Bloomington, Ind.

CUT OUT AND MAIL CARD NOW

SAMPLE LESSON AND CATALOG BOTH FREE

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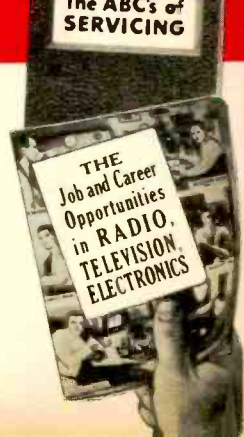
WE PAY POSTAGE



This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive 64-Page Catalog.

NATIONAL RADIO INSTITUTE, Dept. F
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Please mail me the FREE sample lesson and 64-Page Catalog. (No Salesman will call.)

Name _____ Age _____

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Practice Servicing-Communications with Kits of Parts N.R.I. Sends

YOU BUILD AC-DC Superhet Receiver

N.R.I. Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.

YOU BUILD Signal Generator

You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical I.F. amplifiers in receiver circuits. Make tests, conduct experiments.

YOU BUILD Broadcasting Transmitter

As part of N.R.I. Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from N.R.I.'s easy-to-understand texts.

Radio-Television Can Give You a Good Job with a Future

N.R.I. Graduates do Important Work — Get Important Pay

Chief Engineer with Station

"I am Chief Engineer of Station KGCU in Mandan, N. D. I also have my own spare time business servicing high frequency, two-way communications systems." R. BARNETT, Bismarck, N. D.

Paid for Instruments out of Earnings

"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix car Radios for garages. I paid for instruments out of earnings." G. F. SEAMAN, New York, N. Y.

Has Own Radio-TV Business

"We have an appliance store with our Radio and TV servicing and get TV repairs. During my Army service, N.R.I. training helped get me a top rated job." W. M. WEIDNER, Fairfax, S. D.

See Other Side

Here is a line of work that people respect—a vocation where you can advance, win a place for yourself, earn good pay and gain much personal satisfaction in what you are able to do. And you can learn at home in your spare time. Smart fellows everywhere are using their spare time to develop new knowledge, new skills. They know it is the trained man who gets ahead, gets the better job, drives the better car, is respected for what he knows and can do.

Be a Skilled Technician

The technical man is looked up to. He should be. He does important work, gets good pay for it. Radio-Television offers that kind of work. There are more than 40 million Televisions, 150 million home and auto Radios. Millions more are sold each year. There are splendid opportunities for the man well trained in Radio-Television Servicing or Broadcasting. Micro-Wave Relay, Aviation and Police Radio, Two-Way Communications for buses, taxis, trucks, etc. are expanding—making more jobs, greater opportunity.

You Can Train in Spare Time

Keep your job until you're ready for a better one. Learn at home. N.R.I. Courses are planned for men who can study only during spare time. You get many kits to build equipment, get practical experience. You work on circuits common to both Radio and TV. Equipment you build "brings to life" things you learn in N.R.I.'s easy-to-understand texts. Experienced N.R.I. instructors, technicians, specialists devote full time to making sure you get the best and simplest Radio-TV training. Train as fast or as slow as you like.

Tested Way To Better Pay

N.R.I. Training is practical, thorough. You get the benefit of N.R.I.'s 40 years experience training men for success in Radio-Television. Most successful N.R.I. men start without any knowledge of Radio, many without a high school education. Find out what Radio-Television training can mean to you. Make a decisive move today toward becoming one of that select group—a Radio-TV Technician. Send for Actual Lesson and 64-Page Catalog, both FREE. **NATIONAL RADIO INSTITUTE, Dept. F, Washington, D.C.**

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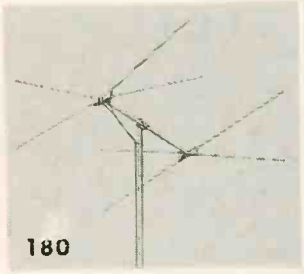
MODEL 280SW *(shown right)*

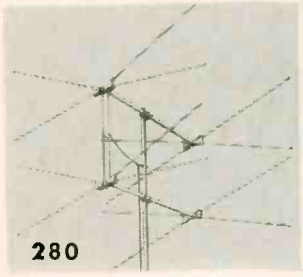
- Double stacked array PLUS high frequency elements.
- All Aluminum Construction.
- Mounts on any mast up to 1¾".
- QUICK-RIG design for speedy one man installation.
- Complete with stacking bars.

MODEL 180SW .... same as 280SW only not double stacked.

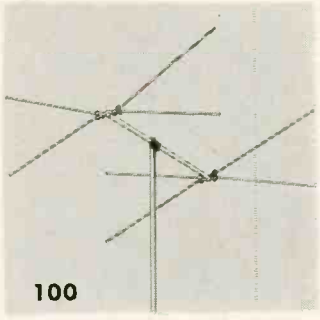
MODEL 180 .... QUICK-RIG 8 element "Lazy-X" Conical.

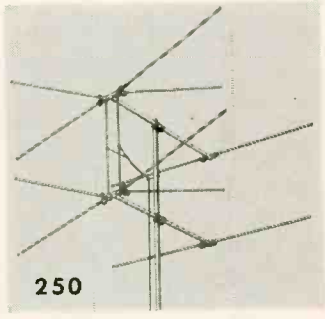
MODEL 280 .... QUICK-RIG double stacked "Lazy-X" Conical.

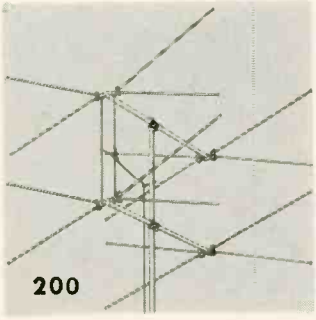




12 NEW RADIART TV ANTENNAS







Proven Unquestionably...

the best performing at

the lowest possible price!

RADIART... the name you can depend upon for QUALITY and VALUE... offers a COMPLETE... and NEWLY ENGINEERED line of superbly performing TV antennas at an economy price. Carefully tested under all conditions... each of these new models is guaranteed to be the best performing at the lowest possible price.

LZX 100 single array

LZX 101 single array, unassembled

LZX 200 8 element conical completely assembled, stacked array

LZX 201 8 element conical unassembled, stacked array

LZX 150 single array

LZX 151 single array, unassembled

LZX 250 6 element conical assembled, stacked array

LZX 251 6 element conical unassembled, stacked array

SUBSIDIARY OF CONSOLIDATED ELECTRIC CO.

THE RADIART CORPORATION / CLEVELAND 13, OHIO

HIGH POWER LOW POWER AC POWER DC POWER

POWER-LAB

BY precise OPERATES YOUR WHOLE BENCH & SHOP

KIT or WIRED

YOU'LL START AND END EACH WORKING DAY WITH THE POWER-LAB

For the first time in the industry, one instrument takes the place of more than 11 pieces of equipment and makes you wonder why no one ever did this before . . . the most useful, often used, test device in your shop.

Here's the story . . . now, you can get all this COMPLETE IN ONE KIT (kit or wired):

- ★ A BATTERY ELIMINATOR
- ★ A BATTERY CHARGER
- ★ A HIGH CURRENT LINE VOLTAGE VARIAC
- ★ AN AC LINE VOLTAGE METER
- ★ AN AC LINE AMMETER
- ★ AN AC LINE WATTMETER
- ★ AN AC LINE ISOLATION TRANSFORMER
- ★ A LOW VOLTAGE, HIGH CURRENT AC SUPPLY
- ★ A DC LINE VOLTAGE VARIABLE SUPPLY
- ★ A DC HIGH CURRENT AMMETER
- ★ AN AGC BIAS BOX

MODEL 711
(100 Watts of Isolation) 711K – **$49.95** kit
711W– **$64.95** wired

MODEL 713
(300 Watts of Isolation) 713K – **$62.95** kit
713W– **$79.95** wired

When you buy POWER-LAB by Precise, you get all the advantages of owning a battery eliminator for servicing auto radios (even signal seekers), an AC-DC Converter, a supply for transistor sets, AND OF MAINTAINING A CONSTANT 115 volts in checking on TV set variations. You can even run the set down to 105 volts for testing for horizontal jitter and back up to 125 volts for high voltage breakdown, thereby eliminating the cause of many call-backs due to arcing . . . PLUS . . . PLUS . . . the 101 uses you'll find each day for POWER-LAB versatility.

Just look at these specs . . . the switches used are more than ample to carry related loads required and the quality of every component is EXCELLENT. You could easily pay three to four times the price of the POWER-LAB for the equipment to perform only a few of the functions of the POWER-LAB!

There's NO OTHER INSTRUMENT LIKE THE POWER-LAB ON THE MARKET. Here again, Precise engineering is proud to be the first to supply a need that has too long existed in the service trade.

Your Distributor will be proud to show you THE POWER-LAB

Prices slightly higher in the West. Prices and specifications subject to change without notice.

ALL SPECS BELOW ARE FOR MOD. 711 AND 713 UNLESS OTHERWISE SPECIFIED

	VOLTS	MAXIMUM	CONTINUOUS
Low Voltage DC	2 ranges 0-15v Full Wave 0-30v Full Wave Bridge	20 amps* 20 amps*	10 amps* 10 amps*
Low Voltage AC	0-24v		20 amps
High Voltage AC	No Isolation 90-140 volts	20 amps 2000 watts	10 amps 1000 watts
High Voltage AC	Model 713 with Isolation 90-140 volts		3 amps 300 watts
High Voltage AC	Model 711 with Isolation 90-140 volts		1 amp 100 watts
High Voltage DC	110-180 volts	.1 amp**	.075 amp**

*Depending on voltage.
**May be increased up to 10 amperes at additional cost.

WRITE FOR CATALOG RE 2-7

SEE THE MANY MORE PRECISE INSTRUMENTS AND PROBES AT YOUR DISTRIBUTOR TODAY!

precise DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.

Prepare for a Good Paying Job—Or Your Own Business

"I Will Train You at Home in RADIO-TELEVISION On Liberal No Obligation Plan!"

Frank L. Sprayberry
President, Sprayberry
Academy of Radio

New Equipment! New Lessons! Enlarged Course! The true facts are yours in my big new catalog . . . YOURS FREE . . .
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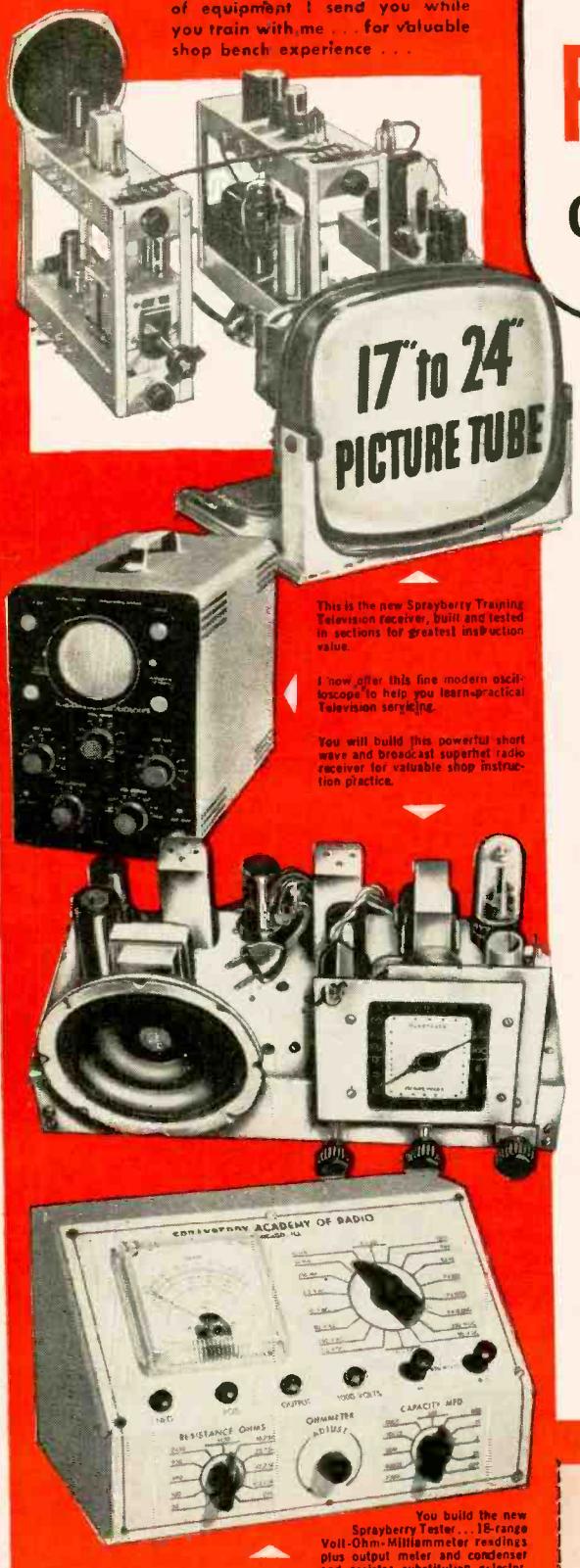
I can train and prepare you in as little as 10 months to step into the big opportunity Radio-Television service field. Train *without* signing a binding contract . . . without obligating yourself to pay any regular monthly amounts. You train entirely at home in spare hours . . . you train as fast or as slowly as you wish. You'll have your choice of THREE SPRAYBERRY TRAINING PLANS . . . planned for both beginners as well as the more experienced man. Get the true facts about the finest most modern Radio-Training available today . . . just mail the coupon for my big new 56 page fact-filled catalog plus sample lesson—both FREE.

Learn PRACTICAL RADIO-TV with 25 BIG KITS

of equipment I send you while you train with me . . . for valuable shop bench experience . . .



In addition to modern lesson training, I also give you plenty of home practice on actual Radio-Television equipment . . . you will build and use the units shown here plus many more. All this equipment is yours to keep . . . keep everything you need to set up your shop.

Train the Practical Way—with Actual Radio-Television Equipment

My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My students are completely trained Radio-Television Service Technicians.

NEWEST DEVELOPMENTS
Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

See for Yourself . . . Make Your Own Decision . . . Mail Coupon Today!

The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item I include in my training. With the facts in your hands, you will be able to decide. *No salesman will call on you.* The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO

111 North Canal Street, Dept. 20-H, Chicago 6, Illinois

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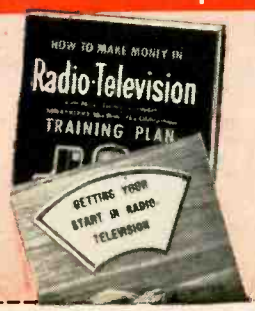

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Dept. 20-H, 111 N. Canal St., Chicago 6, Ill.

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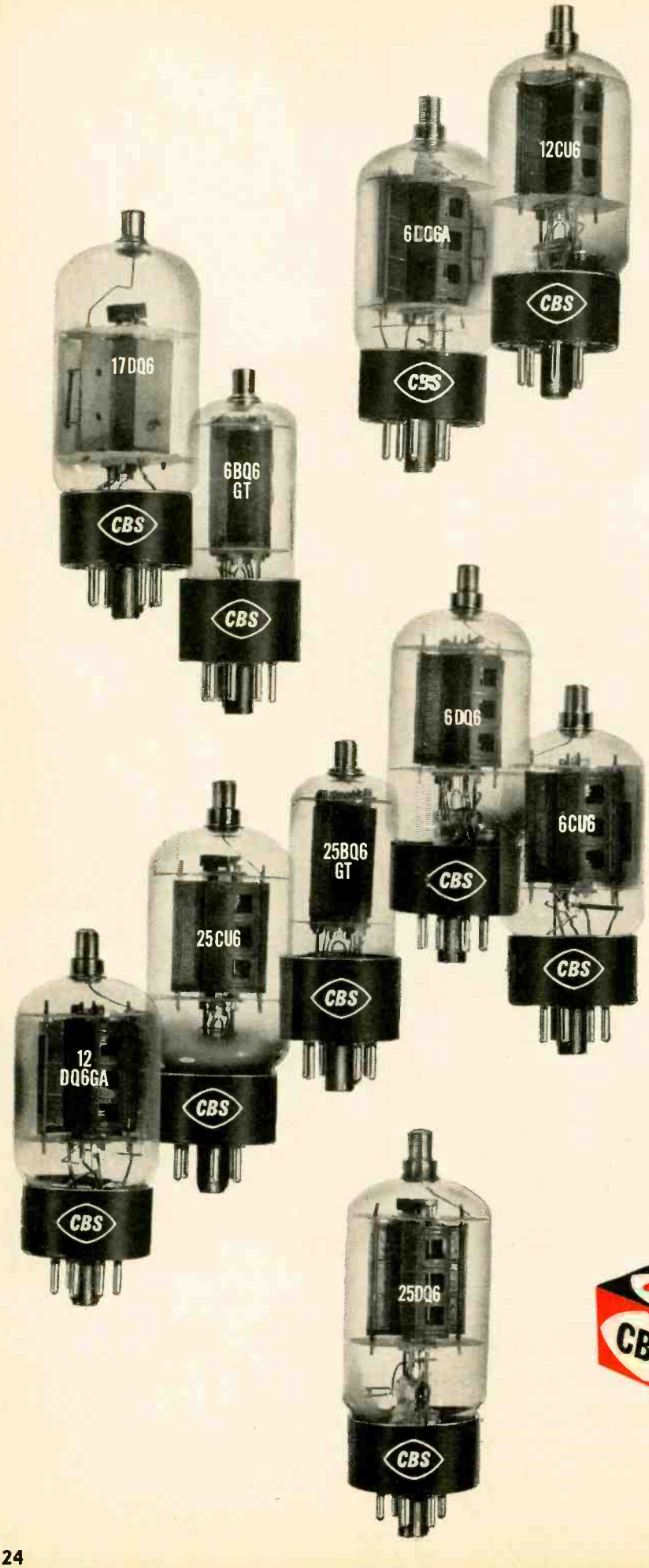

From the originator
of the 6BQ6GT • 6CU6 • 6DQ6

TIPS ON REPLACING HORIZONTAL AMPLIFIERS

No one tube satisfactorily replaces the 6BQ6GT, 6CU6, and 6DQ6 . . . or their heater-voltage variations. CBS knows because, foreseeing the need for each of these three families of horizontal amplifiers, CBS originated the 'BQ6, 'CU6, and 'DQ6. The latter two were designed: 1. With increasingly greater safety margins to combat high voltage and heat. 2. With improved sweep characteristics.

In general, replacement of each tube should be with the original type. But in some sets, larger, wider-angle picture tubes using higher voltages place overloads on the original horizontal amplifiers. Here replacement should be a step upwards at a time: 'CU6 for 'BQ6 . . . 'DQ6A for 'CU6. Following these rules will give reliable safety margins and neither too little nor too much sweep, especially important in receivers with no horizontal width control.

Another good rule is to replace them all with CBS tubes. The reason is logical. It's better to use CBS originals . . . because CBS has had more experience in making them better.

Reliable products through Advanced-Engineering

CBS-HYTRON, Danvers, Mass.
A Division of
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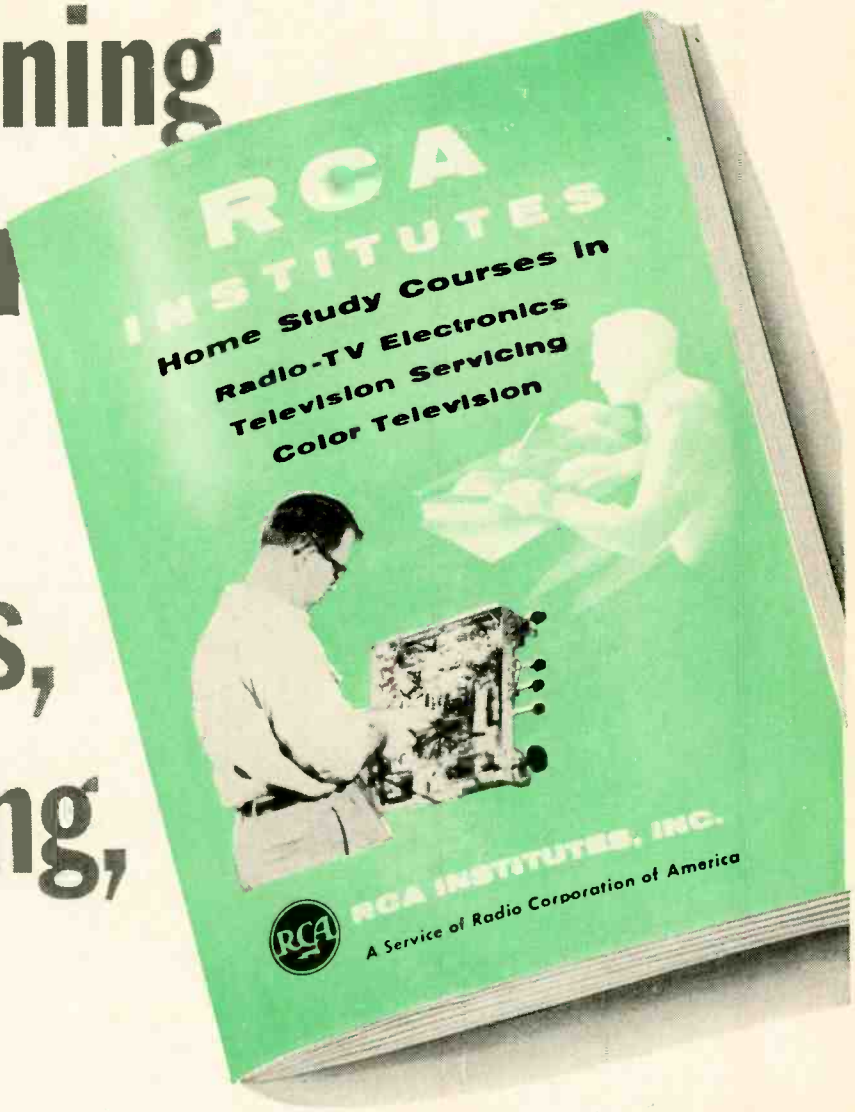
RCA offers you the finest training at home in Radio–TV electronics, TV servicing, Color TV



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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 Farnswor h	*/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 (Eldorado)	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	3/10 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	3/10 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

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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

(For men with previous radio & TV training)

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President, Radio-Television Training Association.
Executive Director, Pierce School of Radio & Television.

COMPLETE! DEPENDABLE!

RTTA offers you the most complete and practical Color Television Technician Correspondence Course. It includes the latest, up-to-the-minute data and procedures for the servicing and maintenance of all Color TV receivers and equipment. Be prepared — gain your share of those profits ahead! This course uses the same step-by-step approach found so successful in the teaching our other famous courses to thousands of men. Starting at the transmitter the lessons guide you through the development and transmission of the composite Color TV signal. With an overall view of how the receiver function each circuit is then analyzed in a simple, easy-to-follow manner that make learning fast and accurate.

Sylvania Now Sponsoring
RTTA's Color TV Technician Course

One of the nation's largest electronics manufacturers and marketers Sylvania Electric Products Inc. in its continuing effort to cooperate with independent service dealers is now sponsoring the RTTA Color Television Technician Course.

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.

Other RTTA Courses

covering all phases of Radio, FM and TV

Radio-FM-Television Technician Training

My Radio-FM-Television Technician Course is especially prepared for men with no previous experience or training. I have trained hundreds of men for successful careers in radio-television-electronics. Many of them had only a grammar school education and no previous experience whatsoever in the field.

Expert FM-TV Technician Training

My FM-TV Technician Course lets you take full advantage of your previous experience — either civilian or Armed Forces. YOU CAN SAVE MONTHS OF TIME. Train at home with kits of parts, plus equipment to build TV RECEIVER. ALL FURNISHED AT NO EXTRA COST!

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(For men with previous radio & TV training)

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14 THOROUGH LESSONS!

Color Television Technician Course

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

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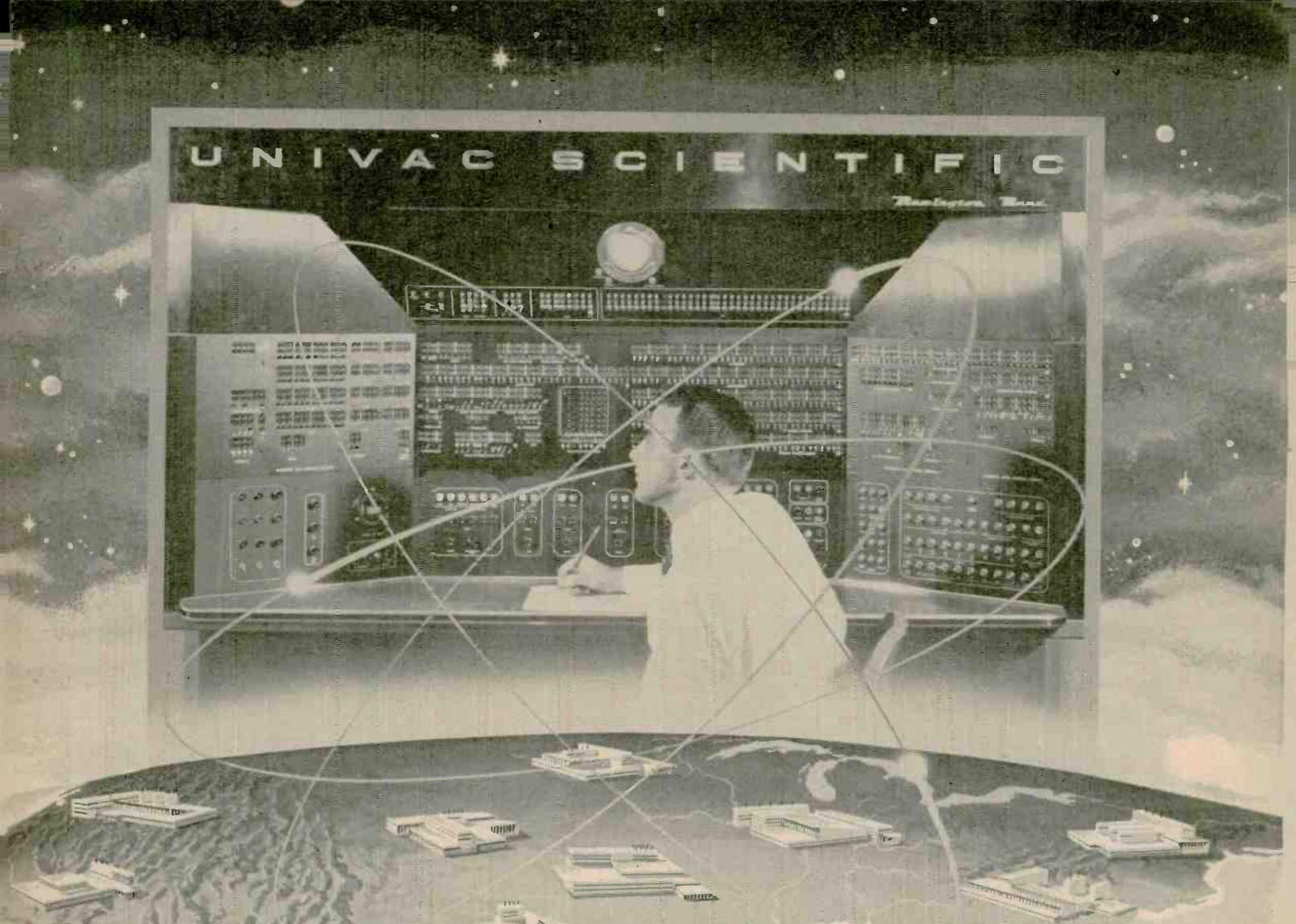

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KIT $69.95
WIRED $109.95

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. Tests all receiving tubes (& pic tubes with adapter). Composite indication of Gm, Gp & peak emission. Simultaneous sel of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). New series-string voltages: for 600, 450, 300 ma types. Sensitive 200 ua meter. 5 ranges meter sensitivity (1% shunts & 5% pot). 10 SIX-position lever switches: free-point connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. Direct-reading of inter-element leakage in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors: separate meter readings of collector leakage current & Beta using internal dc power supply.

NEW COLOR and Monochrome DC to 5 MC LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95
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• Features DC Amplifiers!

Flat from DC-4.5 mc, usable to 10 mc. VERT. AMPL.: sens. 25 rms mv/in; input Z 3 megs; direct-coupled & push-pull thruout; K-follower coupling bet. stages; 4-step freq-compensated attenuator up to 1000:1. SWEEP: perfectly linear 10 cps-100 kc (ext. cap. for range to 1 cps); pre-set TV V & H positions; auto. sync. ampl. & lim. PLUS: direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; filter; bezel fits std photo equipt. High intensity trace CRT. 0.06 usec rise time. Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in volt. calib. Z-axis mod. Sawtooth & 60 cps outputs. Astig. control. Retrace blanking. Phasing control.

NEW TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95
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Entirely electronic sweep circuit (no mechanical devices) with accurately-biased inereductor for excellent linearity. Extremely flat RF output: new AGC circuit automatically adjusts osc. for max. output on each band with min. ampl. variations. Exceptional tuning accuracy: edge-lit hairlines, 330° scale. Swept Osc. Range 3-216 mc in 5 fund. bands. Variable Marker Range 2-75 mc in 3 fund. bands; 60-225 mc on harmonic band. Xtal-controlled Marker Osc., 4.5 mc xtal supplied. Ext. Marker provision. Sweep Width 0-3 mc lowest max. deviation to 0-30 mc highest max. dev. 2-way blanking. Narrow range phasing. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Cables: 50 ohm term. output, 'scope horiz., 'scope vertical with isolation probe.

The specs are the proof...

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HIGH FIDELITY PREAMPLIFIER

#HF61A KIT $24.95, WIRED $37.95

With Power Supply: #HF61 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 using the world's finest components & circuitry, at an incredibly low price. Circuit comprises 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: ±0.1 db 5 cps to 90 kc; at 60 w: ±0.1 db 16 cps to 90 kc. 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. ACRO TO-330 Output Transformer (fully potted). 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 bias-balance adjustments. Std octal socket provided for pre-amplifier power take-off & remote on-off switching. Size: 7" x 14" x 8". 30 lbs. Matching cover available.

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 available.

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". 19 lbs. Wiring Time: 15 min.

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for COLOR & Monochrome TV servicing

NEW!

#324
RF SIGNAL GENERATOR
KIT $26.95 WIRED $39.95

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

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

Half-turn of probe-tip selects DC or AC-Ohms.

Uni-Probe — exclusive with EICO — only 1 probe performs all functions!

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

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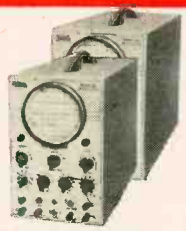
FREE 1957 EICO CATALOG!

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

SINE & SQUARE WAVE AUDIO GENERATOR #377
KIT $31.95
Wired $49.95
Ranges: sine, 20-200,000 cps; square, 60-50,000 cps. Resp. ±1.5 db 60-150,000 cps. Accuracy ±3%.



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

Range 500 kc—228 mc on fund. Cont. sweep width control, 0—30 mc.
KIT $34.95
Wired $49.95
TV/FM SWEEP GENERATOR #360
5MC-4.5MC CRYSTAL .....$3.95 ea.

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

RETMA CAPACITANCE SUBSTITUTION BOX #1120
KIT $5.95 Wired $9.95

RETMA RESISTANCE SUBSTITUTION BOX #1100
KIT $5.95
Wired $9.95

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
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Radio-Electronics

Hugo Gernsback, Editor

ELECTRONIC EXPERIMENTATION

. . . *Today's Experimenters Are Tomorrow's Leaders* . . .

FIFTY-ODD years ago, just after the turn of the century, the wireless art was just emerging. It caught the imagination of the younger generation as nothing had in memory of man. Every mechanically handy youngster began experimenting with wireless: receiving, transmitting or both. Long-distance communication via the Hertzian waves became an obsession—a must for every wide-awake youth.

Then occurred the sinking of the S.S. *Republic* on Jan. 23, 1909, when, thanks to wireless operator hero Jack Binns' CQD (now SOS), almost 500 people were saved from a watery grave. This was the first time in history that radio was used in sea rescue.*

Binns' exploit caused a countrywide—if not worldwide—sensation. Almost immediately the first radio boom in the U. S. began. Hundreds of thousands of young men—and many older ones—caught the radio fever in earnest. The few concerns that sold wireless components were swamped and could not keep up with the demand.

In those days, there was, of course, no voice nor music broadcasting; all traffic was by dots and dashes—Morse code. Large commercial stations were few. Hence, the wireless amateur, just born, took over and soon the air—it was then called ether—was filled with myriads of calls and answers, most of them clashing head on. There being, of course, no Government or other regulating authority in those days, everybody helped himself to a wavelength, whether it interfered with the big commercial stations or not.

Reception at that time was mostly by coherer or autocoherer. Fortunately, at this psychological moment, there occurred a great technical advance that helped usher in the coming Radio Age.

It was the invention of the detector. First came Prof. Reginald Fessenden's electrolytic detector, and then Dr. Greenleaf W. Pickard's long line of crystal detectors, beginning with the silicon detector and many others. Later came a profusion of others such as the Carborundum, the peroxide of lead, the cartridge self-contained electrolytic, the galena, the iron pyrites and the Perikon to mention only a few.

While de Forest's audion—the first vacuum tube—was invented in 1906, it was many years later before it was sold in quantity. This was mainly due to patent reasons and to World War I, which interferred with its mass manufacture. Moreover, the first vacuum tubes sold by unauthorized manufacturers were not very efficient. They were also comparatively expensive.

The period from 1909 until the advent of broadcasting in the early 'Twenties was certainly the heyday of the young art. When broadcasting finally arrived, young radio America was ready. The beginning 'Twenties launched the second radio boom, far and away surpassing the first one in magnitude. Now millions of people, young and old, became interested in radio set building—commercial receivers not having arrived as yet. Most of these home-built sets were crystal receivers with headphones. Loudspeakers were still in their infancy and there was indeed no need for them—the signals made audible by the crystal were too weak and there were no practical, reasonable priced amplifiers.

Then, suddenly and dramatically, in the early 'Twenties, the vacuum tube, now more or less perfected, made its commercial appearance. It swept from the scene almost everything that had existed before. Detector sets, headphones, all went out to make way for the magic tube, the amplifier and the raucous loudspeaker. Commercial, factory-made receivers inundated the country by the millions—and around the 'Thirties most of the original radio experimenters had become a thing of the past. The exception was a large number of shortwave fans and the ever-growing radio hams. The reason for the demise of the true radio experimenters was that good receivers had become cheaper than experimenters could build them.

Since that time, radio experimenting as a countrywide, almost universal hobby has lagged. True, there are still thousands of radio experimenters today pursuing the art as of old, but communication is no longer the sole incentive.

Indeed, if we read the future aright, a new boom is in the making, not a radio, but an electronic, experimenter's boom. The time seems to be ripe for the movement.

The intense, continuous publicity concerning the great shortage of technical men, electronic engineers and specialists seems to have had its effect on the present young generation.

Cycles have a way of repeating themselves and it is very possible that all the ingredients for a new boom are at hand.

The transistor is a most powerful incentive to the new crop of experimenters. Its price already is within reason, and manufacturers tell us that 25-cent transistors will soon be here while the 10-cent type is a distinct possibility under mass production.

The new and coming electronic experimenters will not be as much interested in broadcast reception as were their grandfathers. Instead, they will seek their thrills—and practical knowledge—in high fidelity, simplified electronic computers, robots, solar electronic exploration and exploitation, a vast array of electronic games for entertainment and amusement, electronic toys, house communicators, transistor burglar alarms, transistorized clocks and watches, remote control switches—the list is endless.

The year 1956 was the first in which a number of enterprising manufacturers began to put out transistor experimental kits for youngsters below 15. This is a good beginning and augurs well for the future. It would seem certain that 1957 will see a far greater array of kits and components for the eager electronic experimenter of all ages.

With the Russians already having outdistanced the United States in the number of technicians, our country today is at a critical stage in its history. Our culture and our very life depends on rapid technical progress—*particularly electronic progress*. Let our young electronic experimenters rise to the occasion and fill the breach. Let us not forget, too, that the young electronic experimenters of today will be the electronic engineers, technicians and leaders of our electronic industry of tomorrow. ***—HG***

* See also the account of "Operator Binns' Wireless Log," Feb., 1909, issue MODERN ELECTRICS, the first Gernsback radio publication.

Flexibility Unlimited

A livingroom setback is made into a beautiful hi-fi rack

By FRANCIS COLAGUORI

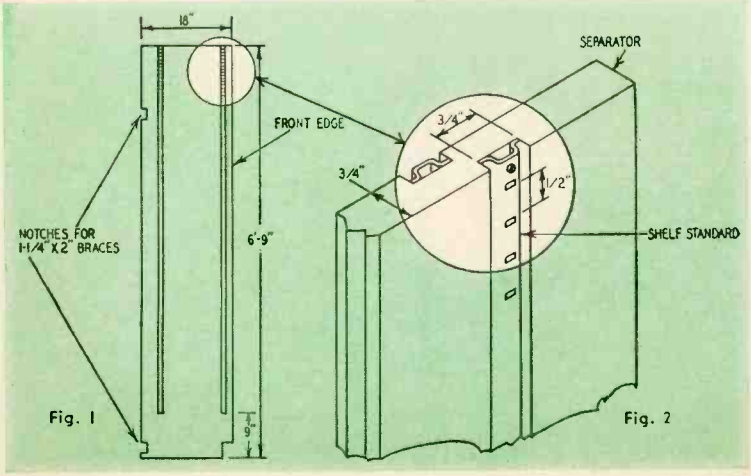
THE idea of planning the entertainment wall started about 2 months after we moved into our new house. The aches and pains of moving day had subsided, a long and dreary winter was about to envelop us in its shroud of boredom—and my wife, Emily, announced with unbeatable feminine conviction that she had had enough of repeatedly stumbling over cables supposedly hidden beneath the rug and picking up seeming yards of connecting wires with her vacuum cleaner.

Together we surveyed our livingroom. A setback along one of our walls about 18 inches deep and 9 feet long caught our eyes and stirred our imaginations. There was the answer—a sort of super house-broken relay rack.

Any hi-fi fan will agree that the relay rack is the most efficient way to mount equipment, and here right before us was a natural for it. A careful study of any room, I believe, will reveal possibilities as good or perhaps better. Our possibilities were almost too good to be true. We had a space from floor to ceiling of

Portion of the hi-fi rack. TV chassis is mounted above picture tube. Section on right contains amplifiers, tuner, preamplifier and record changer.

Fig. 1, left—Layout and dimensions of vertical separator.
Fig. 2, right (detail of Fig. 1)—Installing the shelf standards.



The complete hi-fi setup. Paneling covers the TV chassis and audio amplifier.

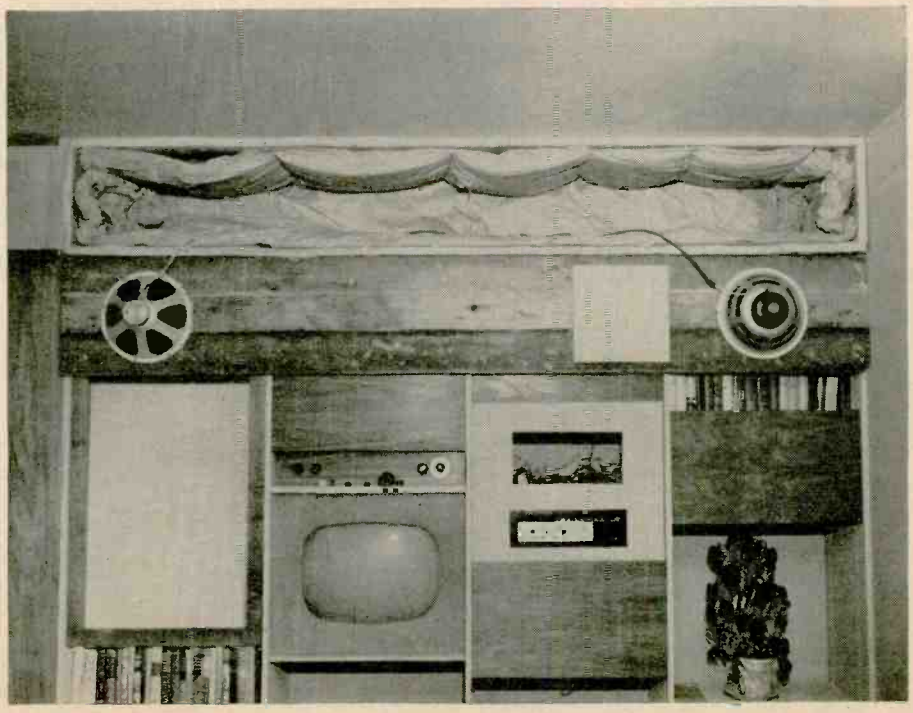
ample width to accommodate a television set, record changer, amplifier, tuner, speaker enclosures and record cabinet. We had space to burn. We could also display handsomely some of our modest collectors' items. Every time we sat and looked at that blank wall our equipment and our objets d' art mentally fell into a different pattern, until we realized that one of the major features we wanted in our recreation wall was versatility.

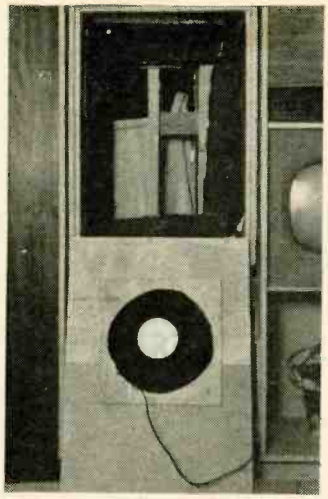
Now we knew what we wanted, but the how-to had not yet become clear. Flexibility was a must. I thought it would present many complex problems, but actually it lent itself to a simplicity that I had not dreamed possible.

One 9-foot recess divided itself into four equal parts, each about 26 inches in width after allowing for the thickness of the dividing partitions. This dimension, I discovered after some research, would accommodate any equipment that I would ever use. The material I selected for the five vertical compartment separators was ¾-inch Novoply, an artificial, nonwarping plywood made of compressed shavings. Each separator was cut 18 inches wide and 6 feet 9 inches long. The lower front corner of each was notched to take a 1 x 4-inch kick plate (Fig. 1). The back edge of each separator was notched 3 inches from the bottom and 12 inches from the top to accommodate a 1¼ x 2-inch lateral strip.

The next operation is one that is not absolutely essential if the tools are not

Dropped speaker board shows speaker mounting and cabinet construction.





Wharfedale speaker compartment showing speaker mounting and hole into closet behind.

available, but it improves the appearance of the finished product. It consists of running a dado the full length of each separator to accommodate metal shelf standards (Fig. 2). These standards are designed for flexible shelf placement, being divided into ½-inch steps along their 6-foot length. They are available at most hardware stores. The dado should begin at the top of the separator and run for 6 feet with a depth sufficient to recess the standards flush with the surface. Two dados were necessary in each side of each separator. I took great care to rout opposite sides of a separator so that the dados were not back to back. If a routing tool is not available, the standards may be mounted on the surface.

Next the 1¼ x 2-inch strips cut 9 feet long were screwed into the notches in the back edge of the Novoply separators provided for them, thus spacing the partitions 26 inches apart. The kick plate was then nailed into place in the notch prepared for it. A temporary diagonal brace was nailed across the front edges for rigidity and alignment. This assembly took place on the livingroom floor. Erecting the assembled dividers and sliding them into the recess was a simple task. The horizontal strips attached in the notches at the rear of the separators were screwed to the rear wall studs and the end separators were fastened to the studs forming the recess.

The next step was to install the Novoply section that was to form the bottom of the overhead speaker enclosure. This was screwed down into the top edges of the separators, finally squaring and holding them. Next the shelf standards were installed in the dadoed grooves, being careful that corresponding slots of all standards were the same distance from the floor.

Installing the equipment

Now for the speaker enclosure. I had a space 15 inches high and 9 feet long in which to mount my two speakers, a G-E 1201-A and RCA SL-12. The bottom is in place, the top, back and sides are formed by the walls and ceiling of the recess so all that remains is the front panel. The lumber for this panel was 1¼-inch material. It was screwed to vertical cleats fastened to the sidewalls. In addition I hinged it to the bottom of the enclosure so that when the screws were removed, it could be easily dropped by one person, even with the weight of the two speakers mounted on it. You can see from the photographs that this panel lends itself to a variety of decor.

I also have a Super 12/CS/AL Wharfedale speaker which I decided to mount in one of the compartments. Behind the wall at the back of the recess is a cellar stairway and a closet. I found that a good spot for locating this

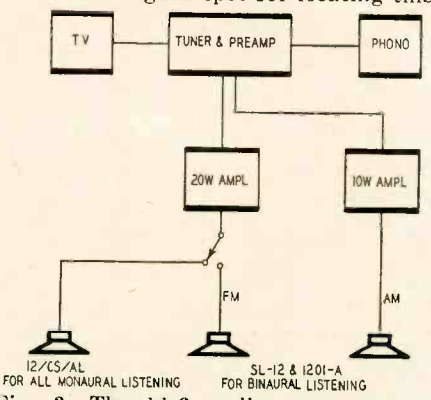


Fig. 3—The hi-fi audio arrangement.

speaker enabled me to cut through the wall into the closet. This gave me a backless enclosure (the compartment) 3 feet high, 26 inches wide and 16 inches deep, plus the 40 cubic feet of volume in the closet. Thus I had an infinite baffle of approximately 50 cubic feet.

The final stage of the project was arranging the compartments and installing the rest of the equipment. Besides the Wharfedale speaker enclosure, the TV alone of all the components had to remain stationary. Perhaps one spot alone in the wall is best for viewing, and we were fortunate in that this particular spot backed on the cellar stairway. This made it possible for me to cut out a section of the wall so I could get enough depth for the neck of the picture tube and also allow proper ventilation for the TV chassis.

Our television receiver is a converted 21-inch set. It was originally a 10-inch RCA 630 model. I made the conversion with a type 201Y1 RCA Converkit which contained a 231T1 universal transformer and a type 211D2 anastigmatic deflection yoke. After these two parts were installed I found that I could not get a full vertical raster. This was corrected by replacing the vertical output transformer with an RCA type 226T1 unit. The high-voltage capacitor was also replaced to meet the higher voltage requirements. Although the original front end still worked I replaced it with a new cascode tuner which greatly improved reception.

Right here a problem reared its ugly head. Because of the odd size of the picture-tube mask I needed, I had to make it myself. I had an old 21-inch mask to which I added a ½-inch plywood frame to make up the difference in the size I needed. Using this as a form, I covered it with Celastic, a cellulose-impregnated fabric which, after being softened with a solution provided with it, can be molded into any shape desired. (This can be purchased at Ben Walters, 156 7 Ave., New York, N. Y.) After the Celastic hardened on the form, I brushed it with glue and then completely covered it with sawdust. When the glue had set, I shook off the excess sawdust which left me a mask with a highly desirable textured finish.

The photographs show where we tucked the 20-watt amplifier (built from a circuit supplied by the manufacturer of the output transformer, an Acrosound TO-300) in an Ultra-Linear Williamson circuit, and the National Criterion AM–FM tuner with its Horizon 5 preamp. I also use a Horizon 10 amplifier with preamp so that, with my two overhead speakers, we can enjoy the binaural feature of the National Criterion tuner. Incidentally, we are located about 30 miles from New York City and the sensitivity of this tuner gives us excellent reception without the need and expense of an extra antenna. The TV sound was tapped at the FM discriminator and is fed through the main amplifier and in turn through the speaker system (Fig. 3). The yoke, picture tube and focus coil connections from the transposed chassis and picture tube are equipped with connectors for easy removal of either chassis or tube.

The Garrard RC-80 record changer is in the compartment at the right of the TV. The walnut-veneered panel drops on its piano hinge and the changer rolls forward on slides. At the lower left we inserted the compartment with sliding doors which is the repository of our entertaining supplies (liquor cabinet, to you). Each of these units is movable except the television set and the Wharfedale speaker enclosure, merely by sliding out the unit and relocating the shelf rests in the standards. *Flexibility unlimited!*

The raw leading edges of the Novoply separators were covered by gluing on ⅛ x ¾-inch strips of wood. Our decor has a slightly modern flavor but with the use of a decorative molding on these edges, a painted finish and suitable show hardware, the entertainment wall could have a traditional or period look.

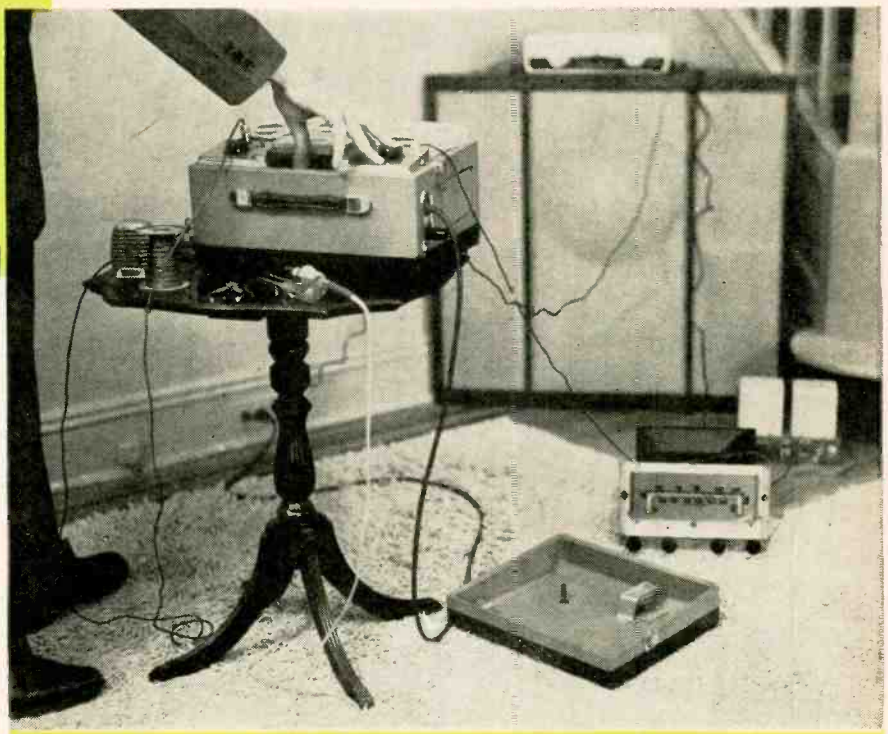
The best of course was yet to come—when all our friends and neighbors dropped in to view the project. I think all lay people consider the hi-fi man as being possessed of some mild and harmless insanity. But at the same time they are deeply envious of the sound-sensory pleasures his insanity has produced. They questioned, they admired and they praised. We glowed and puffed and were proud. But, look out! At least one of them was heard to say "I'd like to have something like this. I'm not handy but if someone helped . . ." END

adding a tape recorder to a hi-fi system

Considerations in selecting the recorder; record–playback curves; principles and techniques

By NORMAN H. CROWHURST

Connecting a tape recorder to a hi-fi system.



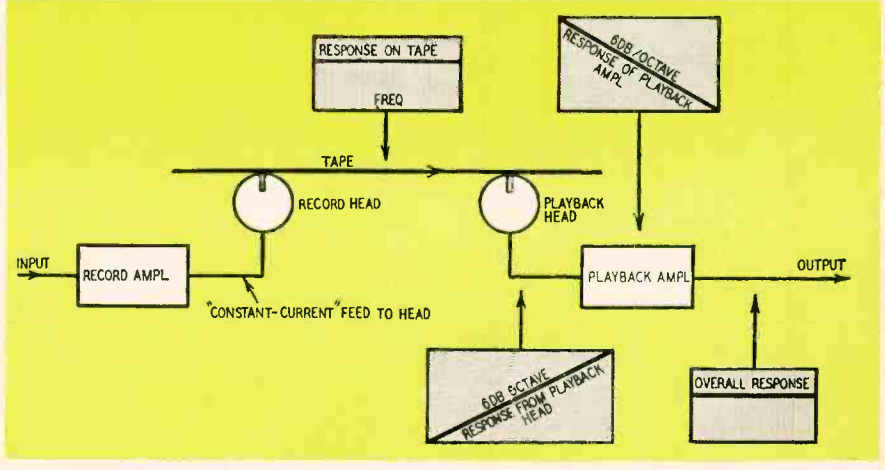


Fig. 1—Theoretical relationships required for flat overall frequency response.

THESE days I meet many hi-fi enthusiasts who are either thinking of adding a tape recorder to their system or have already bought one for that purpose. While there is nothing basically difficult about making this addition, it often seems to involve a number of problems that are not covered either in the literature on the subject or in the instruction manual that comes with the tape recorder.

If you have not already purchased your tape recorder, the first thing to decide upon is the model. When this question is asked, all of us have one thing in mind: "How good can I get it, for how little cost?" You have to compromise between two conflicting factors—your budget and your notion of high fidelity.

One thing to decide at this stage is just how you want to use the tape recorder. Although the process of recording and playing back on magnetic tape is much simpler, in some respects, than the older disc method, it does have a few problems of its own. First of these is the inherent record–playback characteristics needed to get flat overall response.

Record–playback curves

The basic relationship is illustrated in Fig. 1. The record head is a device which magnetizes the tape in accordance with the amount of current flowing in the head. So, if the record amplifier supplies for the same amount of input at all frequencies constant current into the head, the tape will be magnetized to the same magnetic density regardless of frequency. We can say the response on the tape is flat.

The playback head, however, produces a response proportional to the rate at which the magnetization of the tape changes. So, if the frequency is stepped up by a ratio of say 2 to 1, the rate of fluctuation is twice as great and the output will be doubled. In the output from the playback head there will be a slope of 6 db for every octave increase in frequency.

To end up with a flat overall characteristic, we shall need a 6-db-per-octave downward slope in the playback amplifier, as equalization for this inherent property of magnetic tape playback.

This is not quite all, because we have assumed in Fig. 1 that both the record and playback heads are perfect—that they have an infinitely small gap and magnetize the tape, or pick off the magnetism, exactly uniformly, regardless of frequency, from zero to infinity. The fact that every tape head has to have a magnetic gap in it to work at all (and various other losses) results in an overall response for the playback head itself that looks somewhat like Fig. 2. This is the playback response for a fairly good head.

Notice that the 6-db-per-octave rise

departs at 1,000 cycles and reaches a turnover point at 3,000 cycles. Not far above this it begins a rapid descent. So our equalization should take care, not only of the 6-db-per-octave rise in the region below 1,000 cycles, but also of the high-frequency loss above 3,000 cycles.

So far we have assumed that the record head is kept linear. This way of working would run us into difficulties because of the extremely sharp slope in the high-frequency rolloff above 4,000 or 5,000 cycles. An attempt to put all of the compensation for this in the playback head results in two bad features:

1. A considerable amount of peaking has to be used to get a sharp enough characteristic and this results in poor transient reproduction.

2. The excessive emphasis of frequencies from 4,000 or 5,000 cycles upward emphasizes the background hiss on the tape and makes it extremely noticeable.

To avoid this effect the standard record characteristics are arranged to

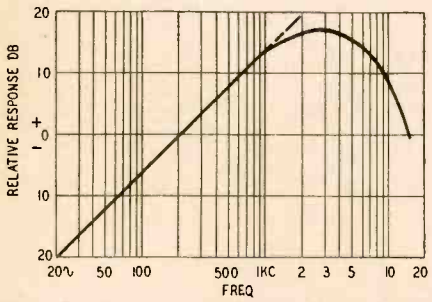


Fig. 2—Response of practical high-quality playback head. Theoretical perfect head follows dashed line.

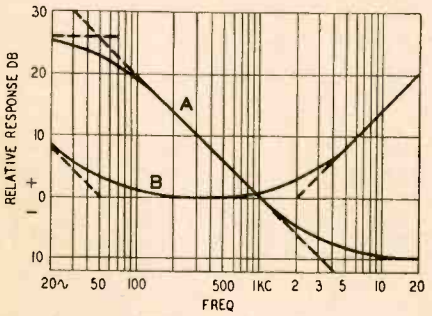


Fig. 3—NARTB standard curves for prerecorded tapes. Curve A is playback, curve B shows standard method of specifying tape recording characteristic—relative current through recording head required to produce NARTB curve.

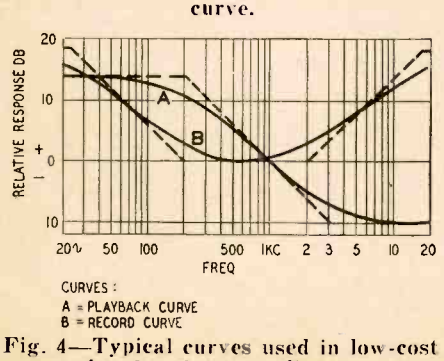


Fig. 4—Typical curves used in low-cost recorder for flat overall response.

produce some of the necessary pre-emphasis at the high-frequency end to offset the playback rolloff. This alleviates some of the difficulty on playback. To finish the job, the playback characteristic does not follow the 6-db-per-octave downward slope all the way, but levels off in the region of 3,000 cycles.

Even this equalization poses a difficult problem for the playback amplifier: A slope of 6 db per octave from, say, 30 cycles up to 3,000 represents a level change of 40 db. In other words, the playback amplifier must have 40 db more amplification at 30 cycles than it has above 3,000 cycles.

The output from a playback head is very low and requires a high-gain amplifier. This extreme emphasis of the low frequencies means that a playback amplifier becomes very susceptible to hum pickup.

Another deficiency that this shows up is the random fluctuation in the magnetic properties of the tape. These dominate at very low frequencies so undue emphasis of frequencies below about 50 cycles can result in considerable exaggeration of these fluctuations on the tape.

For these reasons the standard record and playback characteristics, adopted by the NARTB and other authorities, are shown (Fig. 3). Frequencies below 50 and above 2,000 cycles are pre-emphasized in the record characteristic. This is to minimize the effect of rumble frequencies due to random fluctuations in the magnetic properties of the tape at the low end and hiss at the high end. The playback curve has a 6-db-per-octave downward slope for most of its length but flattens off below 50 cycles to offset the recording pre-emphasis and above 3,000 cycles to produce additional compensation for loss in the playback head.

As this is the standard that has been adopted by the recording industry, all prerecorded tapes will require this playback curve to give a flat frequency response. So, if you want to use your tape recorder for the presentation of prerecorded tape material, the easiest way is to get a professional type recorder in which the playback characteristic conforms to this standard.

This professional characteristic may be regarded as a sort of "minimum compromise" characteristic. Its use results in the overload point being at the same signal level for a range of frequencies from around 100 up to 2,000 cycles. But this has been achieved at the expense of about 30 db more gain at 50 cycles than the amplifier has at 3,000 cycles.

In these days the provision of additional gain is neither difficult nor particularly expensive, but some of the problems that come with it prove to be both. A particular problem is the maintenance of a satisfactory hum level when this characteristic is used. Heads need very careful shielding, with high-quality magnetic shields, and considerable attention is necessary to the input circuit to avoid hum pickup.

Home recorders

These make use of the standard characteristics uneconomical from the viewpoint of the low-priced recorders. So the average home recorder, priced somewhere between $100 and $300, will use different equalization characteristics—a typical sample is shown in Fig. 4.

This follows the same general scheme as the standard curves but does not extend the 6-db-per-octave slope on playback for such a great frequency range. In the example shown, it turns over at 200 cycles instead of 50 cycles. The change in gain, between the different turnover points, is reduced from 30 db for the professional to a mere 18 db for this example.

This difference is compensated for in the record curve by providing additional boost below 200 cycles, not given in the standard characteristics. This change means that frequencies below 200 cycles will reach an overload point at a slightly lower level than frequencies above. For recording the great majority of program materials, this is not a serious difference because the greatest energy content of all program material tends to be in the region between 200 and 1,000 cycles.

With this record curve it is possible to use a maximum record level in this region. Frequencies below and above this region are boosted to help overcome the problems that otherwise occur on playback. By using this kind of record and playback characteristics, the lower-cost range of tape recorders can achieve results that sound comparable to the professional class without the need for expensive shields and very careful attention to the design of input stages.

Home recording

The important thing is that the *overall* response can be made flat. Program material using this record curve will be reproduced flat using the corresponding playback curve. However, we realize that a recording made with the record curve of Fig. 3 (and intended to use the playback curve of Fig. 3) will be considerably deficient in frequencies below 200 cycles if it is played back on equipment using the curve of Fig. 4.

What this says is that the average low-cost home recorder is not capable of giving high-fidelity reproduction of prerecorded tapes. They will, in particular, be deficient in low frequencies. You could, of course, run the output from the tape recorder through a pre-amplifier provided with low-frequency boost to correct for this, but this would get you right into the troubles that the low-cost tape recorder manufacturer has tried to avoid: *you will not be able to produce the necessary emphasis of frequencies below 200 cycles without running into increased hum.*

So adjusting a low-cost tape recorder to play prerecorded tapes proves to be

a much more involved process than would at first appear.

What you really need to decide right now is: What do you want the tape recorder for? Are you just anxious to record selected material from FM programs . . . or maybe from the efforts of musical friends in your own living room—which you can play back at your leisure for future enjoyment? Or do you want to use the system for playing prerecorded tapes as well?

If you will be satisfied with the former, a low-cost tape recorder may well give you much enjoyment. But if you want to get into the prerecorded tape field, you had better look for a somewhat better recorder, something in the lower end of the professional class and costing about $500.

Several manufacturers are planning (some are already appearing) to put on the market prerecorded tape players at a cost lower than quoted above. These instruments (when they are available) will be tape players only—no provision is made for recording. By eliminating switching and all the mechanism associated with record and playback control on a full recorder, it has been possible to produce a simple player at a more reasonable cost.

Connecting it for record

Assuming now that you have selected and bought your recorder, the next problem is connecting into the system. Most of the recorders currently available come with at least two inputs, one for microphone and another for radio, TV or phono. They also usually have an output marked "external speaker." Some do not have a separate input for radio, TV or phono, just a single input for all purposes.

The method of connecting the tape recorder into the system will depend on the provision made on the tape recorder, and on the kind of units used in the system.

If your system is built up of a number of separate units, such as a phono preamplifier, an FM tuner and a main or basic amplifier, a convenient place to take off for the tape recorder is at the output of the FM tuner or phono preamplifier (when you use a high-quality microphone). These usually give an audio output in the region of a volt, which is just right for the radio, TV, phono input on the recorder, where this is provided separately from the microphone input.

If the recorder has only a single input, intended for microphone, radio, TV, phono or whatever you want to put into the recorder, the 1-volt output provided by the tuner or preamp will be too much input for the recorder. It will result in distortion even though the volume control is turned up only a very little way. You will need to build an attenuator into the connecting cord between the tuner or preamp and the recorder.

The best place to do this is in the back of the plug that connects into the recorder. Fig. 5 illustrates typical components that may be used. The suggested values of 1 megohm and 33,000 ohms should be tried first and a sample recording taken. You may find that the attenuation is too much or too little.

If the attenuation is too much, turning the recorder volume control all the way up will still not get an adequate recorded level on the tape. If the attenuation is too little (which is not very likely with these values), you may find you still get distortion before the volume control is turned up an appreciable amount. For too much attenuation try a larger value in place of the 33,000-ohm resistor. For too little attenuation try a smaller value in this position.

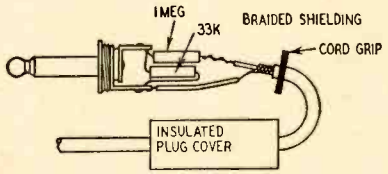


Fig. 5—Inserting an attenuator in the microphone input plug.

Single-chassis systems

That's OK if you have a separate tuner or preamplifier unit from the main amplifier. But many of the low-cost high-fidelity systems available today incorporate the whole high-fidelity system into one unit, which includes the functions of tuner, preamplifier and main amplifier, all in one chassis.

In this case you will not have a convenient 1 volt to use for connecting into the radio–TV–phono input of the recorder. Often the only accessible spot is the output terminals or socket provided for connecting to the loudspeaker. The amplifier should be operated with the controls in the same position as would be used for normal listening. The loudspeaker is disconnected and the arrangement of Fig. 6 plugged into the amplifier output in place of the loudspeaker.

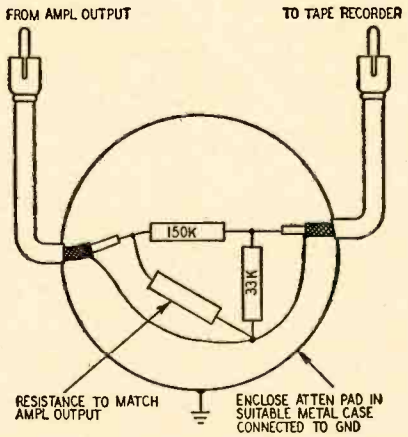


Fig. 6—Attenuator may be needed between tape recorder and amplifier output to reduce hum and noise.

This arrangement provides a matching load for the amplifier output as well as an attenuator to provide a suitable input for the recorder. This is necessary because the amplifier output will be at least 5 or 6 volts while the input to the recorder does not need to be more than about 1 volt at the radio–TV–phono input.

The resistance to match the amplifier output is connected to replace the loading provided by the speaker. Its value should be 4, 8 or 16 ohms, according to the output tapping on the amplifier available. The rating of this resistor should be sufficient to dissipate 1 or 2 watts, so it does not overheat on loud passages of program material.

To minimize possible hum pickup, it is a good idea to enclose the whole arrangement in a suitable metal case with holes made for the leadout. The case should be lined to prevent the wire ends of the resistors from shorting to ground and the case itself should make a direct connection to ground.

The values of 150,000 and 33,000 ohms are shown as typical of those required. Sometimes the attenuation may be either too much or too little. If the level on the tape is too low, the 33,000-ohm resistor should be replaced with a larger one. If there is not sufficient control of volume and it tends to overload too easily, a smaller resistor may be used in place of the 33,000-ohm unit.

If the input for the tape recorder is taken from the output of the main amplifier, it is best not to try putting this into the microphone input. If the particular recorder being used does not come with a separate input for radio, TV and phono purposes, it may be well to make one. An important point in looking for somewhere to connect an input is to be sure that it does not interfere with the high-frequency bias adjustment of the recorder.

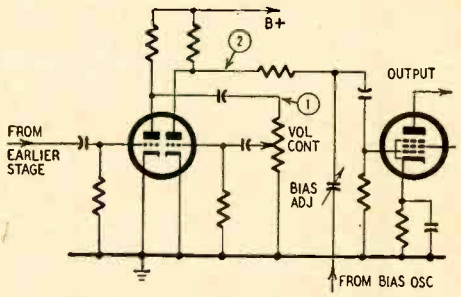


Fig. 7—Stages in low-cost tape recorder showing points where high-level input can be connected. If point 2 is used, a .05-μf blocking capacitor is needed.

In some recorders the high-frequency bias is applied to a separate winding on the record head but in most the high-frequency bias comes through a small adjustable capacitor from the bias oscillator, as shown in Fig. 7. This means that the audio and the high-frequency bias are mixed together at the grid of the output stage so an external circuit must not be connected either directly to the grid or to the other side of the capacitor coupling the grid to the previous plate. How-

ever, either points 1 or 2 in Fig. 7 would be suitable for connecting in an external input. Choice will usually depend on which gives adequate gain for the purpose.

Position 1 does have the advantage that the volume control in the tape recorder can be used to adjust the level. If position 2 is used, the volume control becomes inoperative and the amplifier volume control, feeding this point, must be used. This is not altogether a satisfactory arrangement because it means that the setting used for normal playing cannot be held, as suggested earlier. Using the normal playing setting means that the operating condition of the main amplifier is known and not subjected to changes in background noise or distortion.

So the best place to have a ready control of record level on the recorder is the position 1 of Fig. 7, if the gain can be adjusted to be suitable. This can usually be taken care of by using an attenuator of the type referred to in Fig. 6.

Now we have a method of connecting the high-fidelity system to the tape recorder so we can get recordings on to the tape from our given sources, the phono preamplifier or the FM tuner, as may be desired. For checking purposes, we can always see what we have on the tape by using the recorder's own playback speaker.

Connections for playback

But the real objective in connecting a tape recorder into a hi-fi system is to play the tape back through the hi-fi system. Most systems, whether of the multiple or single unit type, now have a high-level input suitable for connecting in a tape recorder or tuner. This input requires a level of about 1 volt.

The easiest place to obtain this input is from the external speaker socket of the recorder. Inserting a plug here disconnects the internal speaker and provides a voltage for connecting to an external speaker. This can instead be connected into the high-level input just referred to, but there are disadvantages: the output of a low-cost tape recorder is intended for feeding a low-impedance speaker and does not usually have feedback to minimize the distortion in the output tube. So to operate successfully it will be necessary to apply across the output a resistance load equal to the original loudspeaker impedance. Even then, the distortion in the output would be about the same as it is in the recorder's own loudspeaker.

If you want to achieve higher-quality reproduction, it is best to take the tape output from an earlier stage, before going through this rather low-quality power amplifier stage, used for feeding the small loudspeaker in the tape recorder.

We need a 1-volt output from the recorder, somewhere ahead of the output stage. We could connect to the output stage grid, provided we remove this connection when we go to record because the connection will cause loading that will upset the high-frequency bias, as mentioned earlier.

Very often the same point used for radio–TV–phono input to the recorder

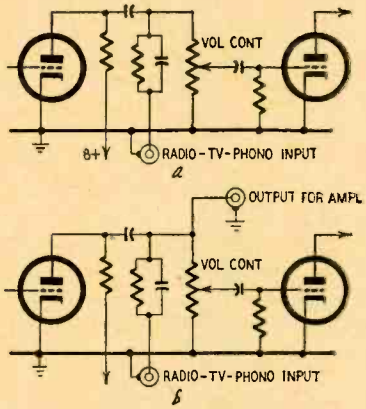
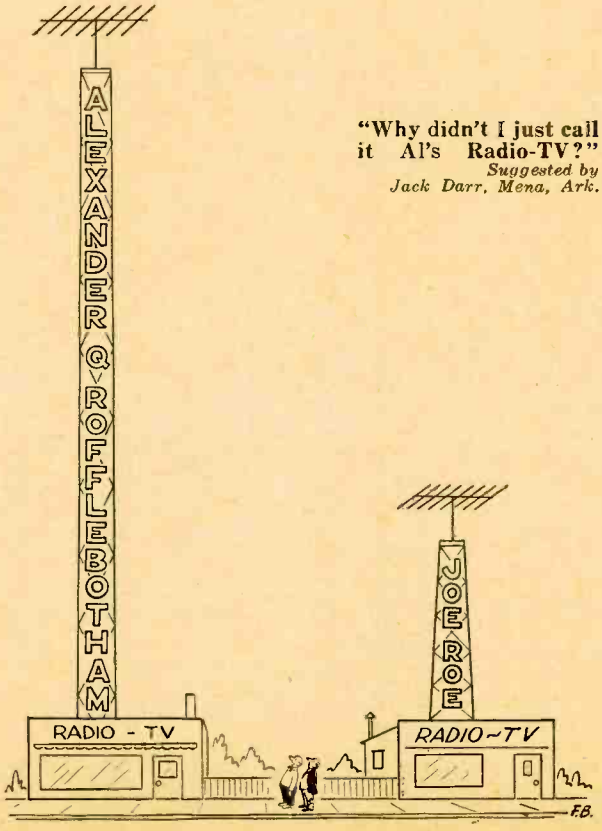


Fig. 8—If radio–TV–phono input includes equalization (a), a separate output should be provided for playback through amplifier (b).

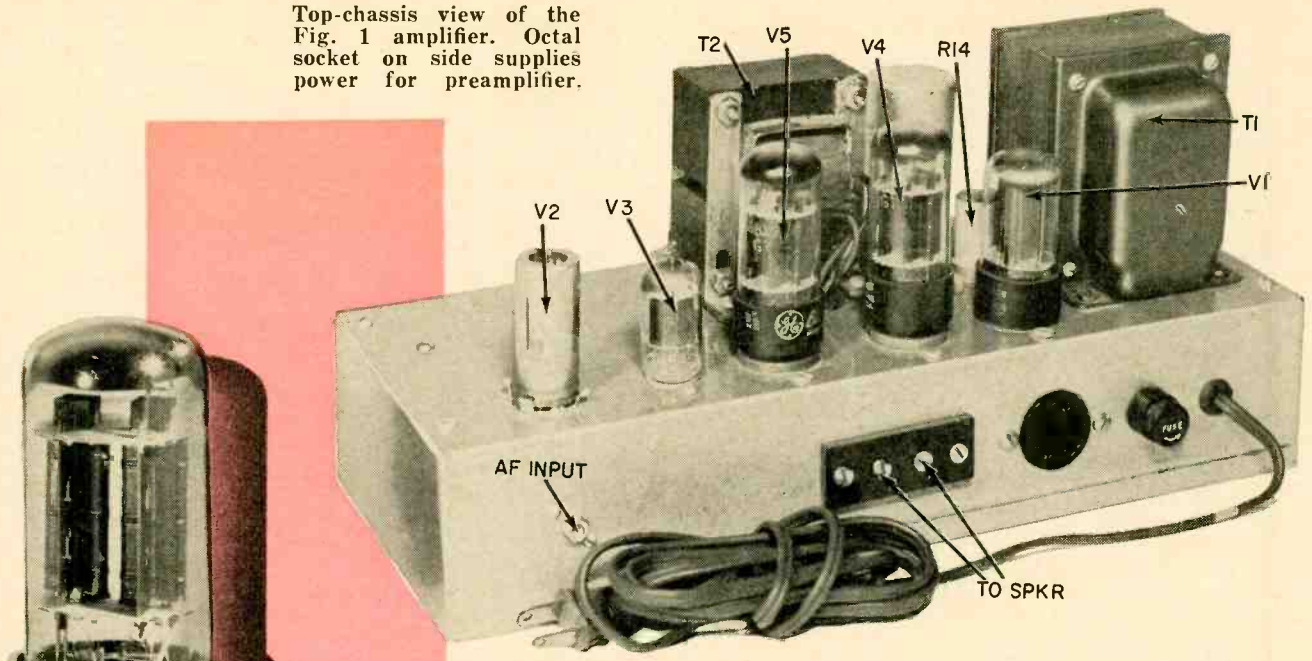
can also be used for taking off the output for the amplifier. If the point had to be "found," as shown in Fig. 7, there is no particular problem. Just use the same point for transfer in both directions and change the connection on the other end from the output from the amplifier to its input, according to whether recording or playback is desired.

Where the recorder comes with a radio–TV–phono input, sometimes this incorporates some equalization as shown in Fig. 8-a. This equalization is provided so that the *record* characteristic shall be flat, so it is not required over again in the playback characteristic. If the same socket is used for taking off the output, the signal will pass through this equalization network again on playback. The best thing under this circumstance is to connect a second output for the playback (Fig. 8-b) that avoids passing the signal a second time through the resistance–capacitance equalizing arrangement.

Care in making both record and playback connections in the right way can give some very creditable results with the low-cost home-recorder variety of tape unit. It is true in this market, as in most others, that you *generally* get what you pay for. So a professional recorder costing a lot more will give better results. But for most of us it is questionable whether the difference in performance warrants the difference in price. And some of the higher-priced models are aimed at the "sucker market"—the man who thinks it *must* be better *because* it costs more. END



"Why didn't I just call it Al's Radio-TV?"
Suggested by Jack Darr, Mena, Ark.



Top-chassis view of the Fig. 1 amplifier. Octal socket on side supplies power for preamplifier.

TV tube for High Fidelity

Twin-triode makes excellent power output tube for audio

By NORMAN V. BECKER

IN the early days of high fidelity, triode power amplifiers were acclaimed by music lovers for good tone quality and cleanness of reproduction. When pentode feedback amplifiers which gave a higher degree of speaker damping and very-wide-range response were introduced, triode amplifiers were forced into semiretirement. But the popular Williamson circuit revitalized the whole idea of triode circuitry and contributed greatly to the popularity of hi fi generally.

Perhaps the controversy of triodes vs pentodes will continue for a long time. In any event triodes still have a place in audio, particularly in medium-power home music systems where no special emphasis is placed on electrical efficiency or excessive output power.

Used with negative feedback, triodes are less prone to ringing, motorboating and other forms of instability which occasionally plague pentode amplifiers with large amounts of feedback. In addition, with the absence of screen and suppressor grids, they can be handled more easily by less experienced audiophiles and hobbyists.

With all their basic simplicity, power triodes have one very bad feature—a low amplification factor. It usually takes a walloping amount of grid signal to drive them to full output. This represents a problem not easily solved by conventional vacuum-tube drivers. Although a stepup driver transformer can do the job without straining, it's an expensive, bulky component which contributes nothing to overall fidelity.

The tube

Sometime ago I ran across a power triode which reduces this drive problem considerably while maintaining reasonable output and plate efficiency. It's the 6BX7, a medium-mu twin triode developed for use as a vertical deflection amplifier in TV receivers. Its physical size is approximately the same as a 6SN7 and base connections are identical. To show its desirability as an audio tube let's compare it with the classical 2A3.

With triode sections paralleled, a single 6BX7 has a plate resistance of only 650 ohms. This gives it better damping characteristics than the 800-ohm plate resistance of a 2A3. An amplification factor of 10 allows the 6BX7 to be fully driven by a 20-volt-peak grid signal while the 2A3 requires about 45. In a single-tube class-A amplifier the 6BX7 can deliver approximately 3 watts into a 2,500-ohm plate load at 5% distortion. Combined plate dissipation of a single 6BX7 is 12 watts as compared with 15 for a 2A3.

The indirectly heated cathodes and 6.3-volt filaments of the 6BX7 permit operation from a common 6.3-volt transformer winding and simple cathode bias can be used.

The amplifier

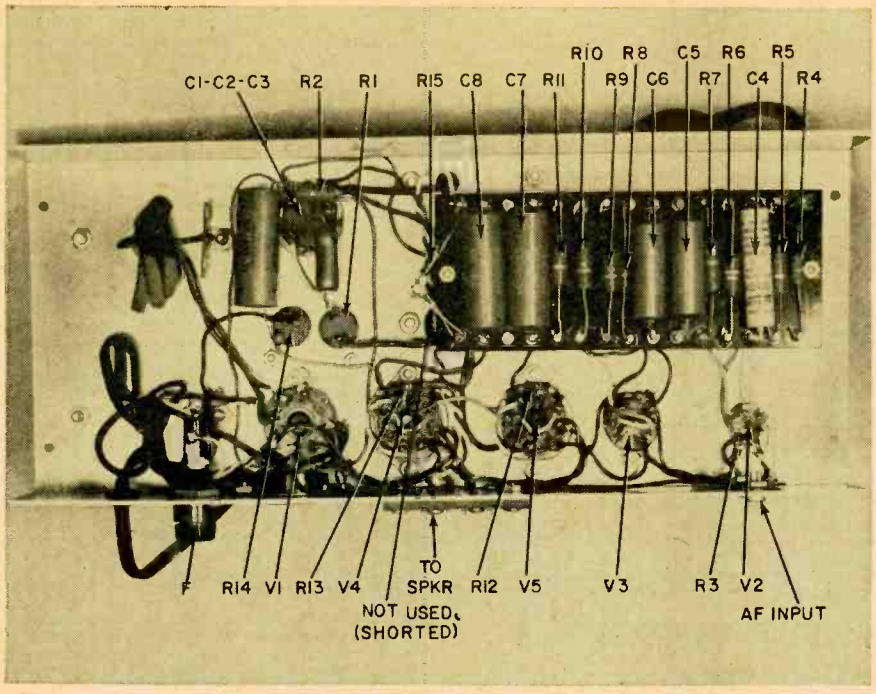
Fig. 1 is the schematic of an 8-watt home music amplifier using a pair of 6BX7's in push-pull parallel output. Circuitry is entirely conventional, except perhaps for the 12AU7 inverter–driver. Twin sections of this tube are paralleled to double its transconductance.

The 6AU6 input tube provides enough voltage gain so that as much as 20 db of overall feedback may be used while good input sensitivity is maintained. (About 2 volts of audio will push the amplifier to full output.)

The amount of feedback is governed by the resistance of R15. Increasing its value decreases feedback and vice versa. How much feedback for optimum performance is somewhat debatable, but in this particular circuit 15 db appears adequate. Due to the phenomenally low plate resistance of the output tubes, feedback in excess of this amount gives no perceptible improvement in speaker damping or tone quality.

T2 is a "no-name" output transformer picked from an electronics bargain counter for $2.95. With a loudspeaker load it tolerates almost 20 db of *uncompensated* feedback from its voice coil winding before instability sets in.

Overall response of the amplifier is flat within 1 db from 20 to 20,000 cycles, with response being down only 2 db at 40,000 cycles (using 1-watt output level and resistive load). Characteristics such as these obtained with a bargain

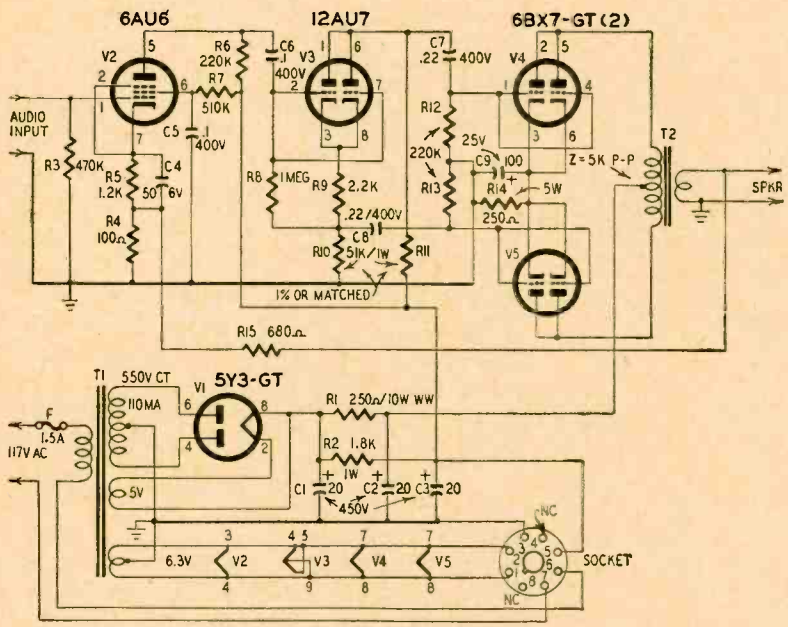


Underchassis view of Fig. 1 amplifier. Terminal-board wiring saves space and makes for extremely neat layout.

output transformer are due in no small measure to the excellent low source impedance presented by the 6BX7's.

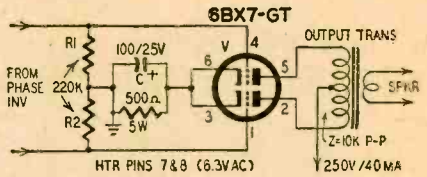
Power output at 1,000 cycles, using a resistive load, is 8 watts at less than ½% total harmonic distortion. Power response is down 3 db at 30 and at 20,000 cycles. Although these figures might appear modest in light of the present trend toward superpower amplifiers, performance of this 8-watter makes for mighty good listening when used with good auxiliary equipment.

Anyone desiring to duplicate this circuit should have no trouble with erratic or unstable performance. I have built five of these amplifiers, each one laid out in a different manner and occasionally using components other than those specified in the parts list. None of these amplifiers presented any problems and all have been in operation for more than 18 months. It has not been necessary to replace a single component in any of them including tubes.



R1—250 ohms, 10 watts, wirewound
R2—1,800 ohms, 1 watt
R3—470,000 ohms
R4—100 ohms
R5—1,200 ohms
R6, 12, 13—220,000 ohms
R7—510,000 ohms
R8—1 megohm
R9—2,200 ohms
R10, 11—51,000 ohms, 1 watt, 1%, or matched pair
R14—250 ohms, 5 watts, wirewound
R15—680 ohms (see text)
All resistors ½ watt unless noted
C1, 2, 3—20-20-20 µf, 450 volts, electrolytic
C4—50 µf, 6 volts, electrolytic
C5, 6—0.1 µf, 400 volts
C7, 8—0.22 µf, 400 volts
C9—100 µf, 25 volts, electrolytic
T1—power transformer, 550 volts ct @ 110 ma, 5 volts @ 2 amps, 6.3 volts ct @ 5 amps (Triad R-12A or equivalent)
T2—Output transformer, 5,000 ohms plate-to-plate primary
V1—5Y3
V2—6AU6
V3—12AU7
V4, 5—6BX7-GT
F—fuse, 1.5 amps
Octal sockets (3)
7-pin miniature socket
9-pin miniature socket
Chassis

Fig. 1—Schematic diagram of audio amplifier using two 6BX7's in push-pull.



R1, 2—220,000 ohms, ½ watt
R3—500 ohms, 5 watts, wirewound
C—100 µf, 25 volts, electrolytic
T—output transformer, 10,000 ohms plate-to-plate primary
V—6BX7
Octal socket
Power supply
Chassis

Fig. 2—Using the 6BX7 as a single-tube push-pull power amplifier.

One precaution: Plate voltage on a 6BX7 should never exceed 270 (measured from plate to ground). In case you use power supply components which differ from those recommended, a 500-ohm wirewound 10-watt variable resistor should be substituted for R1. Its slider can then be adjusted to give correct plate voltage.

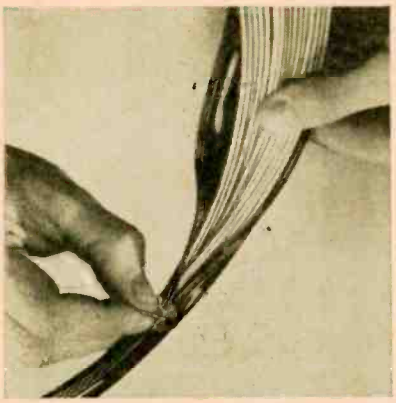
Since the 6BX7 has independent triode sections, it may be used as a single-tube push-pull amplifier. This simple circuit (Fig. 2) makes an excellent low-cost power stage for low-level listening.

The power output of this amplifier is approximately 4 watts at 2% distortion. Voltage requirements are: for the plates, 250 at 40 ma; for the filament, 6.3 at 1.5 amps.

As a well-versed ham might say of the 6BX7, "It's a hot little bottle!" If you're partial to triodes, try it and see.

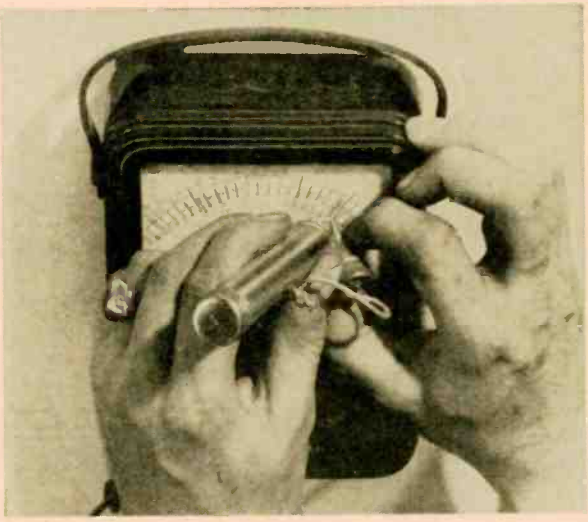
END

what's new?



AN ELECTRONIC ZIPPER

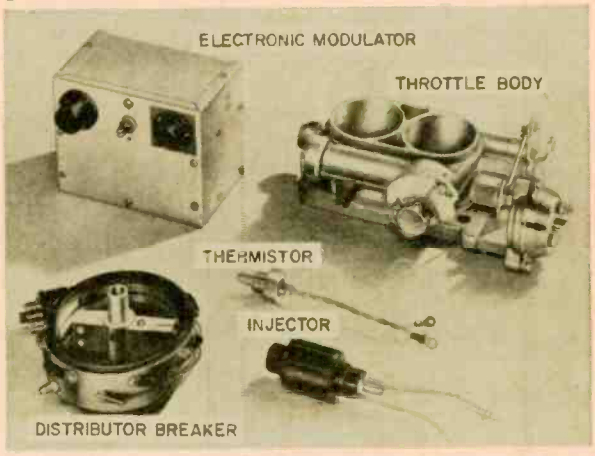
now makes electronic harness assemblies glamorous as well as cheaper and quicker to cable together. Instead of tedious lacing and tying, the cable is zipped up in a protective plastic shield. A sealant can be used to make the tubing permanent and waterproof. The tubing is made in several colors, permitting color-coding, and in two types, the simple one shown here and one with an inside overlap which prevents the zipper from touching the wires. If not sealed, the tubing may be reused any number of times. Zippertubing was developed by a Los Angeles firm, W. A. Plummer Manufacturing Co.



AUDIBLE VISION for the blind technician is provided by the electronic eye shown in action here. Invented by a blind research physicist, Clifford M. Witcher, staff member of the Research Laboratory of Electronics at M.I.T., the probe is now manufactured by a Cambridge (Mass.) concern, Dunn Engineering Associates. The Audible Vision Probe contains lenses, batteries, a flashlight bulb, a cadmium sulphide photocell and a multivibrator circuit with two transistors, which produce a tone which rises as the intensity of the light increases. The photo shows a special attachment for reading meters; a transparent plastic overlay with raised calibrations aids the blind user to determine the reading at the position of the pointer.

STORAGE CELLS

no larger than the smaller mercury cells are now being made by the German Edison Storage Battery Co. These button cells are made in sizes ranging from 50 to 150 milliampere-hours, and a somewhat larger disc type cell is rated at 450 mah. They are of the nickel-cadmium type, with caustic potash as electrolyte and containers of nickel steel. Voltage is about 1.25. The trademark Perma-Seal points up their nonspillable, nonrefillable nature. The cells are intended for use in small portable receivers—transistor or otherwise—measuring instruments, hearing aids, electric clocks and other applications where very small self-contained low-voltage supplies are required. They are also recommended for use in filtering low-voltage rectified ac, having an extremely high electrostatic capacitance.

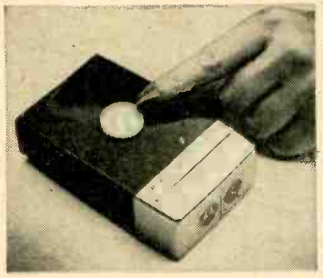


ELECTRONIC FUEL CONTROL

may add as much as 10 to 20 additional horsepower to high-compression V-8 engines, as compared to the latest 4-barrel carburetor, according to Bendix Aviation Corp., who developed the device.

Called the Electrojector, the device shoots electronically timed jets of fuel directly into the intake ports of the cylinders. A transistorized "modulator" unit receives timing signals from the distributor. Besides the timing signals other sensing elements signal the need for fuel under acceleration or idling conditions, the temperature of the motor and even the atmospheric pressure. These signals widen or narrow the timed pulses produced by the modulator's multivibrator circuit. The pulses are amplified and applied to solenoids to open valves and actuate the jets. Thus the correct amount of fuel at the correct instant is always supplied.

two new TV remote controls



By HENRY O. MAXWELL

WE CLOSE this series of articles on remote controls for TV receivers with descriptions of two radically new control units that were introduced after the first articles had been written.* These are Zenith's ultrasonic Space Command, successor to the Flash-Matic described in the September issue, and Motorola's transistorized radio control system.

The Space Command remote control is available in two models. The series 400 has four channels. It turns the set on and off, mutes and restores sound and selects channels by turning the channel selector clockwise or counterclockwise as desired. The connections of the on–off, sound mute, restore, and motor control circuits in the TV set are similar to those in the Flash-Matic arrangement.

The model 200 has only two channels. One mutes and restores sound and the other selects station channels by turning the tuner clockwise.

The control unit is a small plastic box with built-in tuning rods that vibrate at around 40 kc when struck by pressing the proper control key. (See photos.) The inaudible 40-kc vibrations are picked up by a sensitive capacitor microphone built into the front of the receiver. The microphone output is amplified by a 40-kc amplifier and used to perform the various control operations. Limiter and discriminator circuits prevent the control from being operated by random ultrasonic sounds like those from dog whistles, passing jet planes or jingling of keys or coins.

Controlling a receiver by radio is not new—Philco did it in the late 1930's—but Motorola is the first to adapt it to transistorized wireless control for TV. The control unit is a transistorized 2.89-mc oscillator whose signal starts the tuner drive motor in the TV receiver. Circuits in the control receiver prevent the controls from being operated by random or stray signals of strength below or above the normal signal from the transmitter.

The Space Command circuit

Construction of the series 400 control box is shown in the photo. The tuning rods resonate at 37.75, 38.75, 40.25 and 41.25 kc to perform four operations: turn the set on and off; mute or restore sound; turn the channel selector counterclockwise; turn the selector clockwise. The control box for the series 200 has two tuned rods, one at 41.25 kc to mute and restore sound and the other at 40.25 kc to rotate the channel selector clockwise.

The remote-control receiver for the series 400 is shown in Fig. 1. The microphone is a capacitor type polarized at 190 volts. Its response is peaked broadly around 40 kc. V1 and V2-a make up a high-gain amplifier tuned to 39.5 kc (midway between the highest and lowest control frequencies) by L1–C3 and L2–C5. These stages are designed to limit at low signal levels. The resistors in series with the 6CB6 screen and plate and the grid of V2-a are parasitic suppressors.

The output of V2-a is fed to V2-b which triples the frequency of the signal applied to its grid. The plate circuit of V2-b is tuned to 118.5 kc by L3–C9.

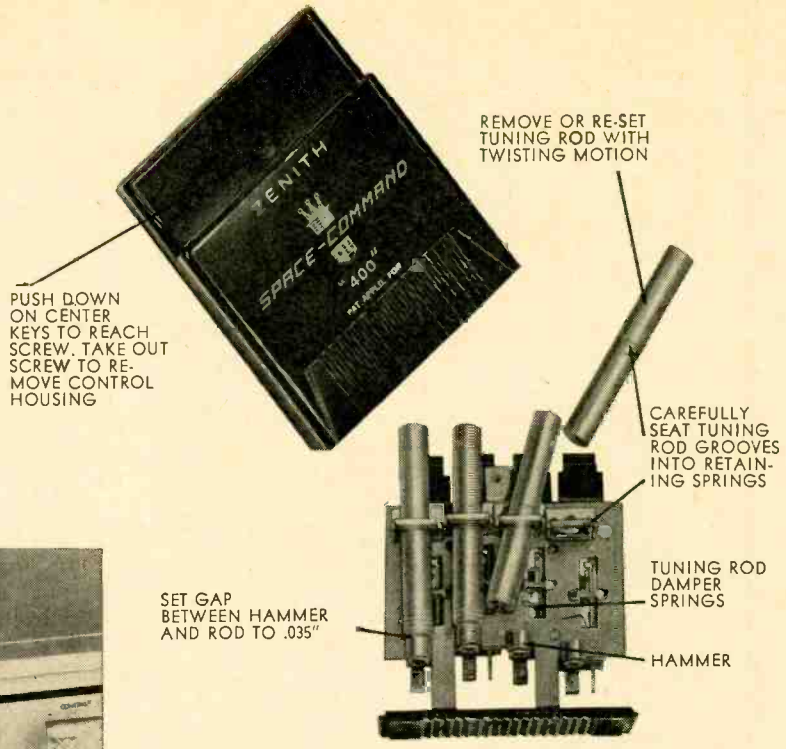
The 6BN6 limits the amplitude of the signal appearing across inductors L4 and L6 in series in the plate circuit. Thus any extraneous noise pulses are limited to the amplitude of the desired signal. The limiter plate load inductances L4 and L6 are tuned to 122.25 and 114.75 kc, respectively, by C12 and C20.

L4–C12 and L5–C14 are coupled by C13 to form a 122.25-kc discriminator transformer feeding V4. Similarly, L6–C20 and L7–C22 are coupled by C21 to form a 114.75-kc discriminator transformer for V7. V4 and V7 are standard Foster-Seeley discriminators similar to those used in FM sets and in some afc circuits.

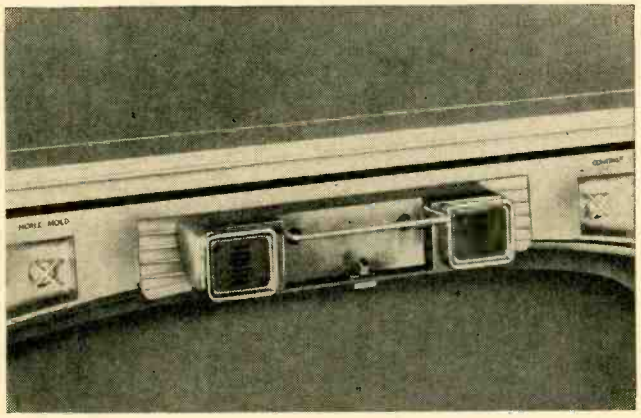
In the normal application, a discriminator is arranged so the voltages developed across the load resistors are in series between ground and a single takeoff point. The dc output is zero when the carrier is within the flat-topped portion of the if passband. The output is positive when the carrier is displaced in one direction and negative when displaced in the other.

In this application, the output of each discriminator is split to provide two dc takeoffs delivering equal voltages 180° out of phase. Displacing the

* "Remote Controls for TV," September, 1956, page 34; "TV Sets with Remote Control," October, 1956, page 58.



Zenith microphone is placed above the picture tube, behind one of the grilles. The other is a dummy, for symmetry.



Interior and exterior of Space-Command ultrasonic transmitter.

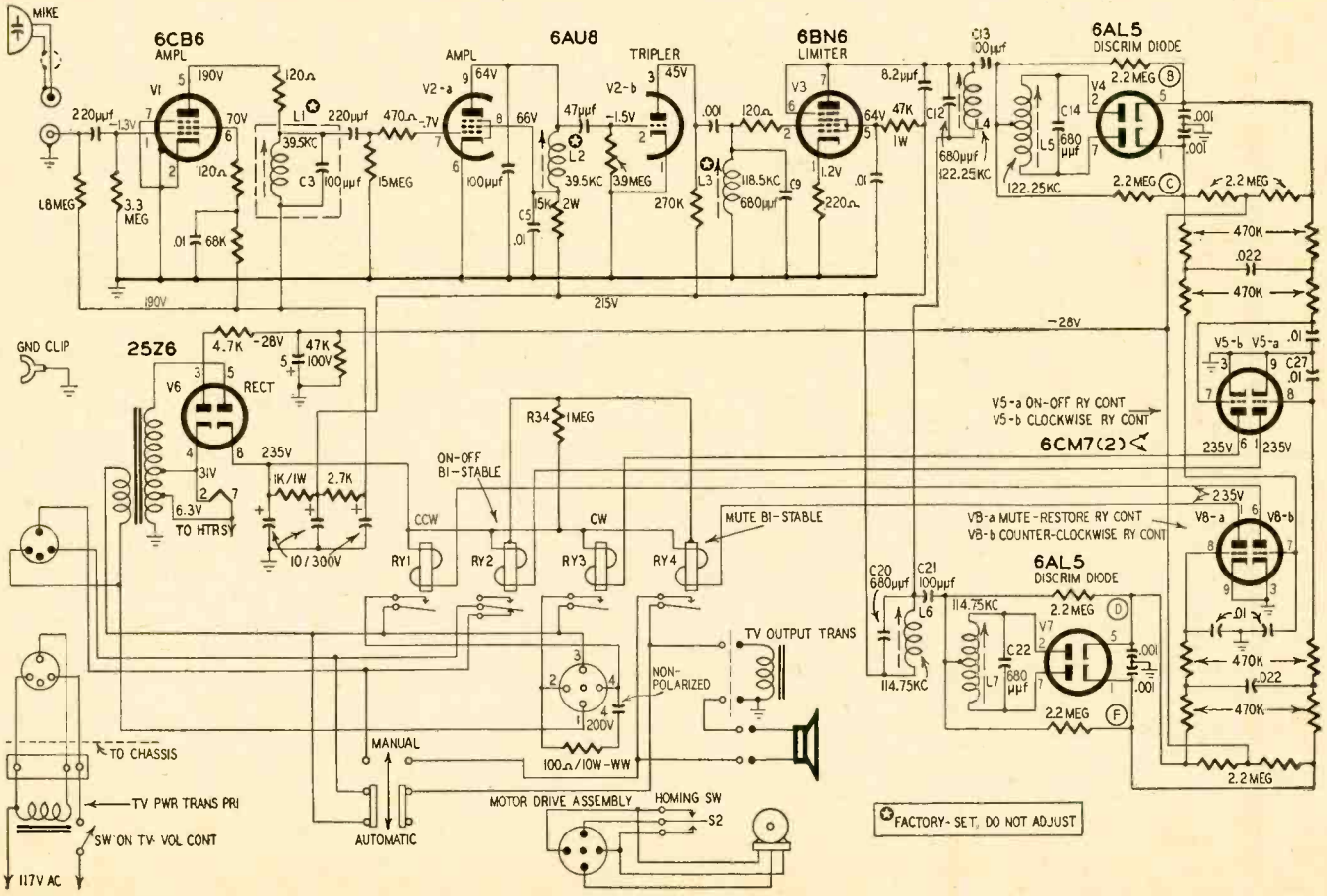


Fig. 1—Eight-tube remote-control unit for Zenith Series 400.

carrier in one direction develops a positive voltage at one of the takeoffs. Moving the carrier an equal distance on the other side of the center frequency develops an equal positive voltage at the other takeoff.

The control signals (carriers) produced by the keys need not be modulated because the third harmonics—developed by the tripler—are 1.5 kc away from the discriminator center frequency. The third harmonics of the counterclockwise and clockwise rotation control signals are 120.75 and 123.75 kc, respectively. They are both 1.5 kc away from the discriminator center frequency (122.25 kc) and will develop equal

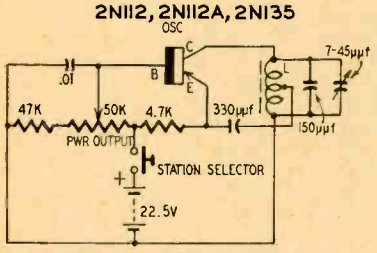


Fig. 2—Motorola TK-74 one-transistor remote-control transmitter.

voltages at the discriminator takeoff points. When the clockwise signal reaches the discriminator, a *positive* voltage appears at point B. The voltage at C is positive when the counterclockwise signal is transmitted.

Similarly, the third harmonics of the on–off and mute–restore control signals are displaced 1.5 kc from the center frequency of the 114.75-kc discriminator. The voltage is positive at D for the mute–restore signal and positive at F for the on–off signal.

The pulsating dc control voltages across the discriminator load resistors are applied to the grids of the 6CM7 relay control tubes through integrators consisting of two 470,000-ohm resistors and a .022-μf capacitor. The time constant to the integrator circuits is about 30 milliseconds. Thus, noise pulses with their sharp rise and fall and random frequency cannot charge the 0.1-μf grid capacitors to a value high enough to overcome the fixed bias and cause the control tubes to conduct and operate the relays.

The combination of tuned amplifiers, amplitude limiter, balanced discriminator and the integrator networks insures maximum freedom from interference and false triggering.

The relay cores are tied to the 235-volt B-plus line through a 1-megohm resistor (R34) so they are at the same potential as the windings. This prevents electrolysis of the windings. R34 limits the current if the relay frame should be accidentally shorted to ground.

(The two-channel five-tube control unit has a single 6AL5 discriminator tuned to 122.25 kc. V1 and V2 are straight amplifiers tuned to 40.75 kc. The 6BN6 operates as a combined limiter and tripler. The discriminator diodes feed the twin triodes of the 6CM7 relay control tube. One section operates the mute relay and the other controls the relay turning the channel selector clockwise.)

Operation

The manual on–off switch on the set's volume control is left in the ON position and the remote control switch on the rear chassis skirt is left on AUTOMATIC when the Space Command is to be used. When the ON–OFF key is pressed on the control unit, the mike on the receiver picks up the 37.75-kc note and feeds it through the amplifiers, tripler, limiter and discriminator to develop a positive voltage at F and across C27 in the grid circuit of V5-a. (Both triode sections of V5 and V8 are normally biased to cutoff by −28 volts applied to the grids through the integrator networks.)

The positive voltage developed by the discriminator drives V5-a to conduction and operates RY2. This relay is a ratchet type with contacts that close the circuit the first time the coil is energized and open it on the next energizing pulse.

The LEFT and RIGHT control keys are pressed and released to turn the channel selector counterclockwise or clockwise, respectively. The ultrasonic control signal is fed either to V5-b or V8-b to close RY1 or RY3, depending on which key is pressed. The contacts of RY1 and RY3 are paralleled across the normally open contacts on the spdt homing switch (S2) on the motor. When the relay contacts close momentarily, 117 volts ac is applied to the tuner drive motor. The motor turns the tuner's channel selector and a drive cam that makes one revolution for each channel. The homing switch remains closed until opened by one of the adjustable index tabs on an index wheel revolving with the tuner control shaft. The tabs can be adjusted so the motor stops on each channel or so it runs past unused channels and stops only when it reaches one that is used in the local area.

The audio control circuit is operated by the MUTE key on the control box. Muting relay RY4 is the same type as RY2. Pressing the MUTE key once flips the relay in one direction to open or close the audio circuit in the receiver and pressing it again throws the relay in the opposite direction. In most sets, RY4 opens and closes the voice-coil circuit and in others it grounds the audio grid to mute the receiver and removes the short to ground to restore sound.

Motorola's remote control

The remote-control unit in the Motorola equipment uses a miniature transistorized transmitter (Fig. 2) to send the signal to a three-tube control receiver (Fig. 3) mounted in the TV cabinet. The receiver operates a relay controlling a channel-selector drive motor like those used in the systems described earlier in this series.

The transmitter in Fig. 2 consists of a p-n-p transistor operated as a 2.89-mc grounded-base Hartley oscillator supplied by a 22.5-volt battery. Oscillator coil L also serves as the antenna. The strength of the transmitted signal is determined by the setting of the POWER OUTPUT control. This control sets the transistor bias and is adjusted at the factory so the radiated signal does not exceed FCC limits for this type of service.

The receiver (Fig. 3) is a single-frequency pretuned trf type with two rf stages, crystal detector and a noise clamp and relay control tube. Its overall sensitivity is 15–20 μv per meter. The antenna is an electrostatically shielded ferrite-rod type on a rotatable mount connected to the TV chassis through a short length of coaxial cable.

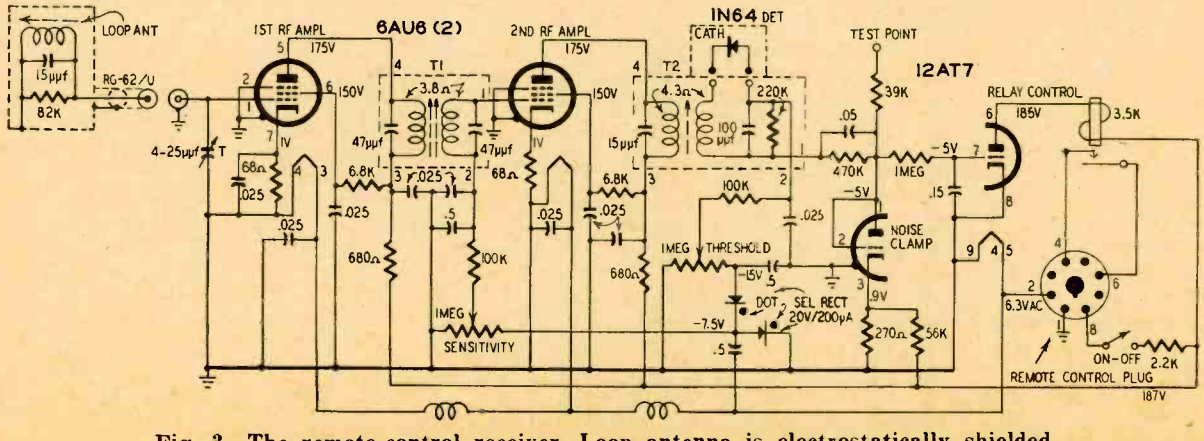
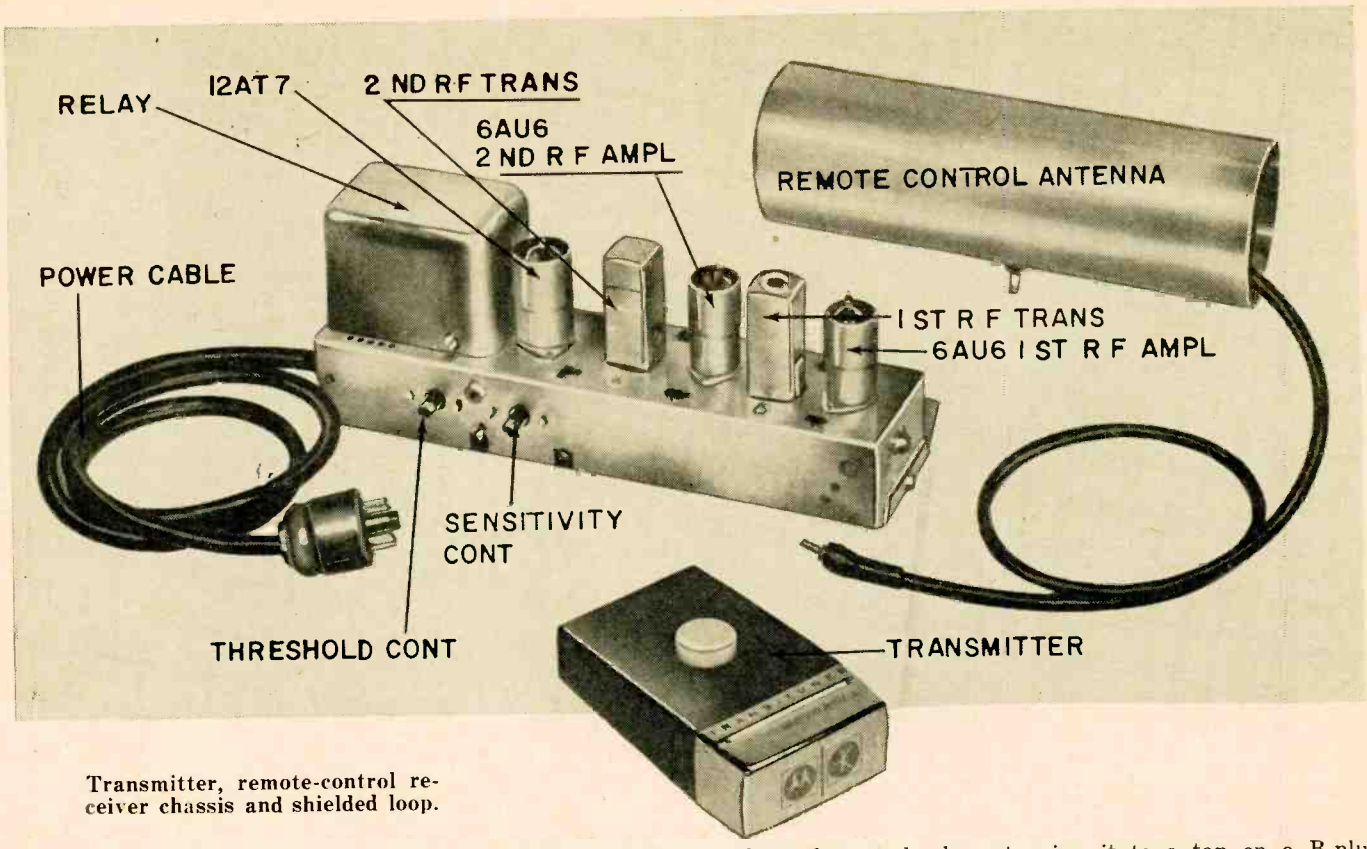


Fig. 3—The remote-control receiver. Loop antenna is electrostatically shielded.



Transmitter, remote-control receiver chassis and shielded loop.

Sensitivity and threshold controls regulate the receiver gain and the amplitude of the incoming signal required to operate the control relay.

The receiver in Fig. 3 is powered by the supply in the TV set. The partial circuit of the power supply and the motorized tuner are shown in Fig. 4.

Circuit operation

When the STATION SELECTOR button is pressed on the transmitter, a signal is radiated and picked up by the receiver. It is amplified by the two 6AU6's and fed to the 1N64 detector. The crystal develops a positive voltage across the 220,000-ohm load resistor and applies it to the grid of the relay control tube. This positive voltage increases the plate current and operates the relay to start the tuner motor.

When the motor starts, the motion of its shaft closes a three-pole switch (Fig. 4) and a motor-driven cam on the tuner's shaft closes the cam switch that operates like the homing switch in units described previously. Contacts 1 and 2 on the shaft switch mute the audio by grounding the grid of the audio output stage, 3 and 4 lock in the motor circuit through the cam switch and contacts 5 and 6 apply a high positive voltage to the picture-tube cathode to blank the screen. When the channel selector has reached the desired preselected channel, the cam switch opens the motor circuit. The motor stops, opening the shaft-switch contacts and restoring picture and sound.

T1 and T2 provide approximately 60-db attenuation at 2.738 and 3.0235 mc to minimize interference from marine and aircraft transmitters, respectively. Interference from these and other stray signals is reduced by controlling the circuit gain with the SENSITIVITY control. This control varies the bias on the grid of the second rf amplifier.

The THRESHOLD control compensates for variations in characteristics of the 12AT7's in the relay-control circuit and for differences in pull-in current required by different relays. It supplies up to 15 volts of negative bias to the grid of the relay control tube, to the anode of the 1N64 detector and to the plate of the noise clamp diode. Its setting determines the detector output voltage required to operate the relay and sets the operating level of the noise clamp.

The diode noise clamp is connected between the relay tube grid and ground. Its plate is biased negative by the fixed voltage on the control tube grid and its cathode is biased slightly positive by returning it to a tap on a B-plus voltage divider. The THRESHOLD control is set so the clamp diode is cut off for normal control signals.

High-amplitude impulse type noises such as produced by automobile ignition systems, lightning and electrical appliances may produce a detector output more positive than that developed by the control signal. When this happens, the clamp diode conducts and the voltage drop across the 470,000-ohm resistor charges the .05-μf capacitor to apply a negative bias to the grid of the control tube to prevent it from firing.

When the SENSITIVITY and THRESHOLD controls are set correctly, the relay will close only on a signal of the correct frequency and of the same amplitude as that of the transmitter. The chances of picking up a signal of just the right amplitude are remote so the control system can be considered interference-free. END

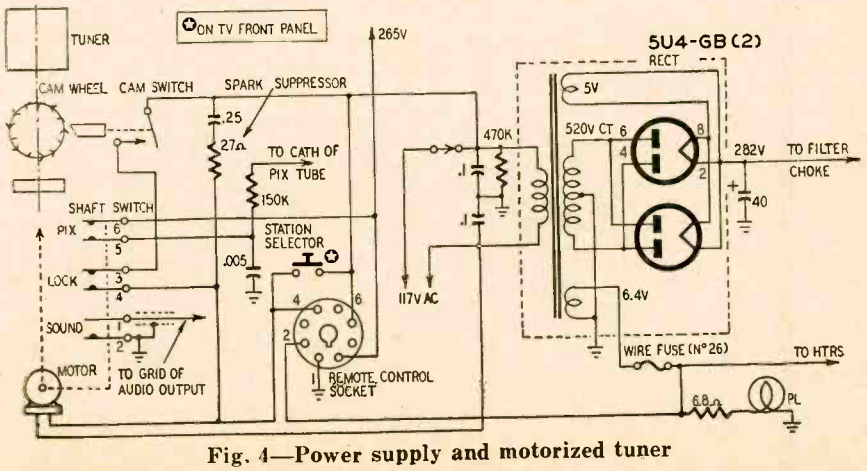
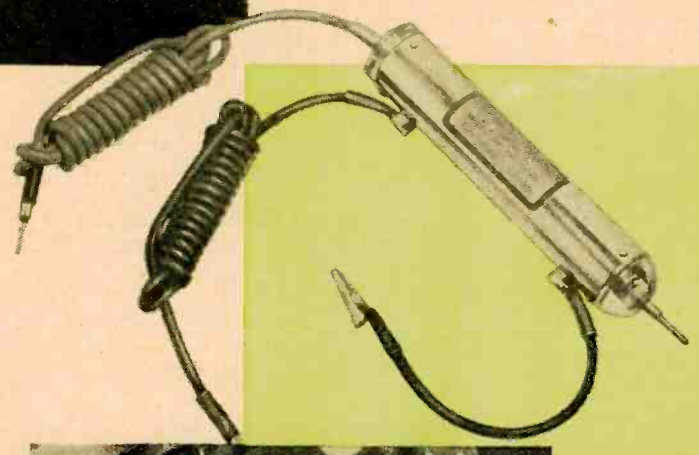


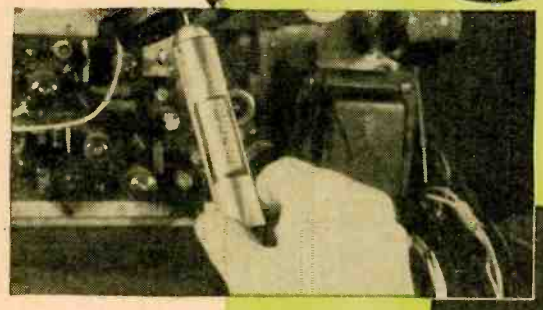
Fig. 4—Power supply and motorized tuner

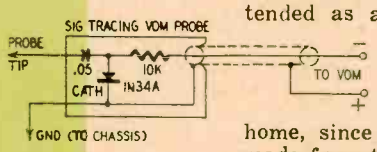
VOM SIGNAL-TRACING PROBES

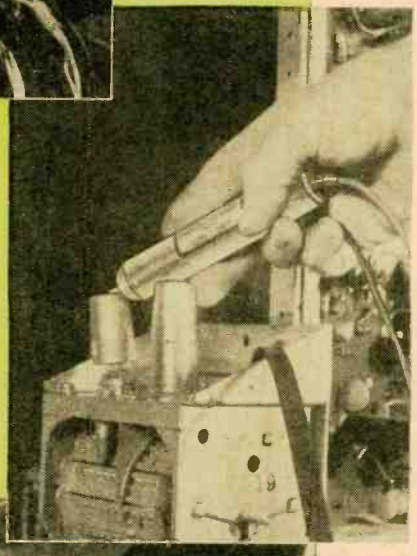
By ROBERT G. MIDDLETON

Numerous tests in monochrome and color sets made with simple instruments









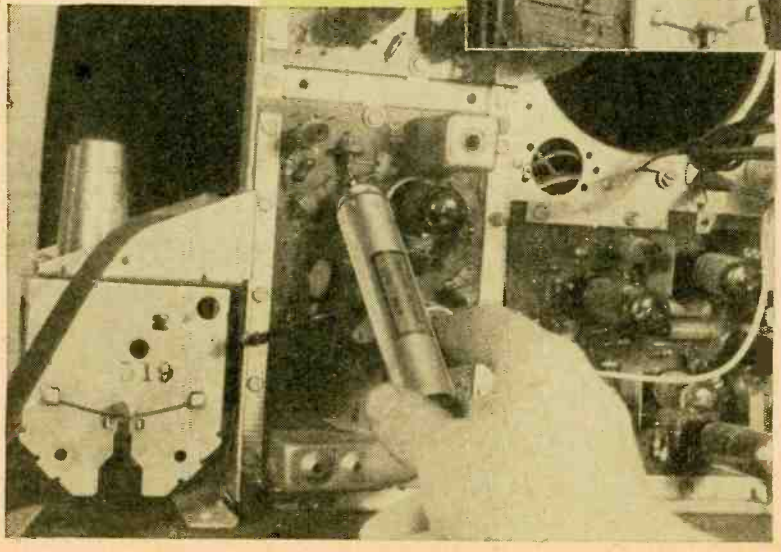


Fig. 1—Diagram shows probe circuitry and typical connection to a vom. Fig. 2 — Above, signal output from video amplifier checked at picture-tube socket. Fig. 3 — Right, local oscillator is tested on low channel with floating tube shield. Fig. 4 — Below, using probe to test output from video detector in plated-circuit set.

A CONSIDERABLE amount of troubleshooting in both black-and-white and color TV receivers can be done with a signal-tracing probe and vom. The test arrangement is unusually simple and straightforward, as shown in Fig. 1. A 20,000-ohms-per-volt vom provides adequate sensitivity for most practical tests.

The vom signal-tracing probe is intended as an aid to servicing in the home, since many of the tests can be made from top chassis. It is a valuable aid in bench work as well. With a conventional vom the probe can isolate trouble, such as a weak or dead stage, to that particular stage. Tests can be made in the horizontal and vertical sync systems, video amplifier, video detector, if amplifier, tuner and audio if circuits. Almost all these circuits can be tested from top chassis and in less time than is required, for example, to substitute tubes. Typical, practical tests which can be made follow:

Weak/or/no high voltage

Try drawing an arc from the plate of the high-voltage rectifier tube; then check for arc at the plate of the horizontal output tube. If there is a weak arc, or no arc, test with the signal-tracing probe and vom. The high-voltage rectifier and the horizontal output tube can be checked by placing the tip of the signal-tracing probe against the glass side of the tube, about halfway up. NEVER TOUCH THE PLATE CAP OF THE TUBE WITH THE PROBE. In a typical receiver the meter reads about 1 volt when the horizontal oscillator and output stages are operating properly; a reading of 0.5 volt or less in the same receiver indicates weak output. With a weak reading, the technician should check the drive to the horizontal output tube by pulling the tube and inserting the tip into the grid terminal. If the probe cannot be inserted, use a test adapter in place of the tube. In a typical receiver a reading of about 20 volts shows that the drive is normal but substantially lower readings indicate horizontal oscillator trouble. Zero reading shows the horizontal oscillator is dead.

A useful cross-check can be made by placing a floating tube shield over the

horizontal oscillator tube and measuring the voltage at the shield. A zero reading indicates that the failure is in the horizontal oscillator rather than in the network between the oscillator and the output tube.

Drive to the yoke can be checked with the signal-tracing probe by holding the tip of the probe against the insulation of the "hot" lead to the yoke. Do not touch the yoke terminal with the probe tip or the probe will be damaged.

Troubleshooting sync loss

Switch the vom back to the first dc volts range and use the signal-tracing probe instead of the conventional test leads. A signal reading can be obtained at the input to each sync stage by inserting the probe tip into the tube-socket terminal or by use of a test adapter. *A TV station signal must be tuned in to provide the signal.*

An open coupling capacitor, for example, will provide a signal reading on the input side and zero reading on the output side. When a test adapter is used, a signal reading can be obtained at both the input and the output to each sync stage. In this method of test the tube is plugged back into the test adapter for normal stage operation. Thus, if a tube is cut off due to improper bias, etc., a reading is obtained at the grid but not at the plate.

Of course, with test adapters it is easy to measure the bias, plate and screen voltages from top chassis, with the tube operating. In measuring the dc voltages the signal-tracing probe is not used and is replaced with regular test leads. (The signal-tracing probe does *not* respond to dc potentials.)

Where there is *loss of horizontal sync only*, the afc circuit can usually be checked for proper signals. In a typical receiver using phase-detector afc, the technician can pull the tube and check the tube-socket terminals; a reading of 1 volt at one plate and 7 at the other plate is typical. In this circuit the reading at one cathode will be about 7 volts and approximately 9 at the other. Weak readings or zero reading indicates that the trouble is due to either the sync or the comparison waveform.

Loss of picture (often sound also)

Fig. 2 shows how the signal-tracing probe tip can be inserted into the video-signal terminal of the picture-tube socket to check for signal drive to the picture tube. If the reading is normal the trouble is in the picture tube or its operating voltages. Where weak or no reading is obtained, check with the signal-tracing probe at the input to the video amplifier tube, with the tube removed. For a typical receiver, a reading of 0.5 volt or greater indicates that signal drive to the video amplifier is OK. But if a weak "or no" signal indication is obtained, check the signal at the grid of the last if stage with the tube removed. A TV station signal must be present, of course, to make these tests.

In a typical receiver, a reading of 0.1 volt or greater indicates that the signal to the last if stage is normal. In such case the conclusion that the trouble is in the local oscillator or rf amplifier is usually justified. With a strong signal present it is often possible to check the earlier if stages and the mixer. As shown in Fig. 1 the ground lead to the signal-tracing probe should be connected to the chassis, especially in low-level tests of this type.

The local oscillator can be checked, as shown in Fig. 3, by using a floating tube shield and getting the signal voltage for the probe from it. Since the probe operates at higher efficiency on the low channels, it is preferable to make this test by tuning the receiver to a low channel. A vacant channel should be used for a clearly defined test. Otherwise the station signal on an active channel may give a small reading which might tend to mislead the technician concerning oscillator output.

Printed and plated circuits

Test adapters are not required for most top-chassis tests when printed or plated circuits are used. Fig. 4, for example, shows a test being made of the video detector output by touching the tip of the signal-tracing probe to the detector peaking coil. Many similar test points are provided on top chassis in such receivers.

However, in receivers using series-heater strings, with point-to-point wiring, it is necessary to use test adapters in most of the checks to permit reinserting a tube and thus maintaining heater-circuit continuity.

Loss of audio

The signal-tracing probe can be applied across the voice-coil terminals of a speaker to determine whether drive is present. A signal must, of course, be present. The speaker coil has a low impedance and the reading is normally low but serves to indicate drive. A high reading at this point shows that the speaker is defective (open voice coil, for example); zero reading indicates circuit trouble.

The signal-tracing probe is next used, if necessary, to check for grid drive to the audio output tube—with the tube removed. For a typical receiver the normal reading will be close to 4 volts with the volume control set for average operation. Clicks should also be heard in the speaker when the tube is removed and reinserted in the socket.

The FM detector can also be checked with the signal-tracing probe. In a typical receiver, the input plate or cathode of the detector will read about 5 or 6 volts with the tube removed.

Checking color TV Signal

Color TV receivers have all the circuits of a black-and-white receiver plus chrominance circuits. The chrominance circuits are energized by a 3.58-mc burst signal which is added to the conventional black-and-white signal. Fig. 5 shows a typical chrominance signal

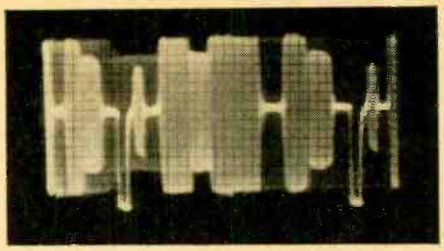


Fig. 5—The chrominance signal with sync and the 3.58-mc burst signal.

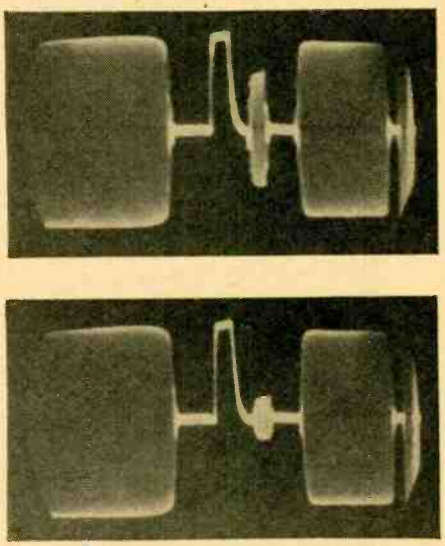


Fig. 6—Top, a normal 3.58-mc burst signal; bottom, a weak burst signal.

with sync and burst. Signal tracing in chrominance circuits requires the presence of a color signal either from a transmitting station or from a color-bar generator.

The first chrominance circuit in a color TV receiver is the chrominance bandpass amplifier. The output from a bandpass amplifier to the color detectors in a typical receiver, with signal tracing probe and vom, provides a reading of 7 or 8 volts, with the color-intensity control advanced for normal color reproduction.

The color-subcarrier oscillator operates at 3.58 mc, and a check of oscillator operation can also be made with the signal-tracing probe. A reading of 20 or 25 volts at the output of the buffer amplifier following the oscillator is typical. Low-impedance points should always be chosen for tests, when possible, to avoid circuit detuning and loading.

The output from the burst amplifier can often be checked with the signal-tracing probe. Fig. 6 shows photos of normal and weak burst signals. In a typical color TV receiver a normal burst signal produces a reading of 9 or 10 volts from the burst amplifier. When the burst signal is absent, however, the meter reading does not fall to zero because of noise voltages present. Hence, the technician should make comparison tests of signal readings with those in a known good receiver of the same type, when possible. END

TALL TOWER TECHNIQUES

Part II: The assembly and erection of tall and very-tall towers

By JACK DARR

JUST as in every other branch of this business, there are a few little hints and kinks that will help you in setting up and installing towers; saving time is saving money. Let's begin with the easiest kind of installation, a medium-height tower, 36 to 48 feet, mounted alongside a house, on the ground. Let's assume a ranch house, about 40 feet long on the side where we're working. The tower will be set in the center of this long side.

The first step is to layout and assemble the tower, putting on the bottom and top kits. Place the tower at one end of the house and set it up so that the *top* end is nearest the house. This will be explained later. (See Fig. 1-a.) Don't install the rotator and antenna as yet, but do install the short piece of masting which will hold the rotator. Be sure that the guy rings are put on before the sections are bolted together. Select the location for the tower and fix up some kind of base for it to sit on. While it is possible for one man to assemble and erect a tower of this size, it is much quicker and safer to use three men. Two of these need not be trained; one skilled technician and two helpers will do.

While the helpers are assembling the tower, the technician lays out the guy wires and installs the guy anchors. At this time, he roughly computes the length of guy wire needed for each guy and fastens them to the tower. If the tower is 48 feet tall and will be set at the center of a 40-foot side of the house, the side guys can be anchored on the eaves at the ends of the house. The screw eyes used for this can be set now. This gives us dimensions about as shown in Fig. 2. The two top guys are the hypotenuse of a triangle roughly 20 feet at the base with an altitude of 38 feet, assuming that the eaves are 10 feet from the ground. This gives us a length of about 45 feet for the two side guys. We said *roughly*, because

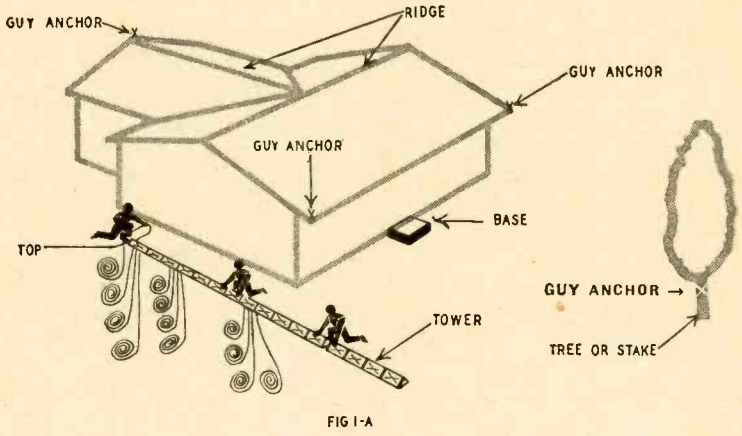


FIG 1-A

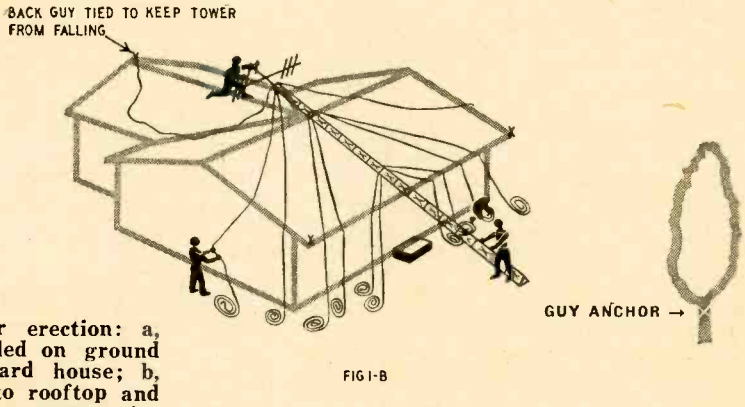


FIG 1-B

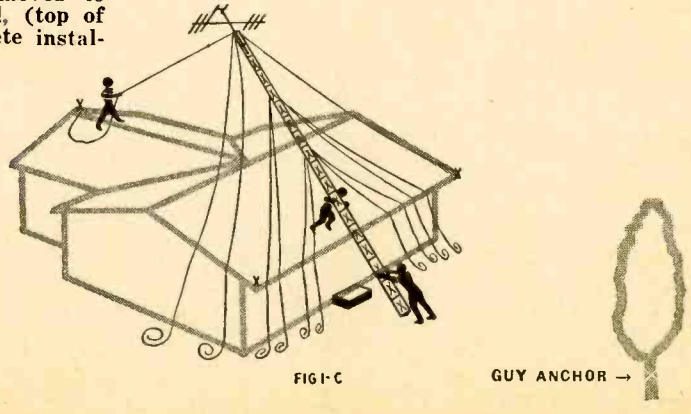
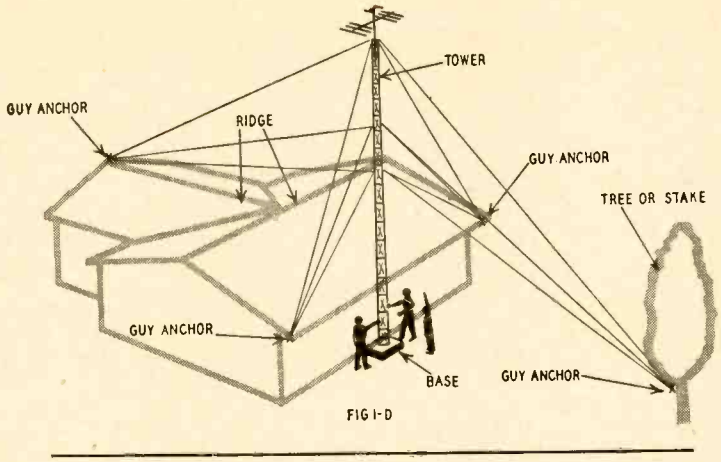


FIG 1-C

Fig. 1—Tower erection: a, tower assembled on ground with top toward house; b, tower raised to rooftop and antenna and rotator installed; c, tower moved to vertical position; d, (top of next page), complete installation.



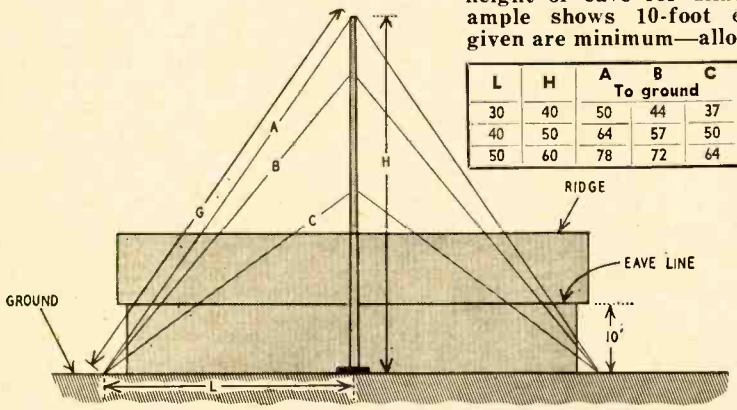


Fig. 2—Computing guy length—deduct height of eave for dimension H. Example shows 10-foot eave. Lengths given are minimum—allow for tying off.

L	H	A	B	C	A	B	C
		To ground			To housetop		
30	40	50	44	37	43	37	32
40	50	64	57	50	57	50	45
50	60	78	72	64	71	64	58

there is no need for detailed calculations: guy wire comes in 50-foot rolls and we can simply cut off one roll for each of these guys. The extra time spent in making exact and unnecessary calculations will save perhaps 30c worth of guy wire! What is important to know here is the *minimum* length of each guy wire, so that we can be sure to use enough on each one.

The back guy is somewhat longer so we would use two rolls connected. The remainder can be cut off after the guy is fastened, and used for the shorter lower guys. Now, let's assume a convenient tree, about 75 feet from the house, for our front guy wire. Using the same method, our front guy figures out around 75 feet so we use two rolls of wire on this one, too.

After fastening these guys at the tower top, each one is unrolled very carefully down the length of the tower, as it lies on the ground. *Keep tension on the wire to prevent its kinking.* At a point about 14–15 feet from the base, fasten the rolls of wire to the tower by wrapping the free end of the wire around a brace or leg. By doing this they will be within easy reach of the rooftop man after the tower is up. The two side guys may be fastened near the base so that the ground men can take them loose and use them to steady the tower, if desired.

Next, the second set of guy wires is fastened to the tower, down 12 feet from the top, brought down the sides of the tower and made fast as before. Tie these rolls of wire a little above the top guys to avoid confusion between them. When working with these wires take every precaution to avoid kinking the wire. If a kink does show up, take it out by turning it over and straightening it before any strain is put on the wire. A kink causes a sharp bend in the wire and will inevitably cause the guy to break in the future! Therefore, after the guys are fastened at their top ends, keep them tight enough to avoid kinks until they are fastened permanently. If a kink does show up, leave that wire loose until enough of the others are fastened to allow climbing the tower and taking the kink out. The other reason for this procedure is that it keeps the wires out of the way while the tower is being raised, but makes them instantly available when they are needed.

With the setup as shown in Fig. 2, a third set of guys should be used halfway up the tower (24 feet from the ground) if average wind velocities are high in the area. However, for fairly light loads, with heavy guy wires, the two top sets of guys, together with a firm hold at the eaves of the house, will hold the tower firmly. In any case, the third set of guys may be added *after* the tower has been raised; if attached now, they would be in the way.

Raising the tower

With all guy wires secured, the tower is then raised (Fig. 1-b). We left the top end of the tower nearest to the

Fig. 3—A 54-foot steel tower installed near two-story house.

house for a reason. The technician climbs to the rooftop and goes to the gable end of the house over the tower. A rope is tied to the top of the tower. The rooftop man pulls up while the helpers lift, and the top end of the tower is raised to the rooftop, with the base remaining on the ground. Now, the roof man lifts the top while the ground men lift the base and walk along the side of the house until the tower rests across the rooftop, at the site selected, the center of the house. Now, the antenna and rotator, etc., are sent up to the roof and the technician assembles them to the tower top. The top should be lifted far enough up over the peak of the roof to allow the antenna sufficient clearance on the far side.

After the rotator and antenna are installed, the rotator cable and lead-in may be fastened to the side of the tower, at least for a few feet down from the top. If they will be in the way, they may be fastened at the top and then coiled up, the coils being fastened with scrap wire to the tower near the top. The rotator cable should be taped with plastic tape firmly to one leg of the tower as ordinary fraction tape will go to pieces in a few weeks. If desired, the rotator cable may be run down inside the tower to keep it out of the way, taping it to the inside of one leg.

For the next step the back guy wire is taken loose from the tower and stretched out. The end is fastened temporarily at approximately the right distance. (Be sure that it isn't too short as this could cause trouble!) The purpose of this is to keep the tower from falling away from the house in the last stages of the lift. If there are enough assistants on hand, one may be detailed to stand by this guy during the lift.

For the actual raising of the tower

(Fig. 1-c), the rooftop man sets the tower itself on his shoulder so that he can lift it with his legs rather than his back. The helpers place themselves at either side of the base. Now, the rooftop man raises the tower clear of the roof; the helpers walk toward the house, keeping a downward push on the base. This is easiest done by a series of very short lifts and moves: the rooftop man lifts clear while the base is brought in a few feet. The tower is then

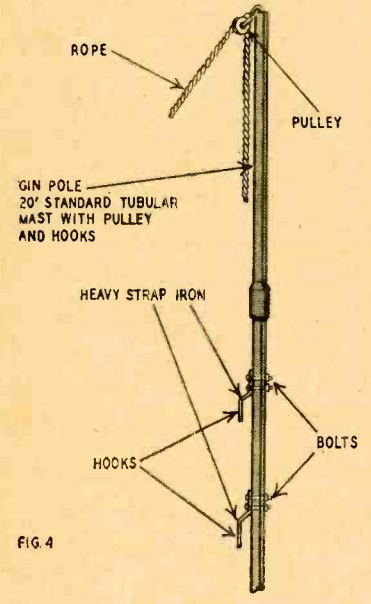


Fig. 4—A gin pole with hooks.

rested on the eave while the rooftop man gets a fresh grip. The ground men meanwhile hold downward on the base to keep it from flying into the air. A good safety precaution during this process is a piece of rope around the waist of the roof man and tied to a chimney so that he can't fall off the eaves!

As the tower approaches the vertical, the rooftop man moves to the eaves. There he lifts part of the weight of the tower but his main function is to guide the tower and keep it balanced sidewise. If there are enough men on hand, the two top side guys can be loosened and taken out to the sides where they can keep the tower from being overbalanced. When the tower is almost to its true vertical position, the topman holds, at the eaves, while one helper holds the base down. The other helpers take the side guys to their anchors and make them fast, temporarily, at this time. Now, the helper goes around back and fastens the back guy to keep the tower from falling away from the house. If the tower is not yet vertical, enough slack may be estimated in this guy to allow the tower to come to a true vertical.

Next, this same helper takes the front guy loose from the tower and makes it fast at the tree, leaving some slack for adjustments. Now, the tower is fairly secure, and the accepted thing is for the entire crew to take a deep breath and light a cigarette! The one major precaution which must be observed during this whole procedure is to keep the tower in balance. No matter how long it is, if it is kept balanced during the lift, it is easy to handle; if it gets off balance, it is doomed. Due to its tremendous leverage, if it is allowed to get a start, it is gone. While the weight is kept balanced, only small lifts will be able to control it perfectly.

After the cigarette, the tower is lifted over to the prepared base and bolted there, if bolts are used. The eave straps or brackets are attached after the tower has been checked for "plumb," with a carpenter's long level, held against two sides of the tower. Special levels are available for this purpose but a common carpenter's level will do admirably. With the tower plumbed and the eave brackets or straps fastened, the top guys are pulled up and fastened permanently. During this process, one man *must* remain at the tower base, looking straight up! This is the *only way* in which the tower can be kept straight during guying! Observation from the side results in a tower which resembles a snake!

After the top guys are set and fastened, the second set is likewise taken loose and fastened to the anchorages. If this is a high-wind country these should have separate anchorages from the top guys for greater strength. The two lower sets of guys may be fastened to the same anchors, but the top guys should have their own.

After the top eight guys are fastened, the tower may be climbed with perfect safety. The technician on the rooftop can climb the tower to the 24-foot level, attach the lower set of guys and then, while the helpers are making these fast, go on up the tower and fasten the rotator cable and lead-in wires.

For any tower climbing at all, even at low levels, the tower man should use a standard safety belt—more about this in a moment. Now the lead-in wires, etc., can be run down the tower and into the house as in any installation.

For safety, the tower must be grounded. If a wooden base is used, drill a small hole through the base near one of the tower legs. Drive a standard 4-foot ground rod through this hole and attach it to the tower leg itself with a clamp. In addition to grounding the tower, this helps strengthen the base.

Unsupported tower installation

The type of installation in which the tower stands alone, without the support of a building, is somewhat more difficult. However, it can be made without using any special heavy hoisting gear if the right methods are used. Let's set up a 36-footer on a flat roof, for instance. Using the flat platform, mentioned earlier, as a base, we assemble the lower 24 feet of the tower. The guy rings and other hardware are assembled as before; the guys at the 24-foot level are merely slipped over the open ends of the legs and the wires fastened to them. The guy anchorages are made, which will probably be on top of parapets, around chimneys, etc. The 24-foot section of the tower is then fastened to the base and temporarily raised to a vertical position. One man holds it there while the other pulls up the *back* guys (in the direction from which the tower was raised) and fasten them *permanently*. The front guys are measured and left free for now.

Now the tower is lowered again and the top section assembled to it. Guy wires are fastened to this section. If the antenna is light, it may be installed now; if a heavy rotator and antenna are to be used, they had better be left off until later. The entire tower is pushed up into place. When it gets to a vertical position it is held by the two middle guys which were fastened earlier. All that is needed is for the remaining guys to be fastened and the tower is secured. One man holds the tower against the two guys while the other fastens the front guys.

The tower is then plumbed and all guys fastened. Now, the technician climbs the tower and installs the rotator and antenna, pulling them up on a handline from the base. Using modern

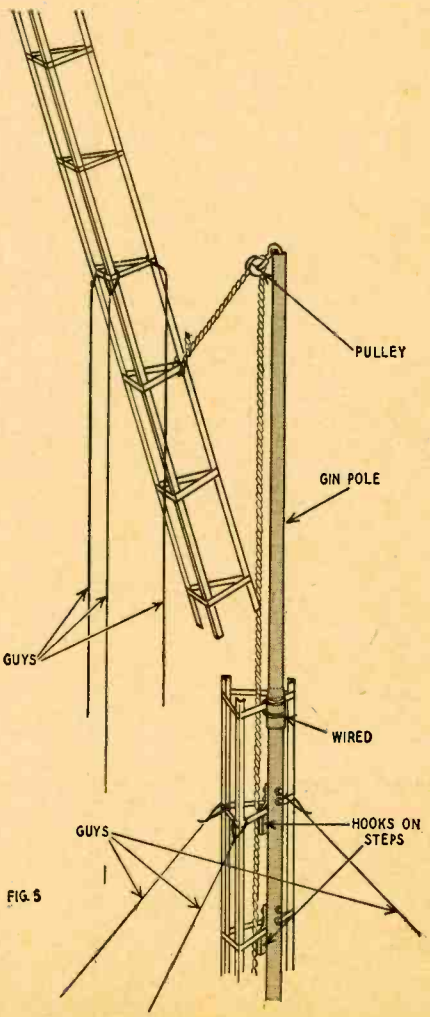


Fig. 5—Assembling tower with gin pole.

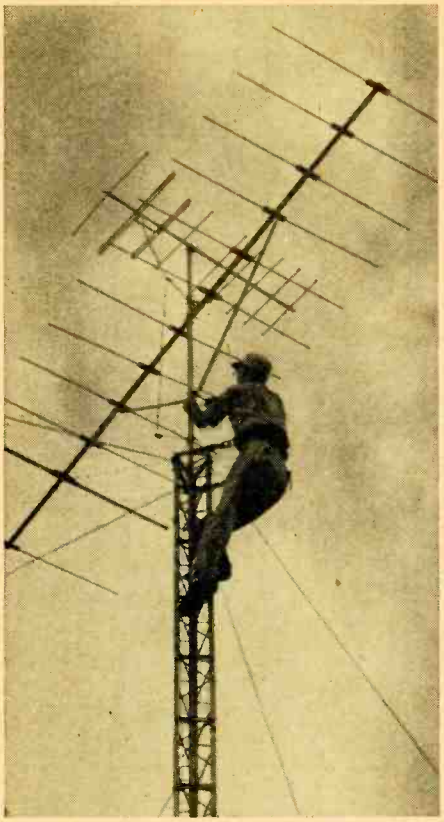


Fig 6—Using safety belt on tower.

antennas with a snap-out feature, they may be sent up folded and snapped into place at the tower top with no trouble. Rotator cables should be connected on the ground before the rotator is sent up. The installer makes all lead-in connections, etc. and comes down the tower, fastening the lead-in and rotator cable as he goes. His last act, before leaving the tower top, is to spray all connections and exposed bolts with a plastic spray to prevent corrosion.

Very tall towers

If the tower in question is one of the very tall jobs, 70, 80 or even 90 feet, a slightly different technique may be required. An 11-inch structure should be used for very tall towers—anything over 50 feet—with a few exceptions, depending upon the amount of support available. (A 54-foot tower may use a 9-inch structure if it rests against the side of a two-story house, thus being only about 30 feet in the clear.) See Fig. 3.

In any case, it would be almost impossible to raise a 80–90-foot tower in one piece because of the likelihood of its buckling and breaking near the middle! A very high and very heavy piece of hoisting gear would be required for a lift like this, too. However, there is a method of erecting these tall ones without too much special gear or trouble.

First, the lower sections of the tower are assembled and set up, using the methods previously outlined, say to 36 feet or so. This part must be well guyed, using at least four guys. Leave the top kit off, as more is to be added.

Next, a gin pole (Fig. 4) is made, using two sections of standard 1½-inch TV mast stock which slip into each other, making a 20-foot piece. Near the bottom of one piece two heavy hooks are bolted about 2 feet apart, or whatever distance there is between two steps on the tower being used. A small pulley is fastened to the top of the pole and at least 200 feet of good ½-inch rope run through it, with a knot at each end to keep the rope from coming out of the pulley.

With the bottom sections set up and well guyed, the installer climbs to the top and fastens his safety belt. The gin pole is then sent up. It is put together and the hooks dropped over two steps of the tower. The top end, with the pulley, should be at least 10–12 feet above the top of the tower. The gin pole is fastened to a leg of the tower with some scrap wire or short ropes to prevent it from slipping sidewise. Now, the helper on the ground assembles two pieces of tower (12 feet) and attaches the guy wires to the top end of the section. He then ties the end of the rope to this piece, about 2 or 3 feet down from the top. It is then hoisted to the tower top, with the helper doing most of the pulling from the ground and the top man guiding it up through the guy wires.

After this section has reached the top the ground man holds the rope, keeping the weight on himself while the top man guides the section into place, lowering it over the ends of the piece already there. The top man then inserts the bolts and tightens them. While he is bolting it in place, the ground man ties the rope off to the tower to hold the weight, and fastens the guy wires of the new section to their anchors. He then begins assembling another 12-foot section.

With the new piece guyed out and safe to climb, the top man takes the gin pole loose and raises it to the top of the new section where he fastens it in place again. The rope is untied and sent down and the process (Fig. 5) is repeated until the tower reaches the desired height. The last piece sent up, of course, is the top section and should have the mast section, etc. to hold the rotator already inserted and tightened up. Last, the antenna and rotator are sent up and installed, and the tower is complete.

One very necessary precaution should be mentioned here: Any tower climbing should be done only with a good standard safety belt, as worn by telephone and power line men. In most cases a light belt is sufficient for tower use, as TV antenna men seldom are forced to hang on the belt while working, as linemen have to do. The pole strap should be short to hold you up fairly close to the tower; the lineman ordinarily works quite a bit away from the pole, therefore he uses a somewhat longer strap.

Your safety belt (Fig. 6) should be checked and tested at regular intervals to be sure that it will hold your weight when you need it! Any cuts, scars or frayed places on the belt or strap should be investigated and repaired if necessary. Hooks, straps and tool pouches are available for carrying tools, wire, parts, etc., up the pole. The end of the handline, a length of light rope used to pull up parts and tools from the ground, can be tied to the back of the belt. Many tower men take it loose after they reach the top, and tie it to some part of the tower. This keeps them from being jerked loose, should a load slip on the way up.

The old sailor's rule of "one hand for yourself and one hand for the ship" should always be observed when working at heights. Keep a firm grip on the tower with one hand whenever possible. If the work demands two hands, check the fastening of your belt before leaning into it! Take every precaution and don't depend upon your belt unless it is absolutely necessary. While the belt will save you from a fall, you'll carry some sore ribs for a while if you lose your balance and fall into the belt. Above all, don't get into the habit that one TV man *almost* developed: When he finished, he would unsnap his strap, fasten it to his belt and then start to lean back into it to see if everything was all right! Needless to say, this never grew into a full-fledged habit with him! After a few bad moments, a few frantic grabs at anything within reach and some bad cuts on the hands, he broke the habit! Always exercise *extreme caution* when working at any height! END

TV Service Clinic

conducted by

JERRY KASS

FOLLOWING up last month's discussion on width controls, we can now attack the problem of insufficient width. This refers only to situations where the lack of width is due to the general aging of components and where a thorough check has been made of resistance voltage and components in the horizontal sweep system. These techniques may also be used in conversions where the new raster lacks up to 2 inches or so.

Before making any of the following circuit changes, replace the horizontal output tube. If available, try a few of the same type. In some cases additional width can be obtained by replacing a 6BQ6-GT with a 6CU6 or the new 6DQ6.

Starting with the horizontal oscillator, the origin of the horizontal sweep signal, the first consideration is the plate supply voltage for this stage. By increasing this voltage the oscillator output or drive is increased. The increase in voltage can be obtained either by decreasing the value of the oscillator plate-dropping resistor, connecting the plate supply lead to a higher B-plus point (if one is available) or feeding the oscillator with the horizontal boost voltage.

In increasing the plate voltage it is a good idea to observe the oscillator signal waveform. Although it does not happen frequently, the increased oscillator output brought on by the increase in oscillator plate voltage may be obtained at a sacrifice—a distorted oscillator waveform. This could produce poor afc action, nonlinearity and other horizontal defects. In addition, the increased drive could produce excessive current flow in the horizontal output transformer, saturating the core and producing white vertical lines on the left side of the screen. In connection with horizontal drive, the drive control should be advanced for maximum width without producing a drive line.

Fig. 1 shows the horizontal output and sweep circuit in the Westinghouse V-2316 chassis. Because this chassis did not provide sufficient width in areas of low line voltage, two changes were made. One was to increase the horizontal drive voltage to the horizontal output tube, the other is discussed later. Oscillator output was increased by changing C424 from 680 to 390 $\mu\mu$f, thus reducing the shunt capacitance, and by increasing R426 from 18,000 to 22,000 ohms.

In the above and following tests, it is important to watch the horizontal output tube's cathode current. Use a dc milliammeter to avoid letting the current exceed about 100 to 110 ma. The 6CD6 is fairly husky and can handle up to 200 ma but cathode current should be limited to 125 or 130 ma. More than this can damage the output tube as well as the primary of the flyback transformer through overheating.

The next spot to consider is the screen circuit of the horizontal output tube, a point often used for the horizontal width potentiometer. All that has to be done here is to decrease the value of the screen-dropping resistor, thus increasing the voltage on the screen grid of the tube. The criterion of how much resistance can be taken out of the screen circuit is the horizontal output tube's cathode and screen current. Check the maximum screen current of a particular tube before experimenting. And don't press the tube too hard because it is probably already working very close to its limits.

Fig. 2 shows the horizontal output circuit of the RCA KCS92 chassis. Here again it was necessary to make a production change in later models to provide sufficient width in low-voltage areas. The original 10,000-ohm screen resistor was replaced with a 6,800-ohm 2-watt unit. It will provide approximately a ½-inch increase in width.

One more point related to the horizontal output tube is the cathode bias resistor. While good design requires such a resistor, not all sets have one. At any rate, increased sweep width can

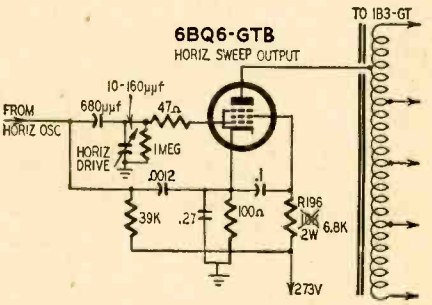


Fig. 2—Output screen resistor was reduced to 6,800 ohms to increase width in RCA KCS92 chassis.

be had by decreasing the value of the output tube's cathode resistor. Maximum width can be had when there is no resistor because then there is no cathode degeneration. However, since this resistor provides bias protection to the horizontal output tube should the horizontal oscillator fail, it should be reduced as little as necessary and never entirely. When working with this circuit, it is especially important to watch cathode current.

Since the width coil acts as a load on the flyback transformer, absorbing power from it, this is a very important point for increasing width. For maximum increase in width the coil may be removed entirely. However, if increased width is desired together with width control, the width coil should be replaced with one having a greater

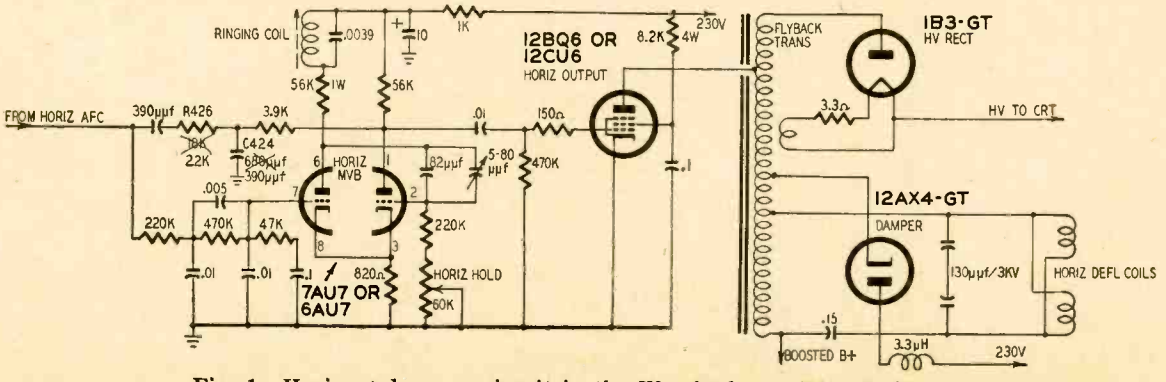


Fig. 1—Horizontal sweep circuit in the Westinghouse V-2316 chassis.

inductance. The higher reactance of such a coil would dissipate less flyback power, leaving more for the horizontal deflection coils. In addition, the original, or higher-inductance, width coil can be connected across taps having fewer turns, as determined by the dc resistance reading between taps. The fewer the turns shunted, the less power absorbed. Of course, the fewer the turns shunted, the less control of width.

Staying with the width coil, a good method of increasing width is to connect a capacitor across this coil. The greater the capacitance, the greater the width

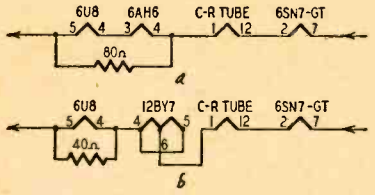


Fig. 3-a—Original circuit wiring. Fig. 3-b—Modification to use a 12BY7 in place of the 6AH6.

increase. The practical limit of this procedure is the value at which horizontal foldover is produced. For the proper retrace time the sweep circuit ringing frequency is about 75 kc. When excessive capacitance is placed across the width coil this self-resonant frequency is reduced and foldover occurs. Actually, what happens is that the capacitor shunts away part of the high-voltage kickback across the flyback secondary. Thus the high voltage is reduced slightly and the beam made less stiff—easier to deflect.

The use of capacitors in this vein is not restricted to shunting the width coil. They may also be used across any two other taps on the secondary of the flyback transformer. Fig. 1 shows two 130-$\mu\mu$f capacitors in series across the deflection coils. Each has a 3,000-volt rating. The value of capacitance can vary considerably, depending upon an individual sweep circuit. The usual range is from about 50 $\mu\mu$f to 0.1 μf, with a voltage range of from 600 to as much as 6,000, depending upon the peak voltages across the taps used.

Another arrangement that works nicely on some sets is to connect a capacitor of about 100 to 200 $\mu\mu$f from the plate of the horizontal output tube to chassis. This sometimes provides a considerable increase in width. The voltage rating of such a capacitor would have to be 6,000 or more.

In some cases, where width deficiency is caused by an excessive load on the boost circuit, width can be increased by disconnecting a circuit, such as the vertical output, from the boost line, and feeding it from the regular B-plus bus.

Change in heater string

I want to replace a 6AH6 with a 12BY7. Unfortunately, my set has a series filament string, with the 6AH6 being in series with another 450-ma tube, the 6U8 (Fig. 3-a). Both tubes are then shunted by an 80-ohm resistor. The 12BY7 can be connected as a 6-volt 600-ma tube or as a 12-volt 300-ma unit. Thus, I do not see any way of removing the 450-ma tube and inserting the 12BY7 without getting involved in some complicated circuit juggling. —Mr. Molnar, Calgary, Canada.

A simple and easy solution is shown in Fig. 3-b. The heater line before and after the tubes involved carries 600 ma. The 6U8 and 6AH6 have a combined heater resistance of about 28 ohms. Thus with the 80-ohm parallel resistor being approximately three times this resistance, the 600 ma breaks up with 450 ma flowing through the tubes and 150 ma through the resistor.

With this in mind, we can then connect the 12BY7 as a 600-ma heater, directly in series with the rest of the line. This would have the 450-ma 6U8 by itself, with a resistance in the heater of about 14 ohms. To maintain the 3-to-1 shunt relationship, the original 80-ohm resistor is then simply replaced with a 40-ohm resistor. The overall voltage distribution is not disturbed because the original 12.6-volt drop across the tubes still remains.

Following along this line, any tube can be connected into a filament string having a lower current rating—simply supply sufficient shunt resistance.

Loss of vertical sync

I have an RCA KCS83 chassis in the shop that works perfectly. However, the owner lives in an apartment house where there is considerable line-voltage fluctuation due to an elevator. This causes frequent vertical roll. The owners of other sets in this house inform me that their pictures frequently bounce but seldom lose vertical sync. Unfortunately, this set appears to be lacking in something but I cannot find a defective component. Because of its splendid action on the bench I doubt that any particular part is bad and I would like some suggestions.—J. M., Detroit, Mich.

Those who told you to check the sync vertical separator circuit are correct. This stage is fairly sensitive and the values should be very close to specifications. However, because of the severe line-voltage fluctuation you will have to try and stabilize this circuit.

At present the grid of the vertical sync separator is returned to cathode which is common to the pentode half of the 6X8 used as the video amplifier. Return the grid circuit to ground (Fig. 4) using the grid-leak arrangement shown. You do not have to install any new parts. The positions of R161 and R162 are interchanged. The parallel combination of R162 and C149 could be on either side of C150. You probably can get better results by changing R161 from 270,000 to 180,000 ohms. Also, try lowering the plate voltage of this stage by changing R165 from 1.2 to 1.8 megohms.

Stabilizing drive

There is a peculiar condition in a model 454 Sentinel. Every time an adjustment is made in the horizontal hold coil there is an accompanying change in output tube drive and width. By experimenting with various values in this circuit I can get proper drive but the hold is unstable. The tubes are good and all voltages and resistances are normal. I would like to eliminate this interaction.—T. S., Fort Wayne, Ind.

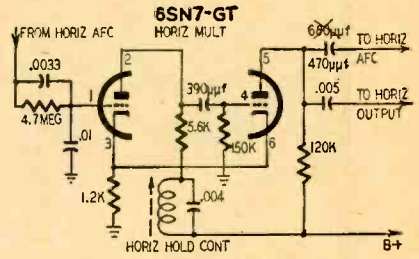


Fig. 5—Horizontal multivibrator in the Sentinel model 454 receivers.

In all probability a circuit modification is not necessary. The horizontal multivibrator in this circuit drives the horizontal output stage (Fig. 5) and feeds back a portion of its output voltage to the horizontal afc circuit. In circuits of this type a common source of interaction between horizontal hold adjustment and width is in the feedback line to the afc circuit. Thus, the remedy lies in reducing the amount of energy fed back. Experimentally vary the resistance and capacitance values in this circuit. However, so as not to disturb any phase relationships your simplest method is to replace the 680-$\mu\mu$f capacitor in the multivibrator plate circuit with a unit of higher reactance. Probably, a capacitor of about 470 $\mu\mu$f would do the trick. If there is still some interaction, try a capacitor slightly lower in value. END

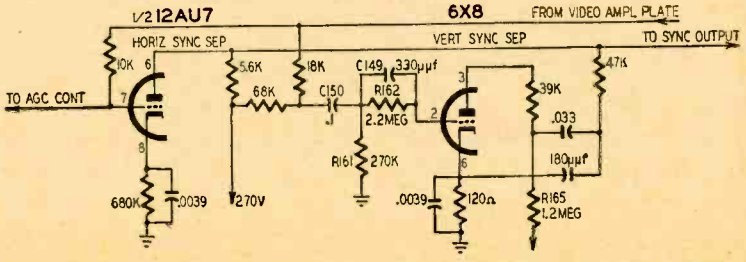


Fig. 4—The sync separators in the RCA KCS83 television chassis.

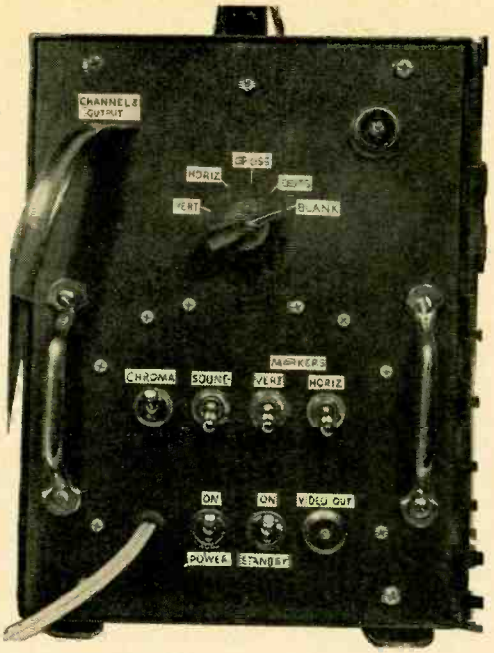


Photo of the instrument's panel. Lettered tabs were added to photo to improve readability.

Portable TV Pattern Generator

Part II—Construction details offer solutions to electronic and mechanical problems

By EARL T. HANSEN

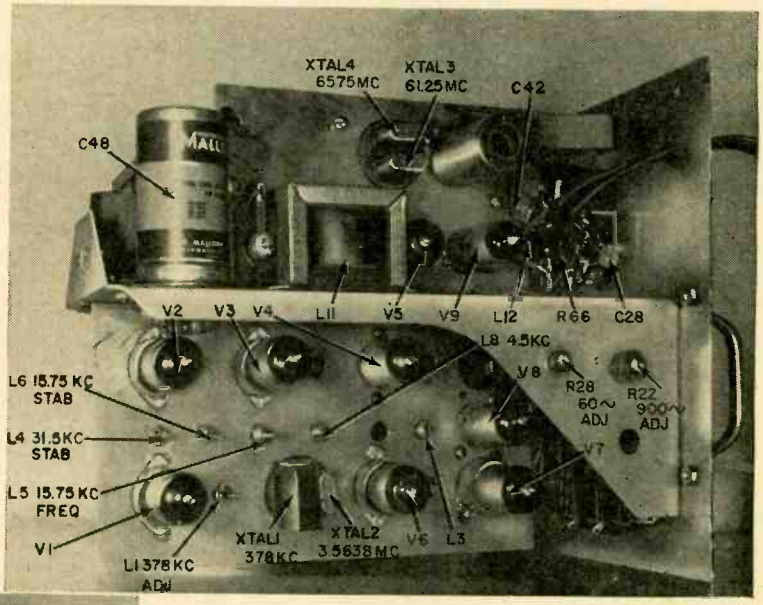


Fig. 7—Left side of generator. Note location of chroma and sync crystals.

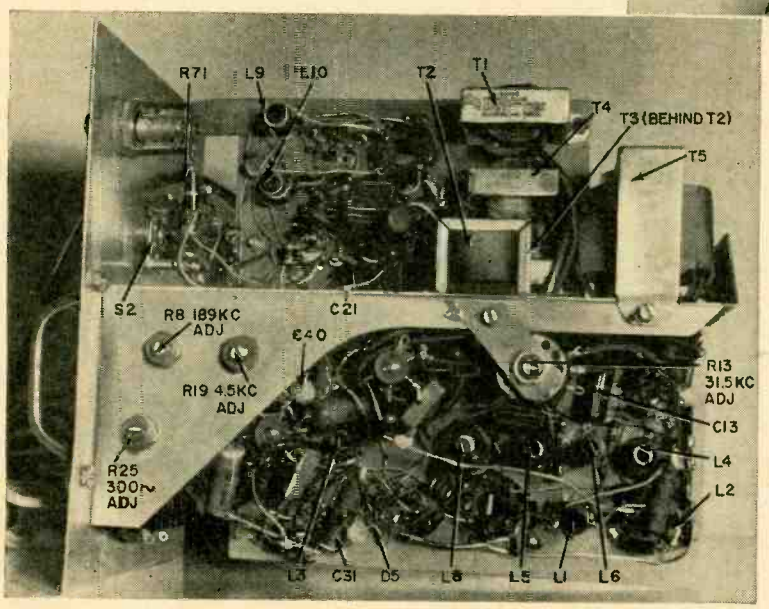
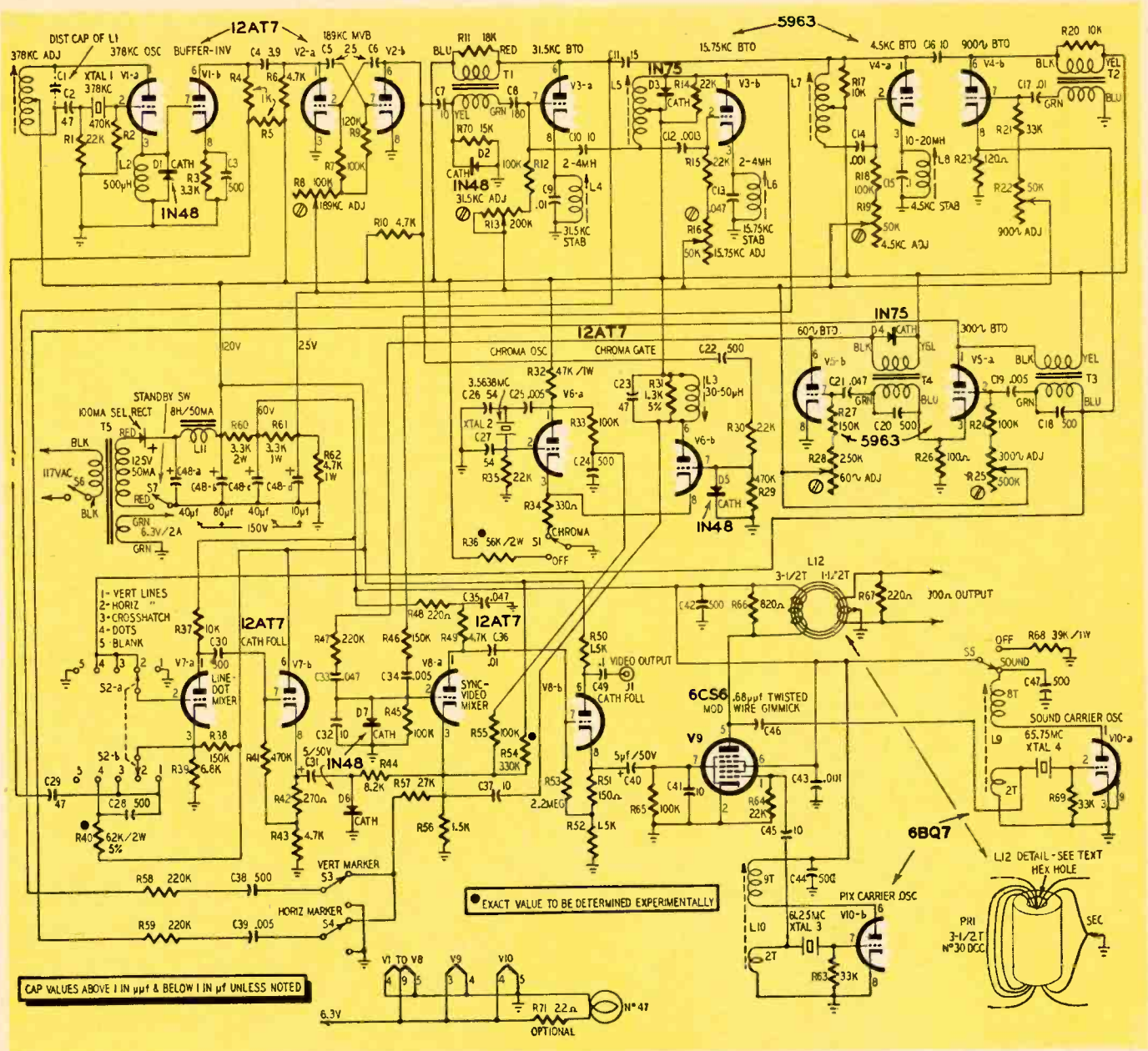


Fig. 8—Right side of the portable television pattern generator.

A DETAILED technical discussion and circuit analysis on this generator appeared last month.

The original model was built into the case of a surplus BC-906-C frequency meter. Where available, this is highly recommended because of its rugged construction and protective cover. If not available, any portable type case could be used. The chassis and the handles on the front panel are from the original unit. A new front panel was made from heavy sheet aluminum, painted with flat black enamel and lettered with white ink. The lettering was painted over with clear nail polish for durability. In making the front panel, the original one was used as a template for marking various holes for handles, chassis bolts and the four corner screws. These four screws plus one large locking screw in the rear hold the assembly in the case. Two



Reprint of the schematic diagram for the crystal-controlled TV pattern generator designed for stability and simple operation. A detailed parts list and circuit analysis appeared in the January issue.

rows of ⅜-inch holes were drilled along the top of both sides and along the bottom for ventilation. Adequate ventilation is important, especially since the power transformer is being operated somewhat above its ratings (more on this later). To utilize space better, vertical sections were added to the original horizontal chassis. (See Figs. 7, 8, 9 and 10.) These sections were cut from a discarded bottom cover of a TV chassis. However, any plated sheet steel would be satisfactory. The upper section does not extend the length of the horizontal chassis. Space is left at the front for the function switch and at the rear for power supply components. A brace was added between the top of the vertical section and the front panel. Holes in these vertical sections should be cut before mounting to the main chassis. Tubes, crystals and many inductances are mounted on these sections while power supply components are mounted on the horizontal section.

The chroma and sync crystals are placed low on the chassis in the coolest location as in Fig. 7. All crystals are mounted with standard octal sockets, one socket holding two crystals. Component layout is not critical, although the block diagram (Fig. 1, January, page 119) should be helpful if the original layout is not followed. Inductances need not be shielded or isolated from each other because they are almost all tuned to different frequencies. The exception is output coil L12. Its toroid type construction minimizes coupling to external circuits. Even so it was placed on the opposite side of the vertical chassis (Fig. 7) to reduce coupling between the picture carrier oscillator and the output circuit.

Coupling between these circuits would reduce the possible percentage of modulation. For this reason oscillator V10 is shielded. Vector turret type sockets are used for V4 and V8. The power transformer used is overloaded on the filament winding. The rating is 2 amps. The load is 3.2 amps. It runs hot but not too hot.

The next size larger transformer with the correct voltages was too large to be practical and therefore the smaller one was used. Since the generator is to be carried and used only intermittently, this seems sensible. However, you may add a 6-volt unit to share the load.

The 378-kc crystal (XTAL1) is available for around 50 cents from several sources handling surplus crystals. Order two or three and use the best one. I ordered 10. Of these, 5 were very active, 1 was weak and the others inoperative. The six active ones were all extremely near the correct frequency. The crystals are available in an FT-241 holder identified as channel 4, 20.4 mc. The 20.4 figure is the 54th harmonic of the actual crystal fre-

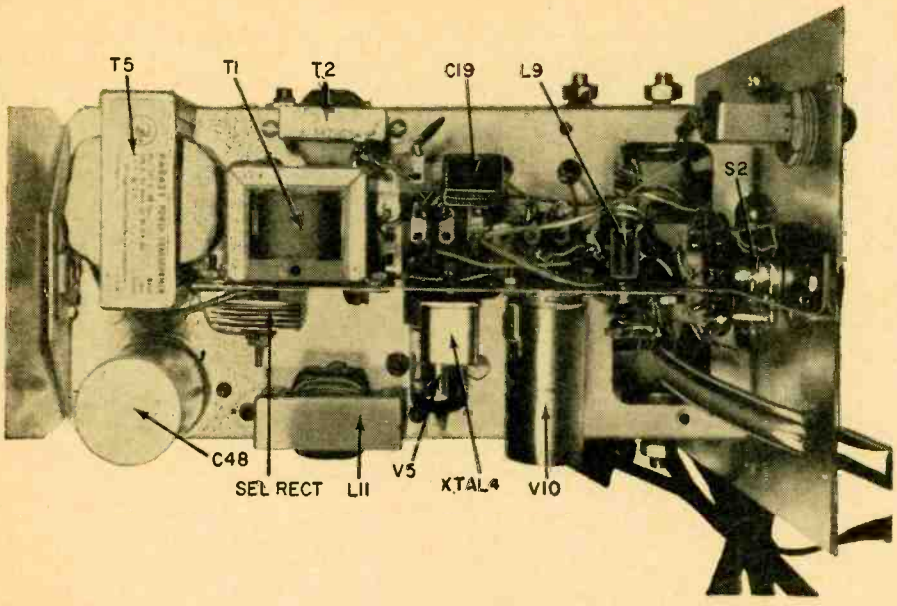


Fig. 9—Top view of generator

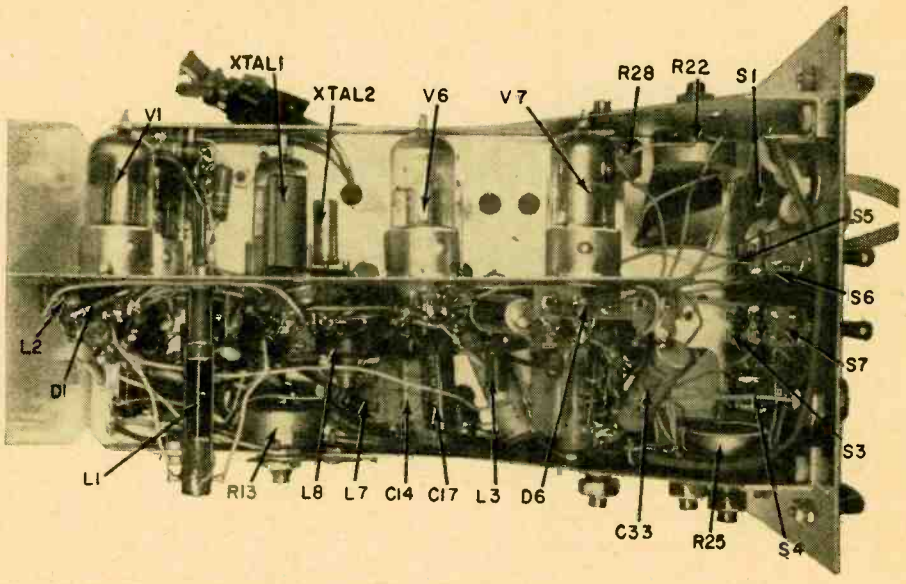


Fig. 10—Chassis seen from bottom

quency, 377.778 kc. This apparently odd figure, when divided down to the vertical sync frequency, equals 59.975 cycles. This turns out to be a rather ideal figure since it is between the monochrome vertical field rate of 60 cycles and the NTSC color field rate of 59.94 cycles. The horizontal rates work out equally well.

Lead dress is generally not critical but it is wise to observe the following. The lead from the plate load resistors of V1-b to C29 on S2-b should be kept away from the chassis as much as possible to minimize stray capacitance. Leads from the crystals to their respective tubes should be kept short and dressed near the chassis. The lead from pin 5 of V9 to L12 should be kept short and C46 should be close to pin 5. The disc ceramic bypass capacitors C42, C44, C47 and C43 should be placed close to the chassis and with the shortest possible leads. R71 in series with the pilot lamp is optional and was used to reduce the current drain. Be sure to use the types of capacitors specified. The high-capacitance disc or tubular ceramic types are fine for bypass or coupling applications but should never be used for resonant or R-C timing circuits as they have poor temperature characteristics. Any capacitors which are critical in regard to thermal drift have been specified as silver mica, NP0 or molded paper.

Winding special coils

L9 consists of 8 turns closewound of No. 30 cotton-covered or enameled wire on a ¼-inch diameter iron-core tuned form. The ones used in the original model were from discarded 22-mc if coils. The 2-turn feedback winding is formed loosely coupled to the coil with the piece of hookup wire from ground to the crystal socket. The winding must be properly phased for positive feedback for the harmonic crystals to operate. L10 is the same except for 9 turns on the main winding.

The toroid output transformer L12 is wound on a ferrite core taken from a discarded sound takeoff transformer. This core is threaded on the outside, about ¼ inch in diameter and 7/16 inch long, with a hex-shaped hole through the center. The primary is wound with 3½ turns of No. 30 cotton-covered wire. The secondary consists of ¾ turn each side of the grounded center tap as shown in the detail drawing. The core is supported by the leads being soldered to a tie strip. If channel 3 is in use in the area where the generator is to be used, you may choose to place it on channel 2. To do this, increase the main windings on L9, L10 and L12 by 1 turn. Crystals XTAL3 and 4 should then be 55.25 and 59.75 mc respectively.

The 300-ohm ribbon output cable was brought out through an elongated hole in the front panel. Plastic sleeving was used where the output cable passed through.

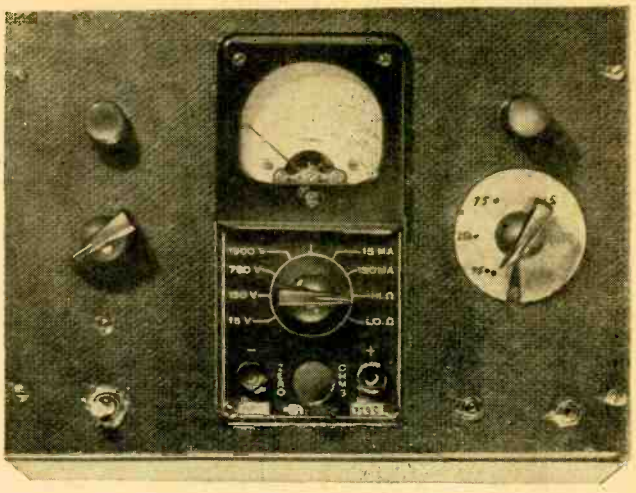
The type 5963 tubes used as blocking oscillators are similar to a 12AU7 but designed specifically for countdown service. They cost only a little more than the 12AU7 at RCA tube distributors.

TO BE CONTINUED

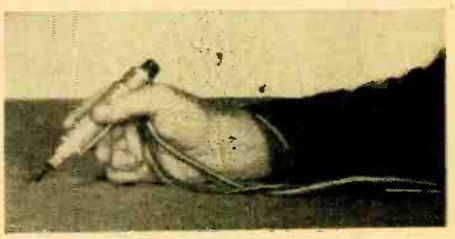
a VTVM for your MULTIMETER

Simple circuit may operate with a 1-ma ammeter

By JOHN A. DEWAR



Vtvm in use with low-priced tester.



Diode probe for use with the vtvm.

WHY another article on constructing a vacuum-tube voltmeter? Plenty of them have appeared in recent years but there is a little excuse for this one: it offers something different.

Most previous circuits required a sensitive microammeter. Fig. 1 shows a circuit which will operate with an ordinary 0–1 milliammeter. It can be used with your present multitester without spoiling its usefulness as a portable instrument. The unit, with a small multimeter may be set in a panel from which it can be readily removed (see photo).

Possibly the greatest advantage is that the multimeter already has a calibrated scale, thus eliminating the nuisance and poor appearance of hand calibration. The voltage divider, R1 to R6, can be designed to accommodate any existing scale by simple application of Ohm's law. Values shown in Fig. 1 are for a multimeter scale 0–1.5, 7.5, 15, 150, 750 volts.

The circuit is conventional and needs little explanation. The power supply is not shown—one from an obsolete radio was used. I found it necessary to use 225 volts for the B supply to get full-scale deflection on the 1.5-volt range. This had a 5-volt winding, sufficient for the 6SN7 heater and it reduces grid current. The B supply does not need to be well filtered.

Potentiometer R7 adjusts the meter to full-scale deflection with a 1.5-volt cell on the 1.5-volt range; R8 is the zero adjustment. The dpdt switch reverses polarity for measuring negative voltages such as avc. Reversing the test leads will not work for this introduces a loud hum in the receiver and disturbs the measurement.

What has been said in other articles on vtvm's applies to this. The accuracy depends on resistors R1–R6. Precision resistors can be used or standard ½-watt resistors selected on a bridge and using series or parallel combinations.

To keep the circuit simple ohmmeter and milliammeter ranges have not been included. However, an ac probe can be added. It is simple and easily constructed (Fig. 2). All parts will mount in a medium-size, aluminum, wet-electrolytic can, with shielded leads to the unit terminated in pin plugs. By adding a pin jack on the panel, connected to the 5-volt ac supply, it can be used without any other change.

The ac readings obtained are more relative than accurate but nevertheless useful. A miniature control mounted in the end of the can is used to calibrate for ac.

If your multimeter hasn't a 0–1-ma outlet, it will be necessary to add one for connection to the unit by bringing out a lead directly from the meter to an extra pin jack. And when using the meter on the vtvm unit, the selector switch should be set to a high dc voltage reading.

A note on computing a divider network for use with meters having a different scale sequence—say 0–3, 10, 100, 300, 1,000 volts: Assume a divider current of .0001 ampere (0.1 ma) for the highest range, 1,000 volts. Then the total divider resistance will be

$$\frac{1{,}000}{.0001} = 10 \text{ megohms.}$$

For the 10-volt position there must be a 7-volt drop across R1 and 3 volts across the remainder. The divider current is

$$\frac{10}{10{,}000{,}000} = .000001 \text{ ampere.}$$

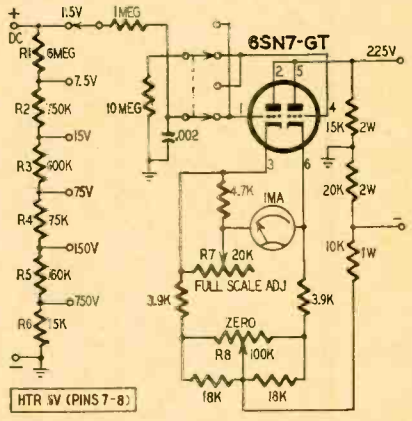
$$\text{Therefore } R1 = \frac{7}{.000001}$$

= 7,000,000, and 3,000,000 ohms for the total of R2–R6. For the 30-volt range the current is

$$\frac{30}{10{,}000{,}000} = .000003 \text{ ampere and}$$

$$R2 = \frac{27}{.000003}$$

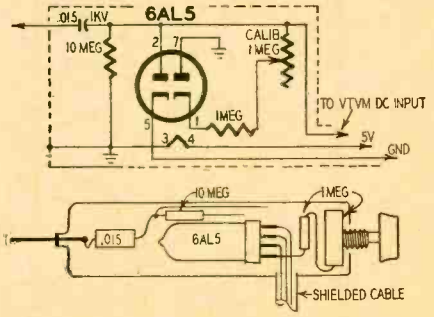
=9,000,000−7,000,000 ohms (R1)=2 megohms. The rest of the divider can be computed in the same manner. END



Resistors: 1—15,000, 1—60,000, 1—75,000, 1—600,000, 1—750,000 ohms, 1—6 megohms, ½ watt (use precision resistors or check standard values for variation in value); 2—3,900, 1—4,700, 2—18,000 ohms, 1—1, 1—10 megohms, ½ watt; 1—10,000 ohms, 1 watt; 1—15,000, 1—20,000 ohms, 2 watts; 1—20,000, 1—100,000 ohms, potentiometers.

Miscellaneous: 1—.002-μf capacitor, 200 volts; 1—dpdt switch; 1—6SN7-GT and octal socket; 1—1-ma ammeter; 1—power supply (see text); 2—pin jacks; 1—chassis.

Fig. 1—Schematic diagram of the vtvm.



1—1, 1—10 megohms, resistors, ½ watt; 1—1-megohm potentiometer; 1—.015-μf capacitor, 1,000 volts; 1—6AL5 and socket; 1—length of 3-conductor shielded cable; 1—chassis (see text).

Fig. 2—Schematic and layout of probe.

transistorized Kilo Volter

By I. QUEEN
EDITORIAL ASSOCIATE

Using a 1.5-volt flashlight cell, this versatile unit provides over 1,000 volts at 50 microamperes for G-M and scintillation counters and other applications

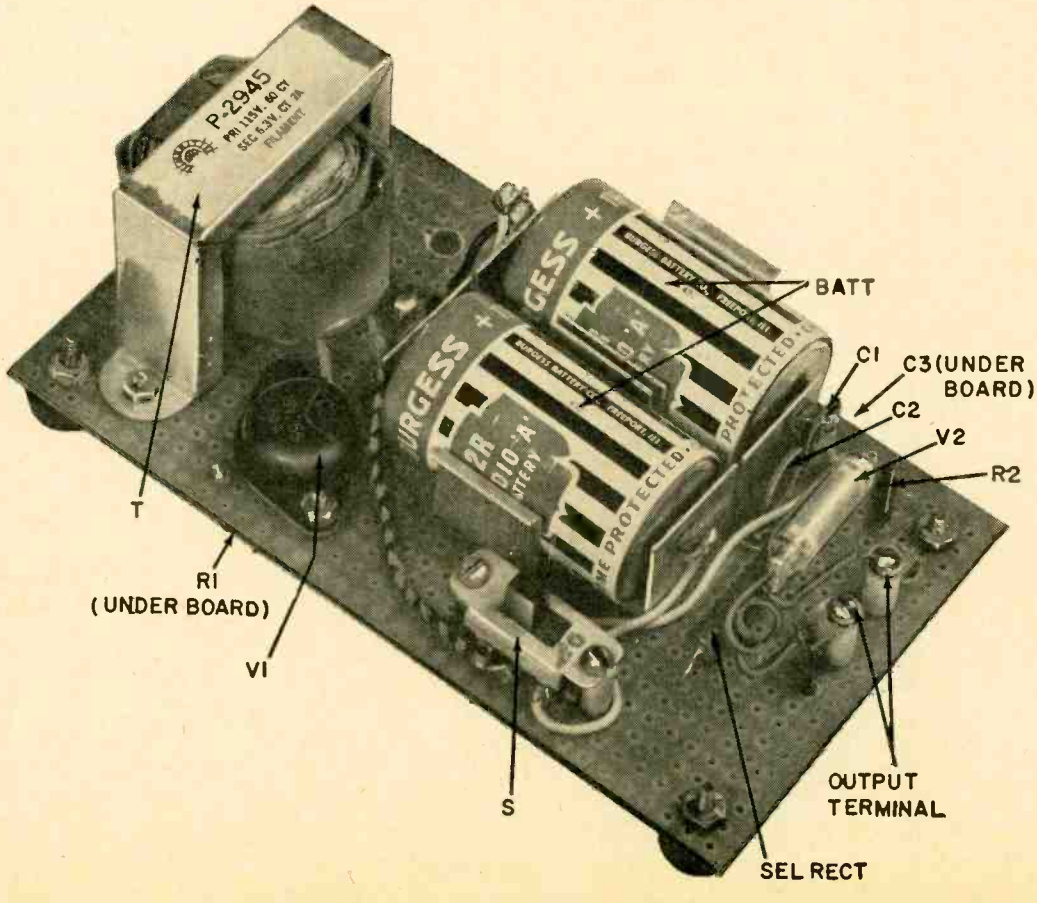
SEVERAL electronic devices require a high voltage at low current for proper operation. Some that come to mind are breakdown testers, Geiger counters, photomultipliers, meggers (for measuring insulation and other high resistance) and photoflash lamps. For example, a conventional Geiger unit requires 900 volts at a few microamps. The actual power is only a few milliwatts at most but the voltage must be *high*. This generator provides more than 1,000 volts at 50 μa from a 1.5-volt dc source. The low-voltage dc energizes a CBS 2N255 power transistor which oscillates at an audio rate. The oscillator output is stepped up by a transformer.

A transistor oscillator eliminates the need for a vibrator which may cause noise, low efficiency and sparking. The transistor is a long-life oscillator that requires no attention. Also, it is easy to control the input power (and therefore the output voltage) when a transistor circuit is used rather than a vibrator.

Fig. 1 shows the generator circuit. The 2N255 can handle several watts with a maximum dc input of 15 volts. In this application it loafs! An input of 1.5 volts at about 225 ma provides an output of 900 volts at 25 μa. The input can, of course, be pushed much higher if needed. Evidently the efficiency is not very high since I use an ordinary filament transformer—a Merit P-2945 which delivers 6.3 volts at 2 amps—for stepup. Actually any filament transformer with a rating of an ampere or less is suitable, and should result in a dc output in the same range. The efficiency can, of course, be increased tremendously by using a special transformer with a high-efficiency core. These are not generally available and are expensive.

Fig. 1 shows a base resistance of 56 ohms. This controls and limits the transistor input and, therefore, determines the output power. For a *variable* output, substitute a rheostat, but include a series fixed resistor of at least 10 ohms to maintain minimum bias on the 2N255.

The rectifier may be a stack of conventional selenium 130-volt units or it may be a special high-voltage type rated for at least 1,000 volts dc at 1.5 ma.



Layout of the kilovolter. Unit can operate on single cell—two are used for longer life.

The filter consists of a two-section R-C network. For some applications additional filtering may be required.

If the kilovolt generator is to be used in Geiger or similar work, the output voltage should be regulated. The Raytheon CK1038 is excellent for this purpose because of its tiny size (see photo). This diode has a current range of 5–55 μa and regulates within a few volts of 900. For Geiger work the tube flow may be adjusted far below the maximum value. For example, connect a microammeter in series with the tube. Now choose the transistor base resistor so that the current is 25 μa. Since the minimum CK1038 current is 5 μa, this allows a range of 20 μa for the Geiger or other load. This is more than ample for most purposes. If the load is to consume more current, reduce R1 until the regulator current is nearly 55 μa. *Do not exceed this limit.* With a 55-μa flow the load may consume anything from 0–50 μa with good regulation.

The regular tube will not operate until its starting voltage (approximately 930) is exceeded.

Generator construction

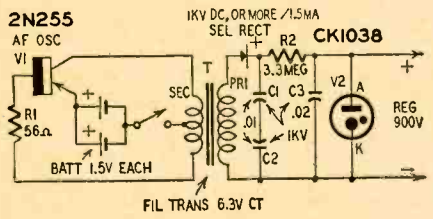
All parts for the kilovolter are mounted on a perforated board measuring 6¾ x 3¾ inches. The transistor plugs into a nine-pin miniature socket mounted beneath the board. You don't need a large hole for this socket—simply mount so that the two transistor pins can plug into the socket through board perforations, which may be slightly enlarged if desired. These pins are emitter and base connections. (See Fig. 2.) The collector ties internally to the metal flange or case (of the transistor) which is painted black except for a small area surrounding one mounting hole. This exposed metal is for making good electrical contact.

Two small screws hold the socket in place. To provide additional support and a collector connection, a third screw is passed through the perforated board and the transistor case. As mentioned, the case is tied to the collector.

Before completing all your soldering, try reversing the high-voltage transformer leads. Output will be much greater one way than the other. This is because the oscillator does not generate a sine wave, but is interrupted or blocked periodically. Thus one half-wave of the ac output is highly peaked and contains more power than the other half. The more powerful alternation must be rectified for maximum output.

The photo shows a pair of cells for the power supply, but a single cell will do the job for short periods. By dividing the work cell life is prolonged. A single No. 6 dry cell will last for hundreds of hours.

Although this generator provides a high-voltage dc output, its shock is not dangerous. If you touch its terminals while power is on, you will feel a tingle, but since the voltage quickly drops, the shock is not serious.



R1—56 ohms, ½ watt
R2—3.3 megohms, ½ watt
C1, 2—.01 μf, 1,000 volts, disc
C3—.02 μf, 1,000 volts, disc
T—filament transformer, 117 volts ct primary, 6.3 volts secondary (Merit P-2945 or equivalent)
V1—2N255 (CBS)
V2—CK1038 (Raytheon)
SEL RECT—selenium rectifier (see diagram)
BATT—two 1.5-volt cells in parallel
Battery holder (Lafayette MS-176)
Perforated board (Lafayette MS-305)
Socket, 9-pin miniature, for transistor
Switch, spst

Fig. 1—Schematic diagram of the transistorized kilovolter.

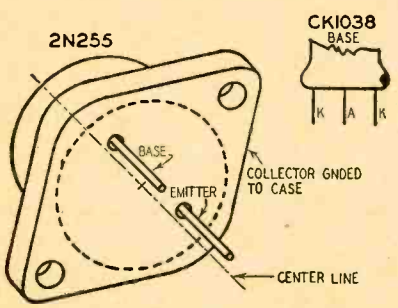


Fig. 2—External construction of the 2N255 transistor.

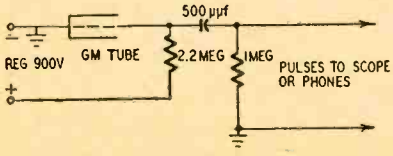


Fig. 3—A simple radiation indicator using the transistorized kilovolter.

An application

This device eliminates the need for the expensive, heavy batteries formerly needed for certain applications. One of the most interesting, useful and easy-to-make is a Geiger counter. Besides the high-voltage generator, all you need is a counter tube, a few resistors and a capacitor. Fig. 3 shows a hookup that indicates radiation either on a scope or a pair of phones. I have used this arrangement with counter tubes CK1049 and CK1026. The latter is only 2⅝ inches in length and is a low-cost unit. Average pulse amplitude (even at high counting rates) is over a volt. The CK1049 is a larger tube and much more sensitive and will indicate *beta* as well as the more powerful *gamma* rays. Its output pulses have approximately 10 times the amplitude of the smaller tube. Counts are audible directly on phones with either tube, without any amplification. A slight tone is also audible (due to incomplete filtering) but this does not interfere with the clicks. On a scope the counts are visible as negative pulses.

Experimental counts may be made with a radium-dial watch or clock. At a distance of about 6 inches the count comes to about 4–5 per second. Even at a foot away a count is still noticeable. Without a nearby radioactive source, the background count (due to cosmic rays, etc.) is less than 50 per minute.

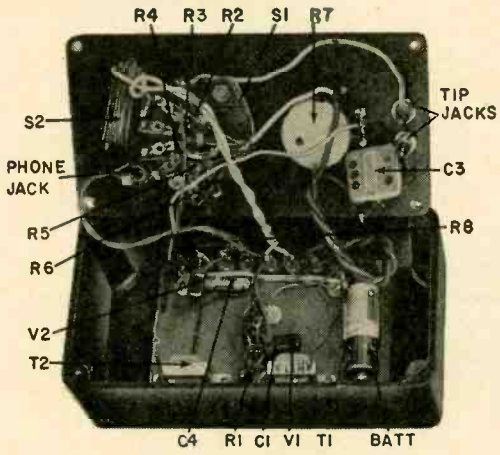
For experimental work, a special socket or probe is not needed for these counter tubes. A metal clamp or even a turn of wire around the tube coating makes a good cathode connection. A battery clip on the center conductor of the tube connects to the anode.

The high-voltage generator is also suitable to energize a photomultiplier type of tube. These ordinarily require about 1,250 volts, which this device can supply easily. Special phototubes in this voltage range are used in highly sensitive *scintillation* counters. END

transistorized capacitance bridge

5-range unit measures from 10 picofarads to 1 microfarad

By LEONARD J. D'AIRO



I'VE noticed that in the shop the least often measured electrical quantity is capacitance, though it is one of the building blocks of electronic circuits. Many a time I've sweated over circuits to the point of despair just because of miscoded or unmarked capacitors. You have probably had trouble with capacitors in television horizontal oscillator and sync circuits where you have had to try one capacitor after another until you hit one which would make the circuit operate properly.

After taking all that I could, I decided to do something about this problem once and for all and give my ulcers a rest. The result is the transistorized capacitance bridge described.

The unit is built into an old portable ohmmeter case and is self-contained. It uses two type CK722 transistors, one of which is an audio oscillator and the other an audio amplifier. A single 9-volt battery supplies the power. Current drain is 1 ma. With five ranges, capacitances from 10 $\mu\mu$f to 1 μf can be measured.

The bridge circuit (Fig. 1) is simple.

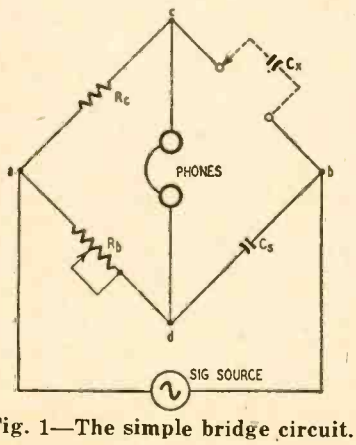


Fig. 1—The simple bridge circuit.

C_x is the unknown capacitance, C_s the standard capacitance, R_b the balancing resistor and R_c the calibrating resistor. The bridge is in balance when the ratio of C_x to R_b is equal to the ratio of C_s to R_c. This is expressed mathematically as $C_x = R_b(C_s/R_c)$. If an audio signal is applied to points a and b on the bridge and a pair of headphones connected to points c and d, the signal will be heard in the phones when the bridge is unbalanced.

As R_b is adjusted toward the point of balance, the signal in the phones begins to decrease until nothing is heard. This point is called the *null* and shows that the bridge is balanced. Now, when C_s is equal to .001 μf and R_b is equal to 100,000 ohms, the bridge will indicate values of 0.1 μf to 1 μf when R_c is equal to 100 ohms, .01 μf to 0.1 μf when R_c is 1,000 ohms, etc. To cover the range of 10 $\mu\mu$f to 1 μf, five calibrating resistors are used, each one switched into the circuit as needed. These resistors will multiply the dial reading by 0.1, .01, .001, .0001 and .00001 times, respectively.

Since the setting of the balancing resistor is proportional to the unknown capacitance, a linear-taper potentiometer can be used and the dial calibration will be linear.

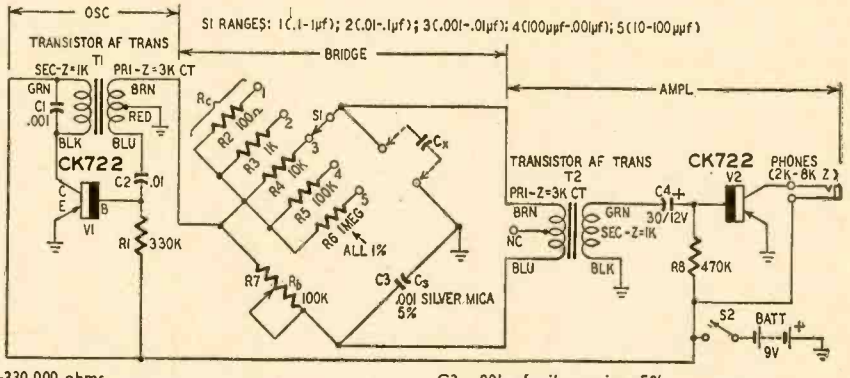
Construction and calibration

The complete schematic diagram of the capacitance bridge is shown in Fig. 2. One CK722, as the oscillator, supplies the audio signal to the bridge. The output of the bridge is then fed to the second CK722, an audio amplifier. The output of the bridge is amplified so that a finer null indication can be obtained for greater accuracy.

Although I built the bridge in the ohmmeter case it is not necessary to do likewise. There are no critical circuits, therefore layout and construction can be tailored to your own requirements. The dial for R_b was made from heavy paper glued to the panel with a coating of dope for protection.

To calibrate the bridge it is necessary only to use an ohmmeter connected to one side and the wiper arm of R_b. Starting at minimum resistance, rotate the shaft toward maximum resistance, marking off on the dial each increase of 10,000 ohms. The 10,000-ohm point is 1, the second 10,000-ohm point is 2, and so on up to 10. When R_c is 100 ohms, these numbers indicate capacitances of 0.1 μf, 0.2 μf, 0.3 μf, etc.; when R_c is 1,000 ohms, the numbers indicate .01 μf, .02 μf, .03 μf, and so on. This calibration will hold true for all ranges provided that each R_c resistor is exactly 10 times the previous resistor and all are held to close tolerances. If not, then each range will have to be calibrated individually with known-value capacitors.

It is well worth the time, effort and money spent building this bridge when you think of the aggravation avoided when you use it. I know. END



R1—330,000 ohms
R2—100 ohms, 1% (0.1-1-μf range)
R3—1,000 ohms, 1% (.01-0.1-μf range)
R4—10,000 ohms, 1% (.001-.01-μf range)
R5—100,000 ohms, 1% (.0001-.001-μf range)
R6—1 megohm, 1% (10-100-μμf range)
R7—100,000-ohm pot, linear
R8—470,000 ohms
All resistors ½ watt
C1—.001 μf, disc ceramic
C2—.01 μf, disc ceramic
C3—.001 μf, silver mica, 5%
C4—30 μf, 12 volts, miniature electrolytic
T1, 2—miniature audio transformers, primary 3,000 ohms ct, secondary 1,000 ohms (Argonne AR113 or equivalent)
BATT—Miniature 9-volt mercury battery
V1, 2—CK722 transistors
S1—single-pole 5-position rotary switch
S2—spst switch
Miniature phone jack
Phone tip jacks (2)

Fig. 2—Schematic diagram of the complete transistorized capacitance bridge.

transistor testing and handling

By W. O. HAMLIN*

Instrument provides test for beta, open and shorted units

EVERY wide-awake service technician should be prepared to service transistorized equipment. Transistors are already widely used in entertainment equipment—battery portable receivers, portable phonographs, automobile and home radio receivers.

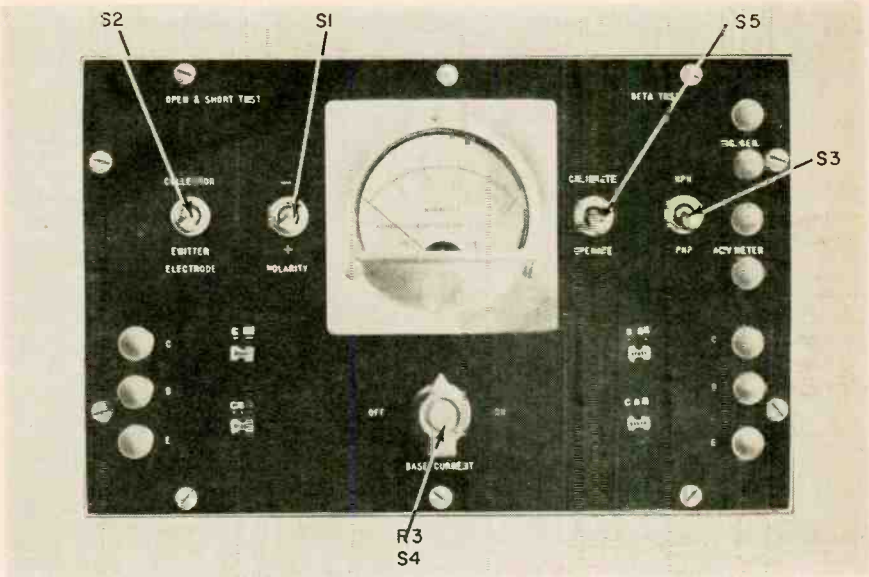
Transistors require special care as they are critical in some respects. Some means must be available for testing them because, in most cases, it would be impractical to stock all transistors needed for the technique of testing by substitution.

Thus, the subject discussed will be precautions in handling transistors, replacement of transistors and how to build a simple transistor tester. For transistor theory I recommend the many fine articles and books that have been written on the subject such as *Transistors* (Gernsback Library) by Rufus P. Turner.

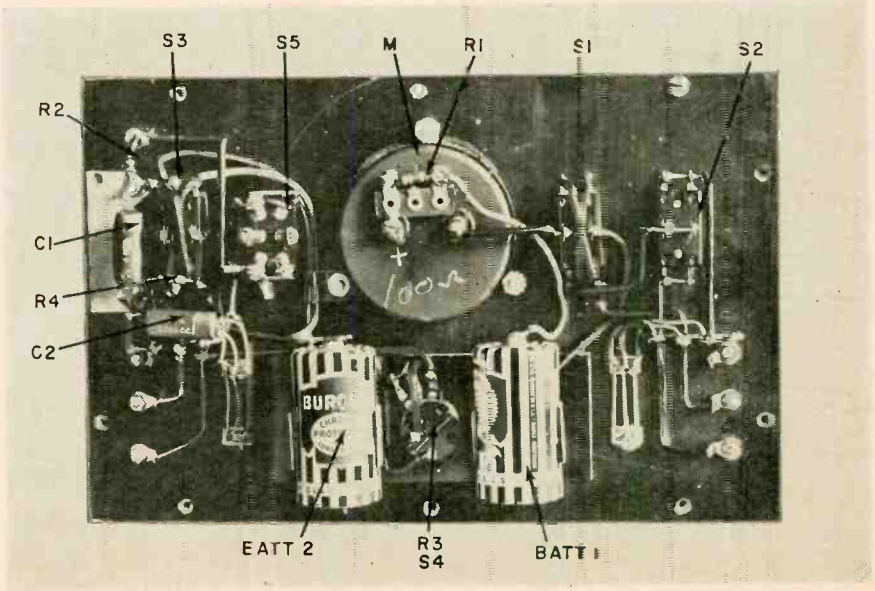
Transistors, mechanically more rugged than vacuum tubes, will withstand over five times more shock than the best military type tubes. Transistors, then, present little or no problem from the standpoint of being dropped or shaken. Their flexible leads, however, are more subject to damage and should not be bent or twisted too rigorously.

Transistors have temperature limits that should not be exceeded, both storage and operating. The storage temperature is of most concern to the service shop as it may be assumed that the equipment was designed for proper operating temperature.

Most present-day germanium units have a temperature range of about



Panel view of the tester. Open and short test and the beta test are combined in one unit. Beta test requires auxiliary audio signal generator and ac voltmeter.



Parts layout of the transistor tester.

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

−50 to 85°C (−58 to 185°F). This range covers practically all normal conditions. But to be sure, do not store transistors in a deep freeze, on a hot radiator or leave them for a long time in the direct rays of the sun.

To illustrate the transistor's temperature endurance, it is good enough for reliable use in automobile radios where the greatest variation in temperature is usually encountered.

One important temperature consideration is the effect of a hot soldering iron when applied to the transistor—it could damage the unit. The first rule is: When soldering on a transistor socket be sure that the transistor is removed first. Some types of transistors have flexible leads that are soldered into the equipment. When soldering these leads it is a good idea to keep the iron away from the transistor body. Solder them with a light, pencil type iron and, as an extra precaution, hold a pair of pliers on the lead between the iron and the transistor. The pliers acts as heat radiator, removing heat before it reaches the transistor.

Transistor replacement

Electrically, the transistor requires more care than the vacuum tube because it is inherently a low-voltage high-current device. It is not difficult to damage the transistor beyond repair by applying too much voltage to it or, in some instances, a voltage of the wrong polarity. The rules to follow in socketing a transistor are as follows:

1. Turn off the power to the equipment.

2. If there is any question concerning the polarity of connection, especially if substituting a different type number, determine whether the transistor is an n-p-n or p-n-p type (Fig. 1) by referring to the manufacturer's specifications.

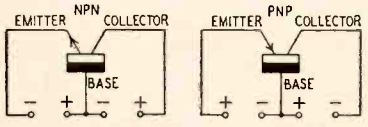


Fig. 1—Symbols for n-p-n and p-n-p transistors indicating the normal voltage polarities.

3. Connect transistors so that when operating an n-p-n type, emitter is negative, or p-n-p type, emitter is positive, to the base and collector. To check the voltage polarity with the transistor out of the circuit it is necessary to measure the voltage between emitter and collector socket terminals with a vacuum-tube voltmeter. This is because the operating voltages are determined by the voltage drops across bias resistors. Thus, in a nonoperating measurement the emitter voltage might be the same as the base voltage or the collector voltage the same as the base voltage, depending upon circuitry. Many of the sockets used are polarized so that no mistake can be made if a transistor of the same type number is used as a replacement. Standard RETMA polarized sockets have base and emitter pins spaced closer than base-to-collector spacing.

4. If you insist on making replacements with the power on, be sure that the base connection is made first. This makes certain that bias is applied when the other elements make contact.

Use the same care in making battery replacements. Be absolutely sure of two things: The voltage is the specified value; the polarity is correct.

Another good rule to follow, particularly for the experimenter, is to avoid high-voltage pulses or transients that could damage the transistor in an instant. When working on new equipment that uses other than very low dc voltages, it is a wise idea to apply the voltage gradually while observing circuit behavior. Also, a capacitive discharge, inductive kick or surge that may result from on–off switching may be large enough to produce a damaging voltage.

Transistor characteristics

Transistors have not become as standardized as vacuum tubes and few types are made by more than one manufacturer. Most of them are registered with RETMA (Radio-Electronic-Television Manufacturers Association) but many have not been and are designated by the manufacturer's own type number. It then becomes evident that to obtain an exact replacement, in many cases, the same brand must be used as the original transistor in the equipment.

Transistors registered with RETMA have a prefix "2N" followed by a number—2N155, 2N145, 2N180, etc.

Wherever possible the exact replacement transistor should be used. In an emergency, or where the original is no longer available, it is possible to substitute another transistor type. Extreme care should be taken in doing this. The characteristics of the replacement transistor should be compared with the original transistor to be sure that they are practically identical.

Transistors can be given a rough check for forward and back resistance similar to a method sometimes used for testing crystal diodes. A crude check may be made with a vtvm. This method gives only an indication of opens and shorts. Using the ohmmeter method is risky—some instruments often have higher voltages than the transistor can tolerate.

One of the major difficulties in obtaining a true measure of static characteristics of a transistor, by using the ohmmeter method, is that the value of test voltage is important and different voltages and meter movements are required to measure forward current and reverse current meaningfully. The forward current is in the order of milliamperes and should be tested at low voltages; the reverse current is in the order of microamperes and should be tested at higher voltages. For a satisfactory transistor test it is not only necessary to test for opens and shorts by checking forward and reverse resistance, but also for its amplification ability.

Building a transistor tester

A simple transistor tester may be built using a minimum number of parts and a 1-ma meter. It is simple to operate and gives a true indication of the transistor's dynamic characteristics and also check for open and shorted units. For economy the tester is designed to use the service-shop audio signal generator and high-impedance ac voltmeter. Of course, these two extra items could be built into the tester, but they are readily available. And their cost may be saved by using terminal posts for their connection to the transistor tester box.

The tester consists of two parts—an open and short checker and a dynamic ac beta measurement. Beta is the small-signal base-to-collector amplification.

The socket arrangement for both open and short test and dynamic test is shown in Fig. 2. These sockets are versatile because they may be used either for equally spaced electrodes in which the collector is indicated by some sort of marking or for the polarized type of arrangement. You can use two sockets for each test circuit as in the diagram and photos or the optional socket in Fig. 2.

The open and short checker consists of the 1-ma meter, a 1.5-volt cell, a series resistance to limit the forward current and suitable sockets and binding posts to take care of most transistors now available. Of course, as new types come out it would be possible to add more sockets in parallel, or clip leads may be connected to the binding posts. A useful addition would be a socket for the new power transistors used in automobile radios. A diagram of the open–short checking device is shown in Fig. 3, on page 63.

Switch 1 is for voltage polarity and applies forward and reverse biases to the transistor. The switch should be in a positive direction for forward current when testing p-n-p types and in the negative direction for n-p-n types. The other switch (S2) switches the element under test from emitter to collector.

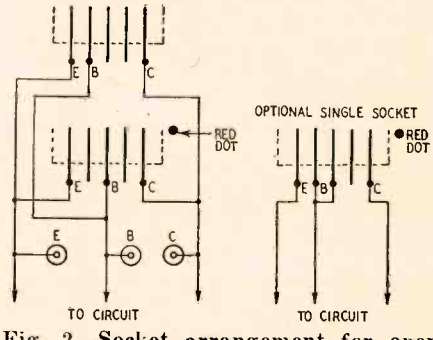


Fig. 2—Socket arrangement for open and short test, and dynamic test.

To test a p-n-p transistor throw switch 2 to the emitter element with switch 1 positive. The current will be

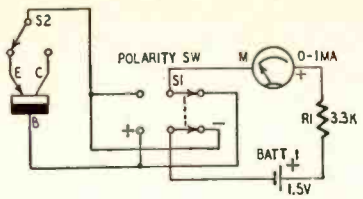


Fig. 3—Schematic diagram for the open-short checker.

high, about 0.5 ma, being limited by a resistor of 3,300 ohms. If there is no meter reading, the emitter is open. Next switch 1 is reversed. The emitter is now biased in the reverse direction, having a very low current which is barely readible on the 1-ma meter. If the meter reads a high current, up to 0.5 ma, the transistor is shorted.

Next, the collector side is checked by throwing switch 2 to the collector side. Now the same forward and reverse check is made by throwing switch 1 from positive to negative.

N-p-n junction transistors may be tested in a similar fashion. The only difference bein gthat the n-p-n transistor polarities are opposite from that for the p-n-p transistor. Forward direction for the n-p-n transistor is a negative voltage on the emitter and collector.

The open and short test just described is only a rough approximation of whether a transistor has the properties required to operate as an amplifier. How good an amplifier it is requires an additional test. This can be done hy measuring beta.

Beta is the current amplification factor in the common-emitter transistor circuit. It is one of the most significant transistor characteristics since it corresponds to the voltage amplification factor of the vacuum tube. We may define beta as the ratio of a change in collector current to a change in base current with the collector voltage held constant. Typical values of beta range from 10 to 50.

A dynamic beta tester is shown in Fig. 4. In this circuit the current amplification factor is accurately measured. Requirements for accurately measuring beta are that the output current is into a zero-impedance load and that the input current is from an infinite-impedance source. These conditions are effectively met in this circuit since the 100,000 ohms in series with the signal generator is essentially infinite in comparison with the base-emitter input resistance of the transistor. The 1,000-ohm resistor in the collector circuit is very small in comparison with the collector-emitter output resistance of the transistor. The BASE CURRENT control (R3) should be wired so that the switch S4 closes and circuit resistance *decreases with clock*-wise rotation. A 10,000-ohm resistor in series with the pot will insure a safe minimum circuit resistance.

To measure beta of a p-n-p junction transistor connect the signal generator and high-impedance ac voltmeter. Set S3 to the p-n-p position. Next the transistor is plugged into the appropriate socket on the right-hand side of the tester. Turn switch 4, which is ganged with R3, the 0.5-megohm potentiometer, switching the full potentiometer resistance into the circuit. Then throw S5 to the calibrate position and adjust the audio signal generator to 1,000 cycles, setting the ouput voltage to 1. One volt is equal to an alternating current of 10 μa to the base of the transistor through the 0.1 megohm resistor. Next S5 should be thrown to the operate position, switching the voltmeter across the 1,000-ohm load resistor. The ac voltmeter now reads the ac collector current in milliamperes, which equals beta when multiplied by 100.

The base-current potentiometer should be adjusted for optimum bias, that is, the bias that will give the maximum value of beta.

N-p-n transistors are tested in the same manner by throwing the S3 to the n-p-n position and proceeding as before.

If so desired, it is a simple proposition to add a new scale to the meter which will read beta directly.

Both the open and short checker and the beta tester can be mounted in the same box. This makes a convenient and neat-looking unit. The panel of this complete transistor tester is shown in the photos.

An additional use of this tester is to check crystal diodes. Diodes with flexible leads may be connected across the open terminals between either E and B or B and C. The diode is then tested in the same manner as either side of the transistor for open and short. The one drawback of this test, as in any ohmmeter test of a crystal diode, is that there is insufficient back voltage to test the reverse characteristics of the diode thoroughly. However, it does show whether or not the diode is open or shorted. END

Parts List for Figs. 3 and 4

R1—3,300 ohms, ½ watt
R2—100,000 ohms, 5%, ½ watt
R3—1-1.5-megohms, potentiometer, 2 watts
R4—1,000 ohms, 5%, ½ watt
C1—1 μf, 200 volts
C2—1 μf, 200 volts
S1, 3—dpdt switch
S2, 5—spdt switch
S4—spst switch (on R3)
BATT 1, 2—1 5-volt cell
M—0-1 milliammeter
Binding posts (10)
Transistor sockets (4) (Cinch-Jones 2H5 subminiature type)
Panel
Cabinet

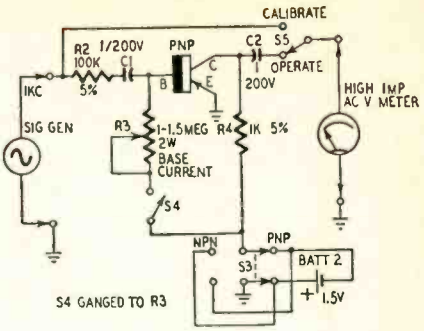
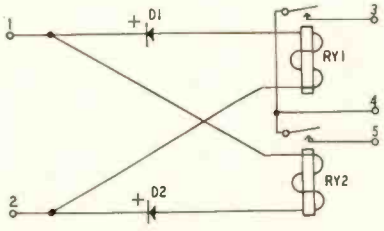


Fig. 4—Circuit diagram of the transistor beta amplification factor tester.

INEXPENSIVE POLARIZED RELAY

When experimenting or doing developmental work, the need frequently arises for a reliable polarized relay. When one is not available or its price is prohibitive, the builder may find this circuit a very effective substitute. By judicious use of surplus components, it may be built for $5, or even less.



RY1 and RY2 are normally open single-pole single-throw dc relays. Their coil resistance and closing voltage are not critical; however, you must remember that the completed unit will be no more sensitive than the relays used in it. For best operation, they should be electrically identical.

Diodes D1 and D2 should be chosen to withstand the voltage and current that the relay coils require. Logical choices are a germanium diode, such as the 1N34, or for higher power a selenium rectifier.

This circuit is designed so that current energizing one of the relays must flow through one of the diodes while the current which would energize the other relay is held back by the high back resistance of the other diode. Moreover, if the input polarity is reversed, the relay which was formerly energized will now be unenergized and the one which was formerly unenergized will now be energized. Therefore, an application of voltage across terminals 1 and 2 will, depending on its polarity, close either the circuit between terminals 3 and 4, or between terminals 4 and 5.

When used in a bridge type circuit, this unit will register either an increase or a decrease in current (since an increase originating in one arm of the bridge will cause current to flow through the indicator circuit one way and a decrease will cause flow in the other direction). Therefore with a photocell as one arm of the bridge (if the circuit is so adjusted that no current flows through the relay) any change in light intensity will correspondingly close one of the relay contacts. By using the relay to turn lights on or off, a device of this type could keep the light intensity constant in studios and other places where this is important.—*Barry Lasker* END

New

MODEL O-11
Shpg. Wt. 21 Lbs.

$69.50

* *An improved model of what was already an outstanding instrument.*
* *Performance is unmatched in this price range.*
* *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5″ Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 2.2 DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

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* *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.

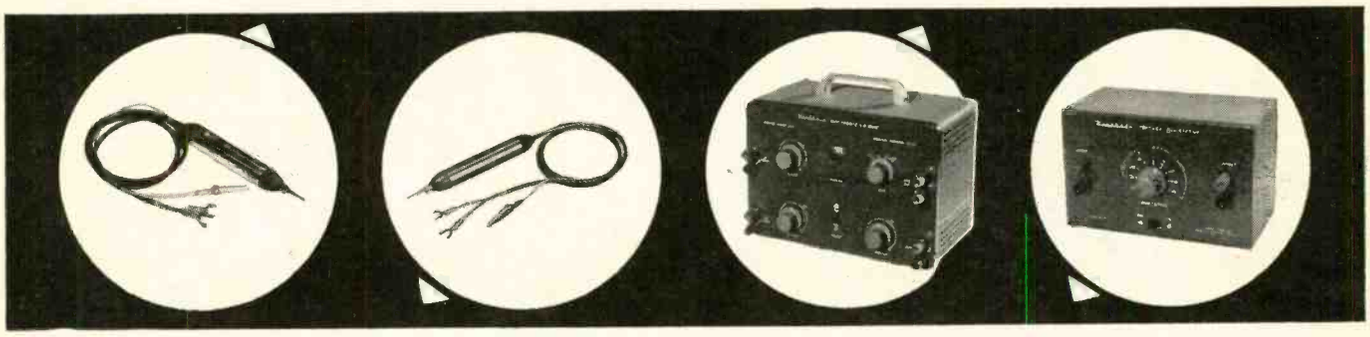
HEATHKIT ELECTRONIC SWITCH KIT

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

MODEL V-7A

$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

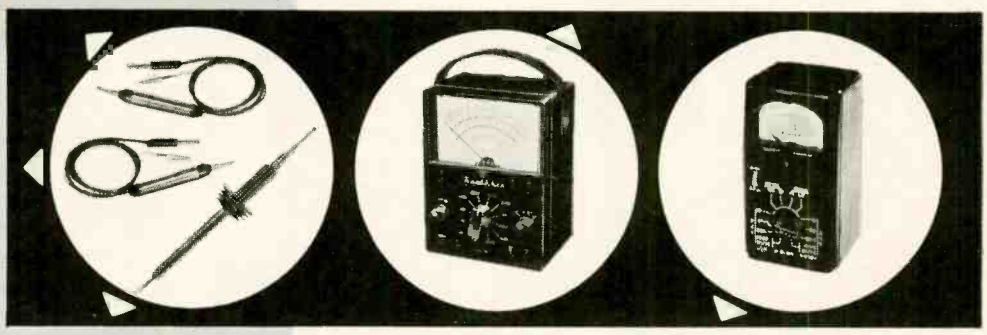
Shpg. Wt. 6 Lbs.

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

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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

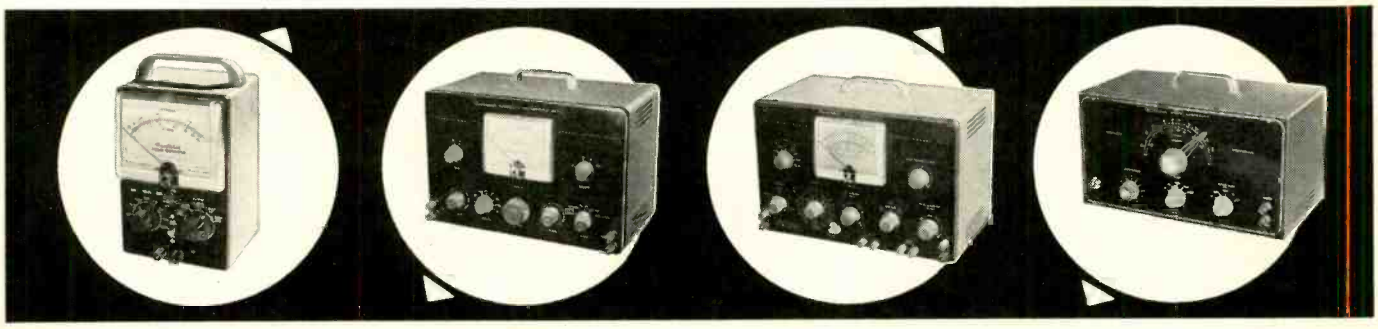
This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. 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.

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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.

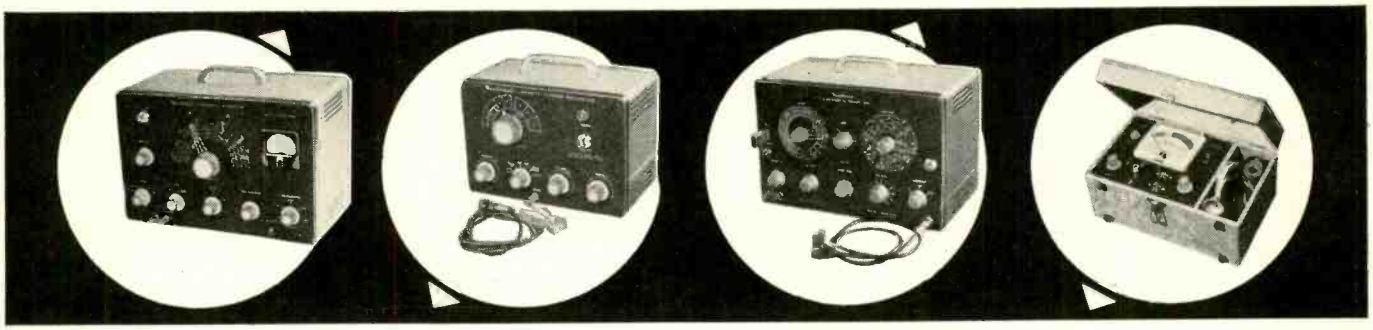
HEATHKIT TV ALIGNMENT GENERATOR KIT

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.

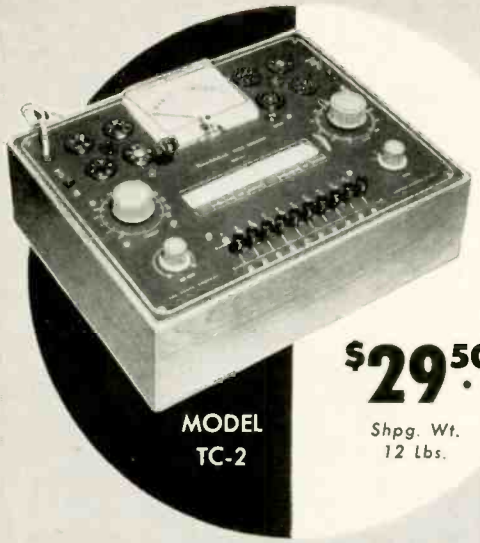
MODEL CC-1

$22.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Tube Checker Kit



MODEL TC-2

$29.50

Shpg. Wt. 12 Lbs.

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

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BENTON HARBOR 20, MICH.

PIONEER DESIGN . . .

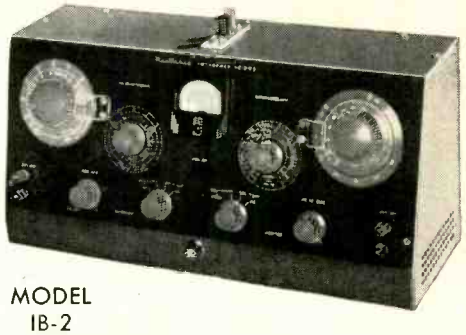
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from 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.

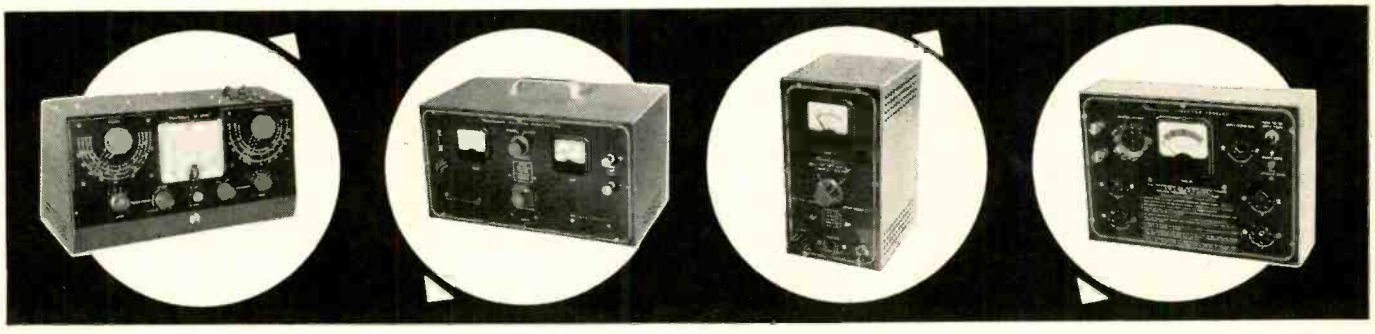
HEATHKIT ISOLATION TRANSFORMER KIT

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.

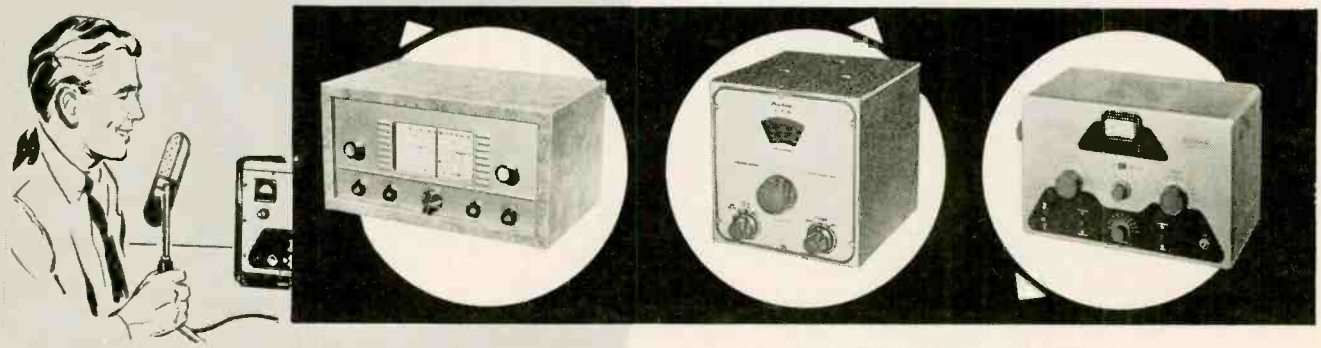
CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95

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

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.

HEATH COMPANY
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BENTON HARBOR 20, MICH.

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.

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.*

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.

MODEL DX-35

$56.95 *Shpg. Wt. 24 Lbs.*

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.

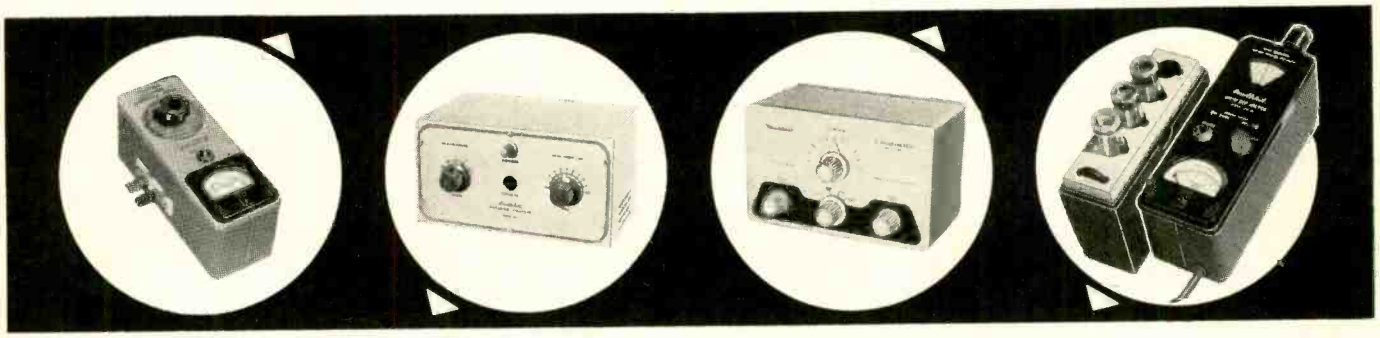
HEATHKIT "Q" MULTIPLIER KIT

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

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

$18.95
INCLUDING NEW EXCISE TAX‡

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.*

Receiver Kit

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.

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

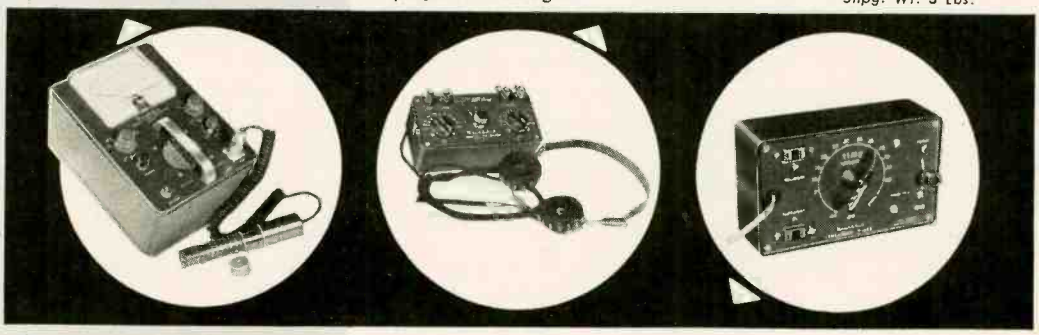
This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. 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 . . .

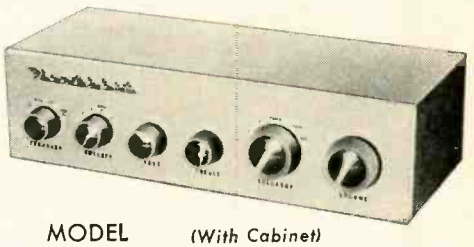
The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. 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 IM 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

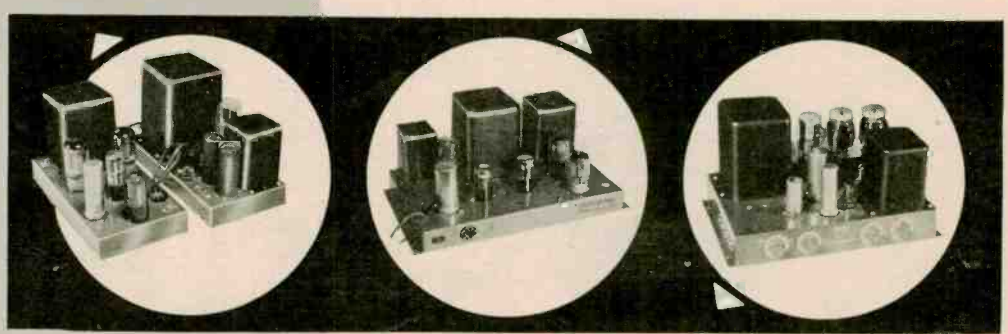
The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the 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.**

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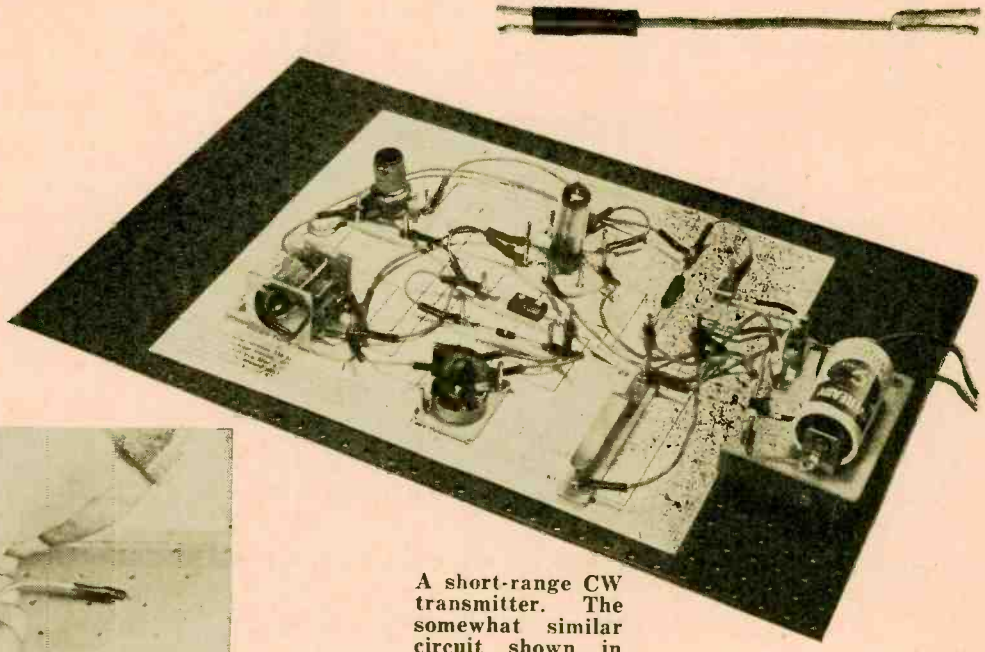
COVER FEATURE

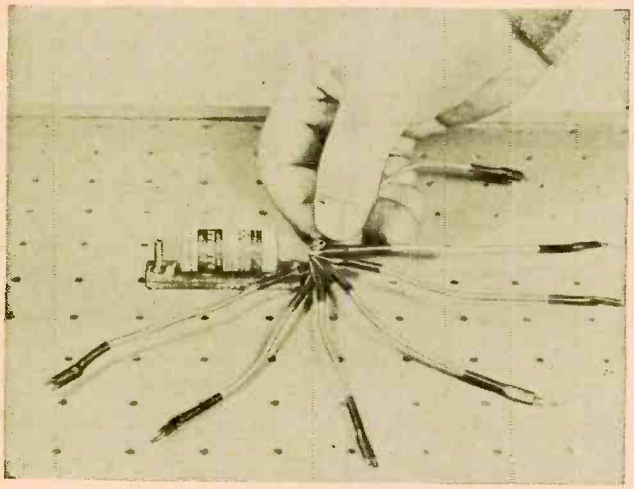
modern touch in circuit kits

Novel techniques aid quick assembly and disassembly

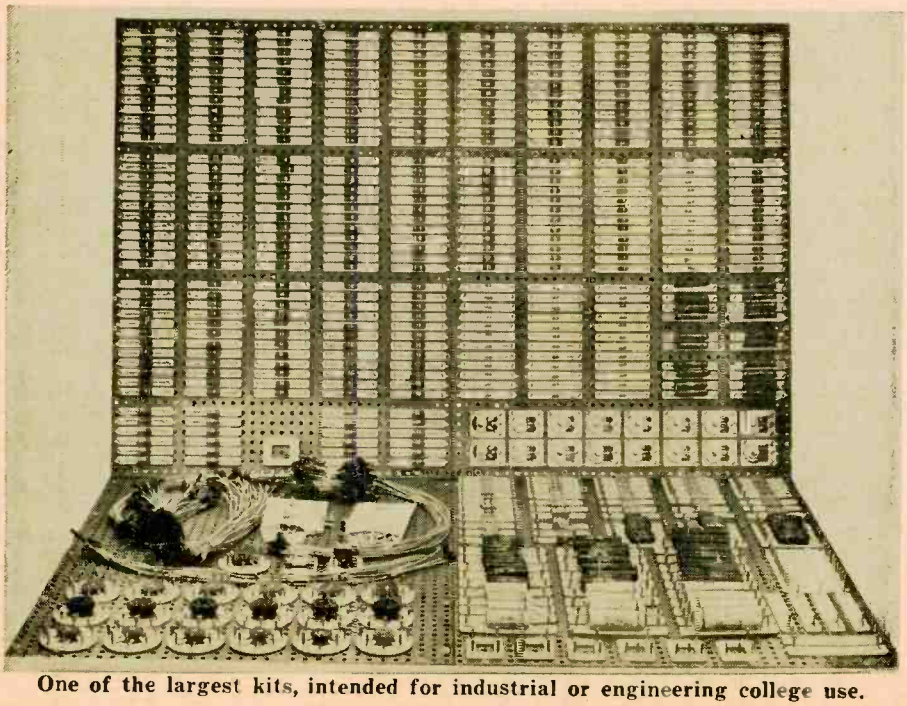
By ERIC LESLIE



A short-range CW transmitter. The somewhat similar circuit shown in part on the cover is a code practice oscillator.



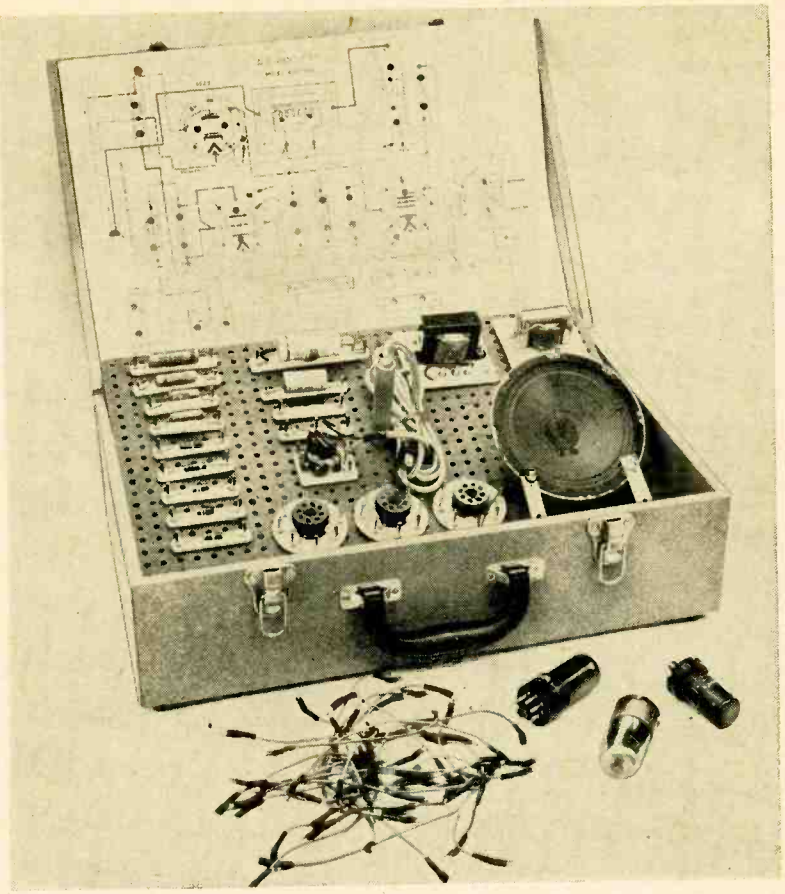
The Jiffy-Clip reduces connection problem to zero.



One of the largest kits, intended for industrial or engineering college use.

OUR cover this month pictures the ultimate in circuit board. Experimenters and teachers have long tried to use such devices—from the original wooden breadboard with a few rows of Fahnestock clips mounted in strategic places to more sophisticated setups with whole subassemblies mounted as single units. The Erec-Tronic equipment on the cover also includes what is probably the ultimate in an experimental or educational kit. (That is, a kit whose components are designed to be used over and over again rather than be wired up once as a permanent piece of equipment.) Several new and original features are responsible for this doubling in ultimates.

The No. 1 secret of the Erec-Tronic system is the Jiffy-Clip, half-a-dozen of which can be clipped onto a smooth pin in almost as many seconds. As illustrated, it is a bit like part of the cross-section of the top part of a dome fastener, and works on the same principle. It can be snapped onto the pin horizontally, or — with less effort — slipped down over its top. In either case, a concave portion on the inner side of the U arms makes a good electrical connection. Invented by Arthur Jubenville, at the time a science teacher in Huntington, N. Y., it is not only the heart of the system but the original and fundamental component. (Its first



A special kit for school use. An audio amplifier is built from it.

use was as a test prod clip to keep the prod on a desired connection while checking a chassis.)

Next come twin features—a pegboard as support for the circuitry, and mounting bases for individual components. These mounting bases have pins which project downward to fit snugly into holes in the pegboard and upward to form connecting pins for the Jiffy connectors (two Jiffy-Clips at the ends of a piece of wire). A single component is soldered firmly between the pins of each mounting base.

Another important—though not entirely novel—feature is the paper templates, each printed with a circuit, such as a radio receiver, code-practice oscillator or voice transmitter. The radio beginner, experimenter or student merely places the correct component mount—identified by a number—over its corresponding numbered outline on the template, plugging its pins into holes in the template and the peg board below. He then connects Jiffy connectors according to the circuit lines on the template and has a working piece of equipment in less time than it would take to draw its schematic.

At present the inventor is producing two main kits: one with a crystal diode and pentode tube, the other with a diode and transistor. Foreshadowing a new trend, the transistor kit is the cheaper one, selling for about $13. The tube kit (without batteries) sells for about $17. The transistor kit is the simpler one, being supplied with 9 templates representing circuits that can be built from its parts. The tube kit has 15 templates and a few more components.

These kits are intended for the hobbyist and also for the more serious student who can find in them a means of reducing his theory to practice with the minimum requirement of cost, space or skill.

Possibly more important, the equipment is a natural for the boy who is just taking an interest in things electronic. The schematic diagram has always been the barrier which completely frustrates the beginner. It intensifies and multiplies his problems, since in effect it compels him to follow instructions in a foreign language. Eliminating the schematic diagram removes the greatest difficulty in the way of the electronic beginner.

Yet the student must learn and the hobbyist must advance if his work is to continue interesting. A system that would chain him to the numbered outline would be worse than useless. So each of the outlines contains the schematic symbol of the component that must be plugged into it, making the user connect symbol and component unconsciously and automatically. And a complete schematic of the circuit appears on each template so that, *after* the beginner has assembled the circuit, he can see how it looks and trace it out schematically, learning the new language without pain.

Soldering is another stumbling block to the electronic beginner, especially the younger one. The Jiffy connector removes that obstacle, making electrical connections far better than those of the average green solderer and making them without mess, dirt or danger. They can be removed even faster than they can be applied, and reused almost without limit.

Another important help to the beginner is the pilot lamp in the battery circuit of the tube kit. A wrong connection simply lights or blows out the pilot lamp instead of the far more costly pentode tube.

These kits are useful and interesting not only to the hobbyist and beginner; they are also made especially for the electronic design or research engineer. Differing from the beginner's kits chiefly in the number of components, they make possible such feats as putting together a three-stage audio amplifier with power supply in only 25 minutes. Experiment shows that a similar amplifier would require at least 16 hours' work if assembled on a metal chassis and soldered together in conventional kit style. Thus the engineer can try various circuit variations—or set up complete circuits—in a fraction of the time that would otherwise be required.

The big kits for industry and education may cost up to $395 and contain over 300 mounted resistors, 100 capacitors, more than a dozen each of sockets and potentiometers, large numbers of extra mounting bases for additional or special components, and all the other components required for assembling advanced circuitry. Use of these kits is spreading from the laboratory and engineering college to some high schools. There is also some use for the simpler kits in elementary lab projects. Intermediate kits of somewhat greater complexity are supplied for educational use, and special ones for building a single piece of apparatus are particularly adapted to some school applications. END

"Here's your next lesson from that TV correspondence school."

The WRONG Quiz

By DAVID GNESSIN

THIS quiz contains five questions. Each one counts 20%. Each question has four multiple-choice answers. All but one are *correct*. Can you find the *wrong* answer?

1. Inspection of a radio receiver reveals a blue glow in the glass of a particular tube. This indicates:
   a. In the case of a mercury-vapor rectifier, the blue glow appears when plate current is drawn, showing fluorescence of mercury, a normal phenomenon.
   b. In the case of high-vacuum tubes, the blue glow between tube elements shows a *soft*, faulty tube, whose gas content may cause erratic action and excess current. It should be replaced.
   c. In the case of tubes handling high voltage and current, such as the 6BG6-G, the blue glow inside the glass envelope, but hot between tube elements, is simple fluorescence and may be considered as normal.
   d. In detector tubes of extremely old radios using the 200, 01A, etc., the glow indicates a *hard* tube, especially selected for detection action, and is considered as normal.

2. Inspection of the tube shows blue glow and cherry-red plate with sparking between tube elements.
   a. In rectifier tubes this indicates excessive current drain, possibly caused by shorted filter capacitor. Replace both capacitor and tube.
   b. In rectifier tubes this denotes end of useful life. It has no connection with filter capacitor. Replace the rectifier tube.
   c. In a power amplifier stage (such as might draw several watts) an open grid return could cause loss of bias, permitting tube(s) to draw excessive current. Turn the set off quickly and repair the grid circuit.
   d. In horizontal amplifier circuits of television receivers this could represent loss of excitation (such as failure of horizontal oscillator circuit). Shut off the receiver. Restore excitation. Test horizontal amplifier tube to see if excess current has damaged it.

3. Measurement of control grid shows 4 volts.
   a. This is normal bias for most amplifier tubes. Look elsewhere for trouble, if any.
   b. This is common effect of leaky or shorted coupling capacitor from preceding plate to this grid. Replace the coupling capacitor.
   c. A gassy tube will do this by permitting a heated grid to emit accumulated electrons like a cathode. During this time the grid will read positive. This tube must be replaced.
   d. Under certain conditions the cathode will be positive with relation to chassis ground. Thus the measurement of the control grid to chassis may well be positive, while representing a real negative voltage with reference to cathode.

4. It is necessary to replace a particular tube in a piece of radio equipment consistently every few months. You're getting tired of the regular replacement.
   a. Check line voltage. If high continually, or high during the time you use the radio equipment, that could be your trouble.
   b. This is farm radio equipment or similar isolated type with control of filament possible to user. Customer pushes up filament control for louder volume. This shortens tube life.
   c. Grid bias too low, resulting in reduced control of emission, causing cathode to be consumed too quickly.
   d. You're buying your tubes from a source which has *seconds*, rejected or otherwise faulty tubes. When a tube fails repeatedly, the source is faulty.

5. A good service technician can quickly spot a dead tube by running his hand over the tubes when the set has warmed up, to see if the tubes are all warm. Or, he can look for the filament light through the glass. When he has detected a tube which doesn't light or isn't warm:
   a. He can check to see if poor contact between tube and socket is causing the open circuit by pulling the tube out and replacing it, jiggling it to insure a perfect contact.
   b. If all the tubes are out and they have parallel filaments, it's unlikely that just this one tube is faulty — the whole filament circuit is faulty.
   c. Certain circuits have different filament supplies to different tubes or batches of tubes. For example, the damper tube in some television receivers has a separate filament supply from the other tubes because of surges in its circuit. Check the filament supply at the socket to see if voltage is being delivered to the tube.
   d. In a series-filament circuit the tube that is not lighted is the only one that is faulty, since the others are all lit.

(See answers page 132)

build a Dynaflex broadcast receiver

An unusual reflex-superhet bedside radio

By FRANK H. TOOKER

THE Dynaflex is a compact broadcast-band receiver of unusual but practical and sound design. Its circuit was born of necessity—I wanted a bedside radio with the following specifications:

1. It had to be small; not over 6 x 12 inches on the base (this was all the space available on the bedside table).

2. It had to be sufficiently sensitive to provide normal reception of local stations night and day with only a foot or two of wire as an antenna. This same antenna should provide good reception of stations up to 1,000 miles away which usually come in at good strength at night.

3. Its power supply was to be a transformer type and it had to be filtered to make hum inaudible at a distance of 1 foot from the speaker.

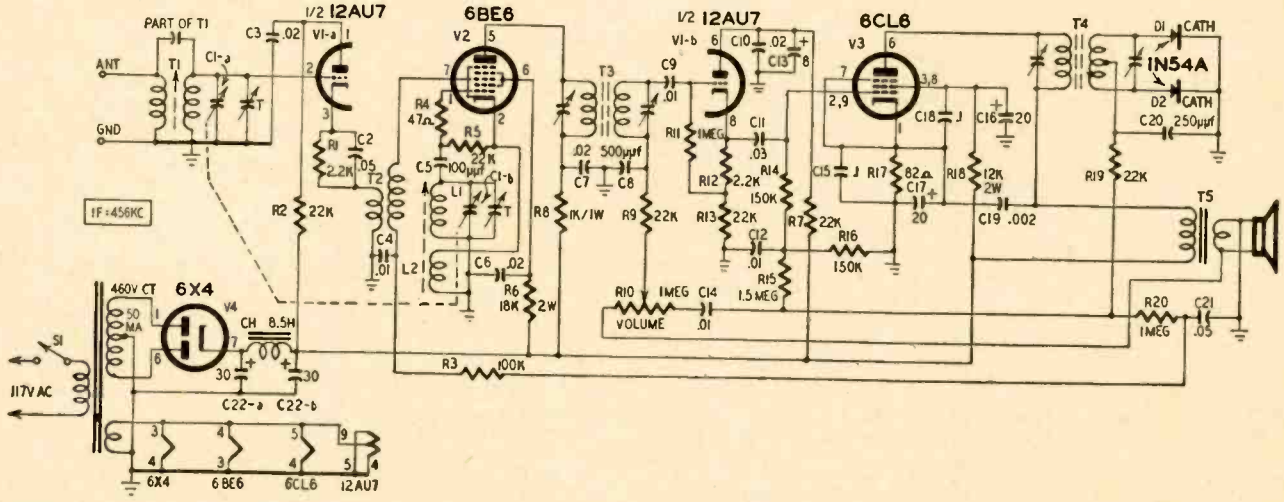
4. For enjoyable listening, especially at night, its selectivity had to be sufficient to separate adjacent stations; it had to have effective agc to prevent blasting; it had to have good image rejection; its audio power output and quality should compare favorably with that of the average table-model radio.

Ordinarily, to be on the safe side, a receiver to meet these specifications would require at least five tubes, not including the rectifier (rf amplifier, converter, if amplifier, detector–af amplifier, power amplifier). But space just wasn't available for a receiver of this size. Consequently, the Dynaflex was born to accomplish essentially these same functions with only three tubes.

How the Dynaflex works

The Dynaflex is a reflexed superhet. Signals from the antenna are fed to the primary of high-Q antenna transformer T1. The secondary of T1 is tuned by variable capacitor C1-a. Because of cathode follower V1-a the tuned circuit of T1 operates virtually unloaded (considering the very short antenna), so its selectivity and image rejection as better than they would be if T1 were connected directly to the signal grid of the converter. The signal impressed on the grid of V1-a appears,

(*Continued on page 89*)



R1, 12—2,200 ohms
R2, 5, 7, 9, 13, 19—22,000 ohms
R3—100,000 ohms
R4—47 ohms
R6—18,000 ohms, 2 watts
R8—1,000 ohms, 1 watt
R10—1 megohm, pot
R11, 20—1 megohm
R14, 16—150,000 ohms
R15—1.5 megohms
R17—82 ohms
R18—12,000 ohms, 2 watts

All resistors ½ watt unless noted

C1-a, -b—dual superheterodyne type variable capacitor, 365-µµf rf section, cut-plate oscillator section
C2, 21—.05 µf, 200 volts, midget, metallized paper
C3, 6, 7, 10, 23—.02 µf, ceramic
C4, 9, 12, 14—.01 µf, ceramic
C5—100 µµf, silver mica
C8—500 µµf, ceramic
C11—.03 µf, 200 volts, metallized paper
C13—8 µf, 250 volts, electrolytic
C15—0.1 µf, 200 volts, metallized paper
C16—20 µf, 300 volts, can type, electrolytic
C17—20 µf, 25 volts, electrolytic (in same can as C16)
C18—0.1 µf, 400 volts, midget, metallized paper
C19—.002 µf, ceramic
C20—250 µµf, silver mica
C22-a, -b—30-30 µf, 450 volts, can type, electrolytic
L1—ferrite antenna coil (Vari-Loopstick or equivalent, see text)
L2—feedback coil, 8 turns No. 28 enameled wire (see text)
CH—8.5 henries, 50 ma, choke
T1—Ferrite antenna coil, high-impedance primary (Miller A-5495-A or equivalent)
T2—antenna coil, self-resonant in broadcast band (Miller 472-UA modified—see text)
T3—iron-core 456-kc input if transformer (Meissner 16-5740 or equivalent)
T4—iron-core 456-kc full-wave output if transformer (Miller 612-C3 or equivalent)
T5—output transformer, 7,600-ohm primary, 3.2-ohm secondary (Stancor A8114 or equivalent)
T6—power transformer, 460 volts ct @ 50 ma, 6.3 volts @ 2.5 amps (Stancor PC-8418 or equivalent)
V1—12AU7
V2—6BE6
V3—6CL6
V4—6X4
D1, 2—1N54A germanium crystal diode
S1—spst switch (may be mounted on R10)
SPKR—4-inch 4-ohm loudspeaker
Chassis, aluminum, approximately 2 x 9½ x 5 inches
Sockets (2), 9-pin turret type, 1½ inches (Vector 6-N-6T or equivalent)
Socket, 7-pin miniature turret type, 1½ inches (Vector 6-M-6T or equivalent)
Shield bases and shields for 9-pin sockets (2)
Shield base and shield for miniature 7-pin socket
Socket, 7-pin miniature, Bakelite (for 6X4)
Cabinet, approximately 11 x 7 x 5-5/16 inches, with speaker cutout
Line cord and plug
Dial
Terminal strips

Schematic diagram of the Dynaflex receiver. Sensitive unit operates well on 2-foot antenna. Switch S1 may be coupled to volume control.

BUILD THE BEST—

get the most for your money in ALLIED'S own

knight-kits!

THE FINEST ELECTRONIC EQUIPMENT IN MONEY-SAVING KIT FORM

LOWEST COST

Our huge buying power means biggest savings for you. You do the easy assembly and your finished instrument is equal in performance and appearance to equipment selling for several times the low KNIGHT-KIT price.

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Months of research, development and field-testing go into each KNIGHT-KIT to bring you proved, advanced design. To assure top performance, premium quality parts are supplied in each kit. KNIGHT-KITS are guaranteed to meet published specifications, OR YOUR MONEY BACK.

EASIEST TO ASSEMBLE

All chassis and panels are punched; all parts are clearly marked; even the resistors are mounted on cards, and keyed for easy identification. Each instruction manual is a marvel of "Step-and-Chek" clarity. You get professional results even without experience.

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FEATURING PHANTASTRON LINEAR SWEEP CIRCUIT

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Model F-146

$49.50

This new oscilloscope delivers performance equal to wired units costing several times more and defies comparison with any other 'scope kit at anywhere near its price. It's the ideal choice for radio and TV servicing, audio work and hundreds of other applications—meets 90% of all 'scope requirements. Here are some of the features that make this kit a standout in its class: *Phantastron Sweep Circuit*—versions of this circuit are used in $1,000 'scopes; provides high linearity of sweep from 15 to 150,000 cps. *Regulated Calibration Voltage*—fully regulated square wave calibrating voltage is injected into signal circuit by spring return switch. *25 Millivolts Per Inch Sensitivity*—three times the sensitivity of other 'scope kits in its price class. *Retrace Blanking*—found only in high-priced 'scopes. *Vertical Amplifier*—frequency response ±3db from 3 cps to 1.5 mc (±6db to 2.5 mc). Input controls are frequency-compensated. Rise time, .25 microseconds. Impedance, 3.3 meg. and 45 mmfd. Includes positive and negative internal sync. Outstanding construction features: CRT protected by heavy rubber ring; sturdy steel case with disappearing handle. For easy assembly: pre-cut color-coded wire; resistors carded and keyed to match instructions; printed circuit; laced wiring harness; "Step-and-Chek" construction manual with wall-size picture diagrams. Supplied with all tubes including CRT, all parts, graph screen, wire, solder. Size, 9¼ x 13¾ x 17¾". Shpg. wt., 26 lbs.

Model F-146. Complete 5" Oscilloscope Kit. Net only **$49.50**
F-148. RF Demodulator Probe Kit. Net **$3.45**
F-147. Low Capacity Probe Kit. Net **$3.45**

knight-kit TV-FM SWEEP GENERATOR KIT

Guaranteed Linearity • Fool-proof Calibration • Wide-Range • Electronic Blanking

All-new; precision-designed for lab use, TV and FM servicing, production line testing. Covers 300 kc to 250 mc continuous on 4 bands (all fundamentals). Center frequencies of VHF TV channels appear on scales. Exclusive KNIGHT-KIT sweep circuit assures perfect linearity—RF sweep output in excess of 0.15 volts, *flat within 1 db*, is available on all bands. Sweep width continuously variable, 0-13 mc. Dual crystal marker oscillator and input for variable marker (RF Signal Generator on next page is ideal). Phase control provides blanking shift, 0 to 180°. Step-type and continuous output controls; separate marker amplitude control. Filter connected to 0-50 mc output jack provides 20 db attenuation of frequencies above 50 mc to assure pure, fundamental output. Sweep voltage for 'scopes on front panel. Professional-looking blue-finish steel case with gray panel. Has "disappearing" handle. 8½ x 12 x 7½". With all parts, tubes, test cable, solder and multi-color pre-cut wire. Less crystal. Shpg. wt., 13½ lbs.

Model F-123

$44.75

Model F-123. TV-FM Sweep Generator Kit. Net only **$44.75**
P-286. 4.5 mc Crystal (.005%). Net **$4.80**
P-143. 5.0 mc Crystal (.02%). Net **$3.95**
P-145. 10.7 mc Crystal (.02%). Net **$3.95**

EASY PAYMENT TERMS

If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan—only 10% down. Write for application form today.

ALL PRICES NET F.O.B. CHICAGO

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order from ALLIED RADIO 100 N. WESTERN AVE., CHICAGO 80, ILL.

ALLIED'S *own* knight-kits... *better by far*

knight-kit 5" ALL-PURPOSE WIDE-BAND OSCILLOSCOPE KIT

2 Printed Circuit Boards • 5 Mc Width for Color TV

Model F-144

$69.00

Wide-band, 5" Oscilloscope; equals or betters the performance of commercially-wired 'scopes costing several times the price. Two printed circuit boards and laced wiring harness assure wiring accuracy and reduce assembly time. Ideal for lab use, color TV servicing and high frequency applications. Provides unusually wide sweep range—*from 15 to 600,000 cps.* Locks in at frequencies as high as 9 mc. Vertical response, 5 cycles to 5 mc. Response, down only 1 db at 3.58 mc color burst frequency; down only 3 db at 5 mc. High vertical sensitivity of 25 mv/inch. Input capacity 20 mmf and 3.5 megs. Outstanding features: cathode-follower vertical and horizontal inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull vertical and horizontal amplifiers; positive and negative locking; faithful square wave response; frequency-compensated attenuator; Z-axis input for intensity modulation; one volt P-P calibrating voltage; astigmatism control; blanking circuit to eliminate retrace lines; DC positioning control. Complete with CRT, all tubes and parts. Handsome, professional, blue-finished steel case with "disappearing" handles. 14½ x 9½ x 16". Shpg. wt., 40 lbs.

Model F-144. Wide-Band 5" Oscilloscope Kit. Net only..... **$69.00**
F-148. Demodulator Probe. Net..**$3.45.** **F-147.** Low Capacity Probe. 12 mmf. Net....**$3.45**

NEW knight-kit VOLTAGE CALIBRATOR KIT

Model F-136

$12.75

Permits the use of any scope as a precision peak-to-peak AC voltmeter. Provides a true square-wave voltage on scope screen. Range switch and calibrated potentiometer permit selecting any voltage between .01 and 100 volts, in 4 ranges. Fifth position of switch feeds external signal to scope for comparison. Constant output on line volt. variation from 80-135 v. ±6% on all ranges. Shunt capacitance only 15 mmf. Use any 20,000 ohms/volt VOM or a VTVM for initial calibration. Direct coupling of output provides ground reference for DC scopes. Portable case, 7¾ x 5¼ x 4⅜". Ready to build. Shpg. wt., 5 lbs.

Model F-136. Voltage Calibrator Kit. Net.... **$12.75**

knight-kit LOW COST RF SIGNAL GENERATOR KIT

Model F-145

$19.75

Build this wide-range extremely stable RF signal generator and save two-thirds the cost of a comparable wired instrument. Ideal for alignment of RF and IF stages in radio and TV sets, and for trouble-shooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 110 mc; useful harmonics to 220 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit with precision-wound coils—no calibration necessary. Has input for external modulator. Maximum audio output, 10 volts. RF output, over 100,000 micro-volts. Step and continuous-type output attenuators. With all parts, tubes, wire and solder. Portable case, 7 x 10 x 5". Shpg. wt., 10 lbs.

Model F-145. RF Signal Generator Kit. Net only..... **$19.75**

Model F-135

$26.50

knight-kit VISUAL-AURAL SIGNAL TRACER KIT

A remarkable value in an instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits—*has highest gain in its price class.* Traces the signal from the antenna to the speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of 91,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; single probe with plug-in head gives instant choice of RF or audio tracing. Provides noise test; built-in watt meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Blue-finish steel case. Shpg. wt., 13 lbs.

Model F-135. Signal Tracer Kit. Net only..... **$26.50**

Model F-129

$37.95

NEW knight-kit 6-12 VOLT BATTERY ELIMINATOR KIT

A valuable new unit for servicing auto radios, mobile gear, etc. Delivers continuously variable filtered DC output from 0 to 15 volts. Provides DC output at 0-8 volts or 0-15 volts. Continuous current rating: 12.5 amps at 6 volts, 10 amps at 12 volts. Can also be used as battery charger. Oversize rectifiers and transformer for better regulation and long life. Two meters provide simultaneous current and voltage readings; ranges: 0-15 volts DC; 0-20 amps DC. Doubly protected: fused primary and automatic-reset overload relay for secondary. Heavy-duty binding posts. Blue-finish steel case with "disappearing" handle. With all parts, solder and pre-cut wire. 9 x 12⅛ x 7¾". Shpg. wt., 20 lbs.

Model F-129. Power Supply Kit. Net only..... **$37.95**

knight-kit AUDIO GENERATOR KIT

Model F-137

$37.50

An ideal audio frequency source for checking audio circuits and speaker response. Covers: 20 cps to 1 mc in 5 ranges. Output voltage: 10 volts into 600 ohms impedance. *Offers the flat response of a lab standard*—±1 db to 1 meg. Generator imp., 600 ohms. Less than .25% distortion from 100 cps through the audible range; less than .5% when driving 600 ohm load at maximum output. Cont. var. step-attenuated output. 17 lbs.

Model F-137. Audio Generator Kit. Net only....**$37.50**

knight-kit RESISTANCE SUBSTITUTION BOX KIT

Model F-139

$5.95

Simplifies determination of resistor values needed in a circuit. 36 standard 1 watt resistance values between 15 ohms and 10 megohms with an accuracy of 10%. 18-position switch; also slide switch for multiplying values by 1000. Extra switch wafer serves as tie points, eliminating buss bar. 5 x 3 x 2". Complete with test leads and clips. 2 lbs.

Model F-139. Resis. Sub. Box Kit. Net. **$5.95**

knight-kit CAPACITANCE SUBSTITUTION BOX KIT

Model F-138

$5.95

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard capacitor values from .0001 mfd. to .22 mfd., ±20%. Values are 600 volts, except .15 and .22 which are 400 volt. 18-position switch selects all values quickly and easily. In bakelite case, 5 x 3 x 2". Complete with all parts, test leads and clips. 2 lbs.

Model F-138. Cap. Sub. Box Kit. Net.. **$5.95**

QUALITY ELECTRONIC TEST EQUIPMENT IN MONEY-SAVING KIT FORM

...easiest to build...you get more...YOU SAVE MORE

4½" Meter

Model F-128 **$16.95**

knight-kit

1000 OHMS/VOLT VOM KIT

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4½" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, —20 to +69 in 6 ranges. *Uses 1% precision resistors.* 3-position function switch and 12-position range switch. Complete kit with bakelite case, (6¾ x 5¼ x 3¾"), battery, pre-cut wire, solder and test leads. Shpg. wt., 2½ lbs.

Model F-128. 1,000 ohms/volt VOM Kit. Net only **$16.95**

Model F-140 **$29.50**

knight-kit

20,000 OHMS/VOLT VOM KIT

Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½" meter; accuracy ±2% of full scale; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust" Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-.1-10-100; DC amps, 0-1-10; Decibels, —30 to +63 in 6 ranges. Uses precision 1% multipliers. Moisture-resistant film-type resistors. Complete kit with bakelite case (6¾ x 5¼ x 3¾"), batteries, pre-cut wire, solder and test leads. Shpg. wt., 5 lbs.

Model F-140. 20,000 ohms/volt VOM Kit. Net only **$29.50**

knight-kit VTVM KIT with Printed Circuit Board

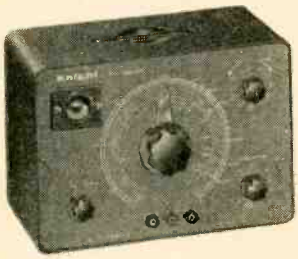
Model F-125 **$24.95** An extremely stable, and highly accurate VTVM. Greatly simplified wiring—entire chassis is a printed circuit board. Maximum convenience in arrangement of scales; 3X AC and DC scale design permits utilization of best portion of each scale for most accurate readings. Also measures peak-to-peak for FM and TV work. Ranges: AC P-P volts, 0-4-14-40-140-400-1400-4000; AC rms volts and DC volts, 0-1.5-5-15-50-150-500-1500; resistance, 0-1000-10K-100K ohms and 0-1-10-100-1000 megohms; db scale, —10 to +5. AC response, 30 cycles to 3 mc. Low-leakage switches and 1% precision resistors. Balanced-bridge circuit. 4½" meter, 200 microamp movement. Polarity reversing switch. Input res., 11 megs. Shpg. wt., 6 lbs.

Model F-125 Printed Circuit VTVM Kit. Net only **$24.95**

F-126. Hi-Voltage Probe; extends DC to 50,000 Volts **$4.75**

F-127. Hi-Frequency Probe; extends AC to 250 mc. **$3.45**

PORTABLE MODEL



Model F-143 **$29.75**

knight-kit LOW-COST TUBE TESTER KIT

Offers high accuracy, top versatility and convenience at lowest cost. Tests 4, 5, 6 and 7-pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. *Features test for new 600 ma series string tubes.* Tests for open, short, leakage, heater continuity and quality (by amount of cathode emission). 4½" square meter with clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 14 filament voltages from .63 to 117 volts. Blank socket for future type tubes. Universal-type selector switches for any combination of pin connections. *Single-unit, 10-lever function switch.* Entire switch assembly is installed as a single unit—saves time and greatly simplifies construction. Illuminated roll chart lists over 600 tube types. Shpg. wt., 14 lbs.

Model F-143. Counter Model Tube Tester Kit. Net only **$29.75**

Model F-142. Portable Model Tube Tester Kit. Net only **$34.75**

F-141. TV Picture Tube Adapter for above. Net only **$3.75**

knight-kit RESISTOR-CAPACITOR TESTER KIT

Model F-124 **$19.50** Measures capacitance and resistance by accurate bridge method; checks for opens and shorts in paper, mica and ceramic capacitors; shows power factor of electrolytics. Large dial shows capacitance and resistance at a glance; balanced-bridge circuit with "magic eye" null indicator measures power factor from 0-50%. Tests capacitors with rated voltages applied. 5 test voltages: 50, 150, 250, 350, 450. Capacity ranges: 10 mmf to 1000 mfd in 5 ranges. Resistance ranges: 100 to 50,000 ohms and 10,000 ohms to 5 megs. Accuracy, ±10%. Automatic discharge feature prevents after-test shock. Blue-finished steel case, 5 x 3 x 2". With tubes and all parts. Shpg. wt., 8 lbs.

Model F-124. Resistor-Capacitor Tester Kit. Net only **$19.50**

Model F-149 **$8.50**

NEW knight-kit TRANSISTOR & DIODE CHECKER KIT

Checks leakage-to-gain ratio and noise level of all junction, point contact and barrier transistors. Also checks diodes, forward and reverse current conduction of selenium rectifiers; useful for continuity and short checks. Easy-to-read meter. Features: spring-return leakage gain switch; calibration control; separate sockets for PNP and NPN transistors. Headphones or signal tracer may be used with checker for noise measurements. Case, 5 x 3 x 2". With 22½ volt battery. 2½ lbs.

Model F-149. Transistor Checker Kit. Net **$8.50**

Model F-119 **$12.50**

knight-kit LOW-COST "IN-CIRCUIT" CAPACITOR CHECKER KIT

Tests capacitors while they are still wired in the circuit! Saves time and bother; an essential instrument for the service technician. Just press a button and the "magic eye" instantly shows opens and shorts (not leakage). Tests opens and shorts on any capacitor of 20 mmf or greater capacity, even if it is in parallel with a resistance as low as 50 ohms. Tests for shorts may be made on any capacitor even when it is shunted by as low as 20 ohms. Blue-finish steel case, 7¾ x 5¼ x 5". With tubes, all parts, wire and solder. Easy to assemble. Shpg. wt., 5 lbs.

Model F-119. Cap. Checker Kit. **$12.50**

EASY PAYMENT TERMS: If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan —only 10% down. Write for application blank.

ALL PRICES NET F.O.B. CHICAGO

ALLIED'S *own* MONEY-SAVING knight-kits

FAMOUS knight-kits FOR HOBBYISTS & EXPERIMENTERS... FASCINATING, INSTRUCTIVE...

knight-kit
"SPACE SPANNER" BAND SWITCHING RECEIVER KIT

Model S-243 **$15.95**

Thrilling Short Wave and Broadcast

Famous 2-band AC-DC receiver in easy-to-build kit form at a very low price. Pulls in thrilling short-wave (6 to 17 mc) and standard broadcast. It's fun listening to amateur, aircraft, police and marine radio. Features highly sensitive regenerative circuit. Bandswitch selects broadcast or short wave. Has 4" PM speaker and beam-power output tube for plenty of volume; headphone connectors for weak signal listening; slide switch cuts out speaker. Uses 12AT7 regenerative detector and audio amplifier, 50C5 power output, 35W4 rectifier. Six controls: Bandspread; Main Tuning; Antenna Trimmer; Bandswitch; Regeneration; Audio Gain. Includes tubes and all parts. 7 x 10½ x 6". Shpg. wt. 4½ lbs.

Model S-243. "Space Spanner" Receiver Kit. Net only..... **$15.95**

S-247. Matching Cabinet for above. 2 lbs. Net..... **$2.90**

Model S-295 **$14.75**

NEW knight-kit TWO-WAY INTERCOM KIT

New low-cost, easy to build intercom system kit. Ideal for use in home or office. Consists of Master unit and Remote unit, each with press-to-talk switch. Remote unit may be left "open" for answering calls from a distance, for "baby-sitting", etc. Remote may also be connected for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier; each unit has 4" PM dynamic speaker. Complete with Antique White cabinets (4¾ x 6½ x 4⅜"), all parts, tubes and 50 feet of cable (up to 200 feet of cable can be added). For AC or DC. Shpg. wt., 7 lbs.

Model S-295. Two-Way Intercom Kit. Net only.. **$14.75**

Model S-740 **$11.75**

knight-kit
"OCEAN HOPPER" RECEIVER KIT

Tops for exciting broadcast, long wave and short wave reception. Highly sensitive regenerative-type circuit. Excellent headphone reception; can be used with 3-4 ohm PM speaker on strong broadcast band stations. Supplied with plug-in coil for standard broadcast; covers long wave and popular short wave bands with coils below. Pulls in thrilling foreign broadcasts, police, amateurs and aircraft. Controls: Main Tuning, Bandspread, Antenna Tuning. Off-On-Regeneration. With all parts and tubes (less extra coils and headset). AC or DC. Shpg. wt., 5 lbs.

Model S-740. "Ocean Hopper" Kit..... **$11.75**

EXTRA PLUG-IN COILS

S-741. Long Wave, 155-470 kc. Net..... 79¢
S-742. Short Wave, 1.65-470 kc.
S-743. Short Wave, 2.9-7.3 mc. } Net each..... 65¢
S-745. Short Wave, 7-17.5 mc.
S-744. Short Wave, 15.5-35 mc.

Model S-735 **$17.25**

knight-kit
"RANGER II" SUPERHET RADIO KIT

Thousands have built and enjoyed the "Ranger" Broadcast Band Receiver. Carefully engineered for easy construction and powerful, sensitive performance. Latest Superhet circuit; tunes 540 to 1680 kc; covers entire broadcast band and exciting police calls. Features automatic volume control, built-in preformed loop antenna, ball-bearing tuning condenser. Develops excellent tone quality from Alnico V PM dynamic speaker. Supplied with following tubes: 12SA7GT converter; 12SK7GT IF amp.; 12SQ7GT det.-AVC-audio; 50L6GT audio output; 35Z5GT rect. Complete with handsome brown plastic cabinet (6 x 9 x 5) tubes, speaker, all parts, and instruction manual. AC or DC operation. Shpg. wt., 8 lbs.

Model S-735. "Ranger II" Superhet Radio Kit. Net only..... **$17.25**

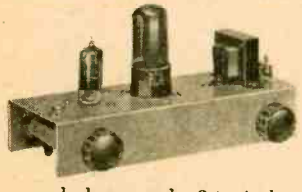
Model S-730 **$19.95**

knight-kit
3-WAY PORTABLE RADIO KIT

A low-cost portable radio covering the full standard broadcast band from 535 kc to 1650 kc. Delivers excellent reception on AC or DC current or from self-contained batteries. Sensitive Superhet circuit features automatic volume control, economical operation. Includes powerful 5" Alnico PM dynamic speaker, efficient ferrite loop-stick antenna. Supplied with following tubes: 1R5 converter; 1U4 IF amplifier; 1U5 detector-AVC-audio; 3V4 audio output. Complete with attractive portable case (7⅝ x 10 x 5¼"), tubes, speaker, all parts and instruction manual. Shpg. wt., 6 lbs.

Model S-730. 3-Way Portable Radio Kit (less batteries). Net. **$19.95**

J-651. Battery Kit for above..... **$2.50**



Model S-790 **$8.95**

knight-kit LOW COST PHONO AMPLIFIER KIT

It's easy to build this fine-performing, low-cost compact phono amplifier. Ideal for use in a portable phonograph—simply add any record player and a 3 to 4-ohm speaker. Amplifier works with crystal or ceramic cartridges. Inverse feedback circuit for rich, clean tone quality. Delivers full 1½-watt output with less than .25 volt input. Includes efficient tone control; has AC outlet, controlled from amplifier switch. Complete with tubes and all parts. Size only 4½ x 7 x 4"—fits into almost any portable phono case. Shpg. wt., 3 lbs.

Model S-790. Phono Amplifier Kit. Net only..... **$8.95**

FAMOUS knight-kit CRYSTAL SET KIT

Model S-261 **$2.15**

Thousands of beginners have started in radio and electronics by building the KNIGHT-KIT crystal set. This feature-packed set delivers loud, clear reception of local broadcast stations. A germanium crystal diode detector assures high sensitivity and simple operation—no crystal adjustment required. "Hi-Q" coil boosts sensitivity. Ball-bearing variable capacitor for easy tuning. With all parts and simple-to-follow instructions. Shpg. wt., 1 lb.

Model S-261. Crystal Set Kit. Net only..... **$2.15**

S-267. Accessory Kit. 2000-ohm headphones and all parts for outdoor antenna..... **$2.95**

Buy with confidence from ALLIED—America's Pioneer in Electronic Kits

finest quality electronic equipment in lowest-cost kit form

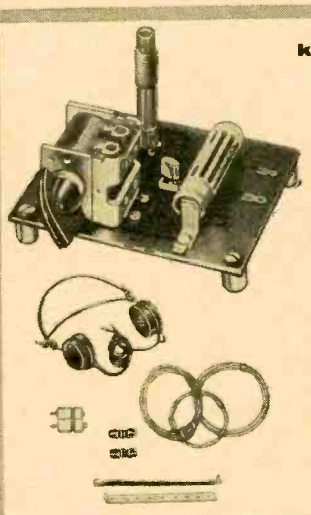
EASY-TO-BUILD HIGH PERFORMANCE KITS • WIDELY USED BY MANY LEADING TRAINING SCHOOLS

NEW knight-kit ELECTRONIC PHOTOFLASH KIT

Model S-244 **$28.50**

New feature-packed photoflash kit—designed for top quality dependability—available at a money-saving low price. Ideal for black and white or color photography. Xenon-filled reflector-bulb assembly gives over 10,000 flashes at less than ½¢ each! 1/700-second flash freezes the fastest action. Has 50 watt-second output. Provides light approximating daylight in spectral quality; permits the use of outdoor-type film indoors. Film guide number for color (ASA10) is 45. Designed for "X" or "O" shutters only. Requires sync cable (available from any photo supply dealer) and either battery or AC supply listed below. Complete outfit with battery weighs only 3½ lbs. Kit includes all parts, carrying case and easy-to-follow instructions. Shpg. wt., 3 lbs.

Model S-244. Electronic Photoflash Kit. Net.... **$28.50**
S-246. AC Power Supply Kit. Easy to assemble.... **$3.75**
J-626. Battery for above (Burgess U-200)..... **$8.47**



knight-kit TRANSISTOR RADIO KIT

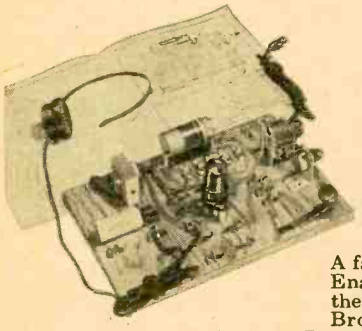
Printed Wiring • Works from Penlight Cell

Model S-765 **$4.35** **Smooth Variable Capacitor Tuning**

Experiment with the marvel of transistors! Printed circuit requires no wiring—just assemble with a few solder connections and enjoy excellent reception over the full AM broadcast band. No tubes to burn out—no crystal. Compact—fits in the palm of your hand—operates for months from a single penlight cell. Transistor provides plenty of power for strong headphone reception. Complete with all parts, transistor and penlight cell. Shpg. wt., 8 oz.

Model S-765. Transistor Radio Kit **$4.35**
S-266. Accessory Kit. 4000-ohm headphones and all parts for outdoor antenna..... **$3.15**

FAMOUS knight-kit LAB KITS

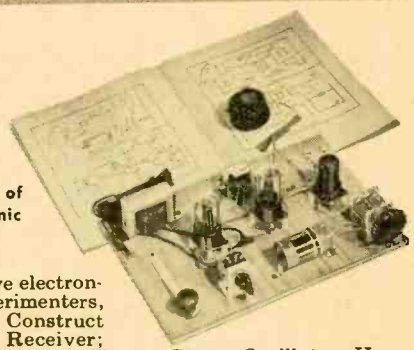


6-IN-1 RADIO LAB KIT

Model S-770 **$7.95** **Build Any of 6 Electronic Projects**

A fascinating and instructive kit. Enables you to build any one of the following projects: Standard Broadcast Receiver; Wireless "Home Broadcaster"; Code Practice Oscillator; Code Practice Broadcaster; Signal Tracer; Sine Wave Generator. Perfect for beginners. Once basic wiring is completed, circuits may be changed without soldering. Safe to build and operate; only tools needed are screwdriver, pliers and soldering iron. The ideal kit for students and beginners in electronics. Kit includes mounting board, tube, all parts and easy-to-follow instruction manual. Less headphone (also serves as mike). Shpg. wt., 6 lbs.

Model S-770. "6-in-1" Lab Kit. Net only..... **$7.95**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna kit for above..... **$1.05**

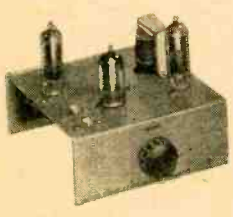


10-IN-1 LAB KIT

Model S-265 **$12.65** **Build Any of 10 Electronic Projects**

A wonderfully instructive electronics kit. Ideal for experimenters, beginners—fun to build. Construct a sensitive Broadcast Receiver; Amplifier (for phono or mike); Wireless Phono Oscillator; Home "Broadcast Station"; Code Practice Oscillator; Capacity-Operated Relay, or any one of *four* other fascinating projects. Low voltages; safe to build and operate. Only tools needed are soldering iron, screwdriver and pliers. Perfect for self-instruction in circuit fundamentals, and packed with practical applications. Kit includes mounting board, tubes, all parts, hardware, microphone, and 12-page builders' manual. Shpg. wt., 10 lbs.

Model S-265. "10-in-1" Lab Kit. Net only..... **$12.65**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna Kit for above..... **$1.05**

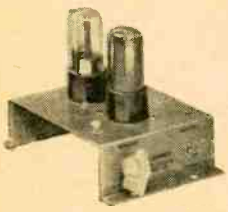


knight-kit WIRELESS BROADCASTER KIT

Model S-705 **$9.50**

This fascinating unit makes it possible to "broadcast" witn phonograph or microphone through any standard radio receiver up to 50 feet away—without any connection to the set. May be used with crystal or magnetic cartridge, or with microphone. Broadcasts a clear, full-toned signal. High-gain stage permits using magnetic cartridge without need for external preamp. Complete with all parts, tubes, wire and solder (less microphone). 4½ x 5 x 6". Easy to assemble. Shpg. wt., 3 lbs.

Model S-705. Wireless Broadcaster Kit. Net only..... **$9.50**
S-556. Microphone for above with 5-ft. cable..... **$3.95**



knight-kit PHONO OSCILLATOR KIT

Model S-760 **$5.85**

This low-cost phono oscillator may be used with any crystal phonograph for "broadcasting" recorded music through any standard radio receiver up to 50 feet away. Requires no direct connection to radio set. Operates on any frequency between 600 and 800 kc. Has controls for adjustment of modulation level and selection of clear frequency on radio receiver. Uses 50L6GT tube and 35Z5GT rectifier. Complete with all parts, tubes and instructions. 4¼ x 4¼ x 4½". Shpg. wt., 1 lb.

Model S-760. Phono Oscillator Kit. Net only..... **$5.85**

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Model S-239 **$3.95** **Transistor Circuit—Powered by Penlight Cell**

An ideal code practice oscillator. Uses transistor circuit. Extremely low current consumption—powered by single penlight battery. Provides crisp, clear tone (400 to 600 cps). Has input jack for earphone; screw-type terminal strip for key. In compact bakelite case (2⅜ x 3¾ x 1½") with anodized aluminum panel. Complete with all parts, transistor, battery and easy-to-follow instructions. Shpg. wt., 1 lb.

Model S-239. Code Practice Kit.... **$3.95**

See Next Page for Amateur Kits

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BASIC 25-WATT LINEAR-DELUXE HI-FI AMPLIFIER KIT

Model S-755

$44.50

Williamson-Type Circuit
Printed Circuit Board
Chrome-Plated Chassis

This super-quality hi-fi basic amplifier is designed to satisfy the most critical listener. Intended for use with tuners incorporating built-in preamp or with separate preamp. Incorporates latest Williamson-type circuit and has potted matched transformers. Delivers maximum output of 45 watts. Frequency response is: ±0.5 db. 10 cps to 120 kc, *measured at 20 watts.* Harmonic distortion is only .15% right up to 30 watts. Intermodulation distortion is only .27% at 10 watts and only .4% at 20 watts, using 60 cps and 7 kc, 1:4 ratio. Hum level is —85 db below full rated output. Output impedance, 4, 8, 16 ohms. Input voltage for 25-watt output is 1.8 volts. Uses two 12AU7's, two 5881's, and a 5V4. Etched circuit is utilized in voltage amplifier and phase inverter stages to speed assembly. Has output tube balancing control, variable damping control, and on-off switch. Handsome chrome-plated chassis, 14 x 9 x 2". Overall height, 7". A deluxe true hi-fi amplifier equal in performance to amplifiers selling at over twice the price. Complete with all parts and tubes. Easy to assemble. Shpg. wt., 27 lbs.

Model S-755. Basic 25 Watt Hi-Fi Amplifier Kit. Net only **$44.50**
S-759. Metal enclosure for above; black finish. 3 lbs. Net $4.25

knight-kit

10-WATT HI-FI AMPLIFIER KIT

Model S-753 — Chrome-Plated Chassis

$23.50

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ±1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Inter-mod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chromed chassis; punched to accommodate magnetic cartridge preamp. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-753. Amplifier Kit. Net ... **$23.50**
Model S-235. Preamp Kit for above ... $3.10
S-757. Metal Enclosure. 3 lbs. $3.95

knight-kit

20-WATT HI-FI AMPLIFIER KIT

Model S-750 — Chrome-Plated Chassis

$35.75

True hi-fi for less! Frequency response, ±1 db, 20-20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono 72 db below 20 watts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records. Built-in Preamp. Outputs: 4, 8, 16 and 500 ohms. 23 lbs.

Model S-750. 20-Watt Kit. Net **$35.75**
S-758. Metal Enclosure. 3 lbs. $4.15
S-752. Chrome-plated escutcheon for cabinet installation of amplifier. Net $1.40

LOW-COST TOP QUALITY KITS FOR THE HAM

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Model S-255

$38.95

50-WATT CW TRANSMITTER KIT

Built-in Pi-Type Antenna Coupler

Check the features packed into this new transmitter kit and you'll see why it's one of the greatest Amateur values ever offered. Compact and versatile, it is the perfect low-power rig for the beginning Novice or seasoned veteran. Features: 50 watts input to 807 final; high-efficiency 6AG7 modified-Pierce oscillator takes crystal or VFO without circuit changes; bandswitching coverage of 80, 40, 20, 15, 11-10 meters; pi-section antenna output matches line impedances from 50 to 1200 ohms —permits use with any type of antenna; no separate antenna tuner required. Crisp, clean, cathode keying of oscillator and final. Power take-off plug supplies filament and B-plus voltages for other equipment. Copper-finished chassis and cabinet interior, filtering, shielding, bypassing, and coaxial SO-239 antenna connector provide excellent TVI suppression. Meter reads either plate or grid current of final. Jacks for VFO, crystal and key. Supplied with all parts and tubes. Less crystal and key. 8⅝ x 11⅛ x 8¾". Shpg. wt., 18 lbs.

Model S-255. 50-Watt Transmitter Kit. Net ... **$38.95**

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SELF-POWERED VFO KIT

Model S-725

$28.50

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread: separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output on 80 and 40 meters. With Spot-Off-Transmit switch for "no swish" tuning. Extra switch contacts for operating relays and other equipment. With all parts and tubes. 8 lbs.

Model S-725. Self-Powered VFO Kit. Net. ... **$28.50**

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AMATEUR RF "Z" BRIDGE KIT

Model S-253

$5.85

Measures standing wave ratio (SWR) and impedance of antenna systems; also for adjusting antenna networks for optimum results. Any VOM may be used for null indicator. High accuracy with 20,000 ohm/v VOM. Correction factor info supplied for other VOM's. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart. 1½ lbs.

Model S-253. "Z" Bridge Kit. Net only **$5.85**

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RADIO

(*Continued from page* 82)

in true cathode-follower fashion, at almost identical voltage level but with increased power at V1-a's cathode. Here the signal current flows through the primary of transformer T2 and induces a stepped-up signal voltage across the secondary of T2. Thus rf amplification is obtained at this point in less space and without the possibility of instability of the more conventional amplifier. V1-a is one half of a double triode 12AU7. Resistor R1 is V1-a's grid bias source; capacitor C2 bypasses R1 to prevent signal loss in the resistor. Transformer T2 is broadly self-resonant across the broadcast band; thus it requires no external tuning capacitor.

Coil L1 is the oscillator tuning coil. It is a Vari-Loopstick with a feedback coil L2 added to provide oscillations. This arrangement was preferred over a ready-made oscillator coil because it permitted the feedback coil to be adjusted easily for optimum conversion sensitivity and minimum harmonic generation. The high Q of L1 and the tight coupling between it and the feedback coil permit normal operation of the converter with but few turns on L2. Thus, the cathode is near ground potential and minimum oscillator voltage appears at the signal grid. Resistor R4, between the oscillator grid of V2 and the tuned circuit, also helps to discourage harmonic generation and, at the same time, maintains the oscillator's rf voltage level more or less constant over the receiver's tuning range.

The output at the plate of converter V2 is impressed across the primary of iron-core if transformer T3, the secondary of which feeds the grid of the second cathode follower V1-b. V1-b is the remaining half of the 12AU7 double triode. Like the previous cathode follower, this one also permits the circuit connected to its grid to operate at maximum efficiency. However, V1-b has an even more interesting and important role to perform in this receiver. The high-transconductance 6CL6 pentode V3 ordinarily oscillates vigorously when it is used as an if amplifier due to its relatively great internal plate-to-grid capacitance.

In the Dynaflex, oscillation in the 6CL6 is prevented in the following manner: There is a certain value of resistance which, when placed between the control grid and ground of the tube in an unstable amplifier circuit, will just prevent the stage from oscillating. Any value of resistance lower than this is so much the better. Suffice it to say at this point that the very low output impedance of cathode follower V1-b—on the order of 500 ohms—is considerably lower than that necessary to stabilize the 6CL6. In fact, the stability of the circuit is so good that an iron-core if transformer can be used to advantage as T4. Feedback between the two sections of the 12AU7 is largely prevented by the grounded plates which act as shields around the elements in the cathode-follower circuits.

The 6CL6 is a high-gain television

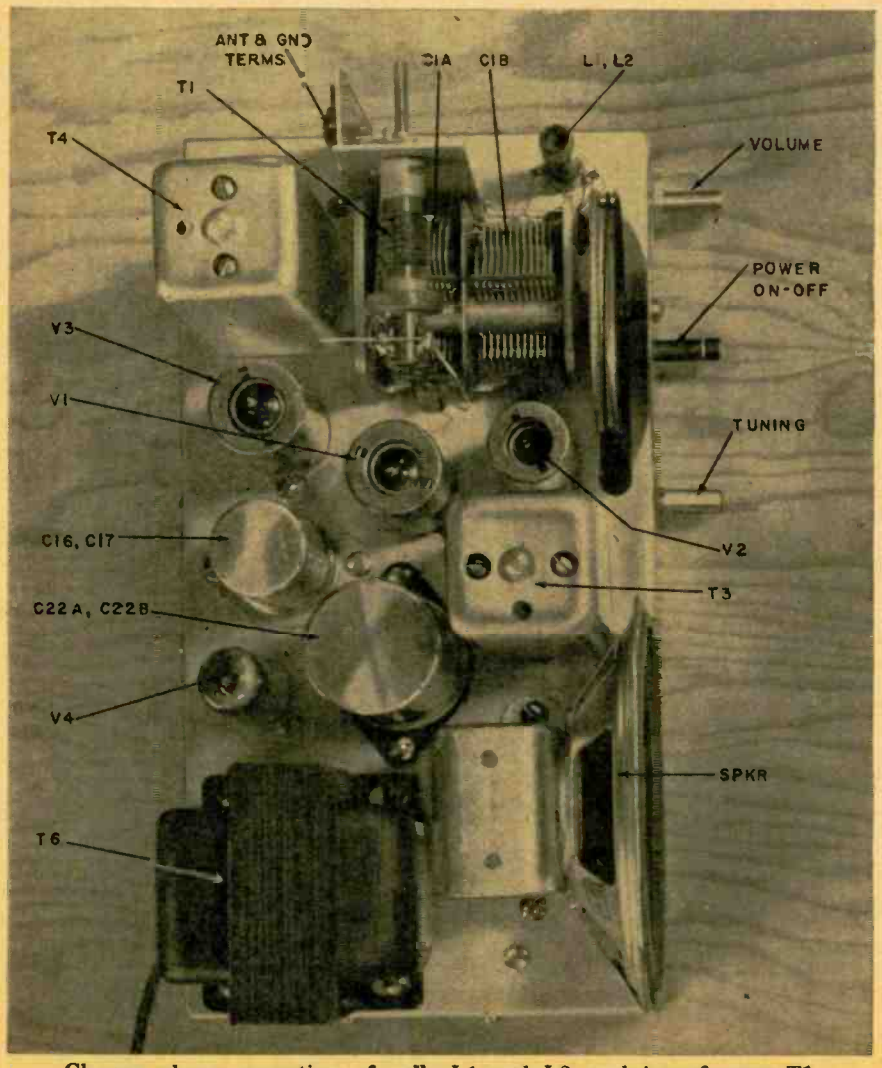
video power amplifier tube. Not only does it make a very effective if amplifier, but its power sensitivity and power-handling ability enable it to perform as an effective combined audio and power amplifier as well. In a straight amplified circuit a single 6CL6 will put out some 2 watts of audio. Approximately ¼ watt is available from the tube in the Dynaflex's reflexed circuit before the audio begins to break up. And ¼ watt of audio fed into an efficient speaker is more than adequate for most home-receiver applications.

A full-wave diode output if transformer is used as T4 and germanium crystal diodes (D1 and D2) perform the dual functions of detection and developing the negative agc potential. Full agc is applied to V2 and about 9% agc is fed to V3 through the combined voltage-divider and diode load resistance (R15 and R16). Audio from the detector is reflexed back into the 6CL6 via capacitor C14, volume control R10 and cathode follower V1-b. Resistors R9 and R19 and capacitors C8 and C20 operated as if filters.

The minimum-volume end of the volume control potentiometer is connected to ground through the secondary of audio output transformer T5 to introduce negative feedback in the audio circuit. This improves audio quality at low- and medium-volume settings of the control and, at the same time, helps to combat the reflexed-circuit phenomenon known as *play-through*. Play-through is the audio which comes from the speaker when the volume control is set at its maximum counterclockwise or normally off position. A certain amount of play-through remains in the Dynaflex, but at a very low level.

Constructing the Dynaflex

The layout of the Dynaflex is shown in the photos, and the assembly of the turret cokets is given in Tables I, II and III, so no space-consuming wiring instructions are needed. Most of the smaller parts mount on the turrets. Anyone who has successfully built and aligned any other superhet should have no trouble with the Dynaflex. Detector diodes D1 and D2 are located very close to the self-resonant rf transformer T2. Ordinarily, this type of layout could be a cause of trouble but, as a result of the inherent high stability of the circuit, all that was needed to prevent overall oscillation of the converter and if amplifier was a small shield of flashing copper between the diodes and T2. The receiver motorboats when the shield is removed.



Closeup shows mounting of coils L1 and L2, and transformer T1.

T2 is connected as an autotransformer. There are four lugs on the terminal board but only three are used. When the transformer is removed from its shield can, it will be seen that two wires are connected to one of the terminal lugs. This would normally be the antenna connection. To use the unit in the Dynaflex just disconnect one of these leads and solder it to the fourth, originally unused lug on the terminal board. This will divide the winding into two separate coils. Measure the dc resistance of the coils and use the one with the lowest resistance as the primary. Connect it in the cathode circuit of V1-a. The secondary will measure

TABLE I—ASSEMBLY OF TURRET V1

Component	Socket Pin	Turret Lug
R1	3	B
R2	1	A
R7	6	C
R11	7	E
R12	8	E
R13	——	E to Ground
C2	3	B
C3	1	Ground
C9	7	F
C10	6	Ground
C11	8	D
Jumper	——	A to C
Jumper	4 and 5 to Ground	
Jumper	Center post lug to Ground	

NOTE: When the turret socket is assembled in the chassis: Connect lug A or C to B plus; connect lug B to the primary of T2; connect lug D to pin 2 of V3; connect lug F to the secondary of T3. Pin 2 on the V1 socket goes to the stator of C1-A, pin 6 goes to plus side of C13.

TABLE II—ASSEMBLY OF TURRET V2

Component	Socket Pin	Turret Lug
R4	1	A
R5	2	A
R6	6	E
R9	——	B to F
C6	6 to Ground	——
C8	——	B to Ground
Jumper	3 to Ground	——
Jumper	Center post lug to Ground	

NOTE: When the turret socket is assembled in the chassis: Connect one end of C5 to lug A; connect lug B to the black lead of T3; connect lug E to B plus; connect lug F to the center terminal of R10.

TABLE III—ASSEMBLY OF TURRET V3

Component	Socket Pin	Turret Lug
R14	9	F
R15	——	F to C
R16	——	F to Ground
R18	3	A
R20	——	C to B
C12	——	F to Ground
C19	1	D
C21	——	B to Ground
Jumper	1 to 7	——
Jumper	4 to Ground	——
Jumper	Center post lug to Ground	

NOTE: When the turret socket is assembled in the chassis: Connect lug A to B plus; connect lug B to one end of R3; connect lug C to the junction of R19 and C14; connect lug D to the red lead of T4 and the blue lead of T5.

about 35 ohms and the primary less than 10 ohms, so it is easy to distinguish between the two. The top lead of the secondary coil—the one originally intended to go to the grid according to the diagram accompanying the transformer—should be connected to the signal grid (pin 7) of the converter.

Dividing the winding into two separate coils increases the resonant frequency somewhat, but using the transformer without its shield can increases its inductance and decreases its resonant frequency so its performance in the Dynaflex is very near that originally intended. Agc bypass capacitor C4 is connected across the transformer's terminal board.

The oscillator coil assembly (LI and L2) is easily made. Remove the length of slack wire from the lower half of the coil form and wind L2 immediately below L1, the coil already on the form. L2 consists of 8 turns of No. 28 enameled wire wound in the same direction as L1. The lead of the L2 nearest L1 is then the one to be connected directly to the cathode (pin 2) of the converter. To prevent the turns of L2 from shifting, cement the coil to the form with a generous application of either polystyrene coil dope or plastic household cement.

Self-bias of 11 to 12 volts is developed at the junction of R4 and R5 when R5 has the specified value of 22,000 ohms. This bias, which can be checked with a vtvm if desired, should remain constant over the receiver's tuning range after the slug in L1 and the trimmer on C1-b have been adjusted to make the oscillator cover the necessary band of frequencies. Thanks to the decoupling afforded by cathode follower V1-a, there is very little if any interaction between the tuning of the oscillator coil and that of antenna transformer T1. The threaded brass rod on the slug of L1 should extend somewhere in the neighborhood of ½ inch beyond the metal end cap of the coil form when the oscillator is properly adjusted.

The plate of V1-b and the screen and cathode of V3 are bypassed for both radio and audio frequencies. A 6CL6 requires only 3 volts of bias, thus the value of 82 ohms is correct for R17, the cathode bias resistor. Because of its compact construction the receiver runs warm when enclosed in the cabinet. The temperature is kept down to a moderate level—about 120°F in an 80° ambient temperature—through adequate ventilation provided by 1⅛-inch diameter holes in the rear and left side panels of the chassis and 1 x 3-inch slots cut through the underside of the cabinet. The cabinet is mounted on four small ⅛ inch thick sponge-rubber discs which act as feet to permit air to flow under the cabinet and up through the two ventilating slots. All components used in the receiver are of the type used in television receivers, for these are capable of operating properly in a rather warm atmosphere. Filter capacitors C22-a and C22-b are rated at 450 volts as an added precaution. The actual level at the output of the filter is 220 volts dc.

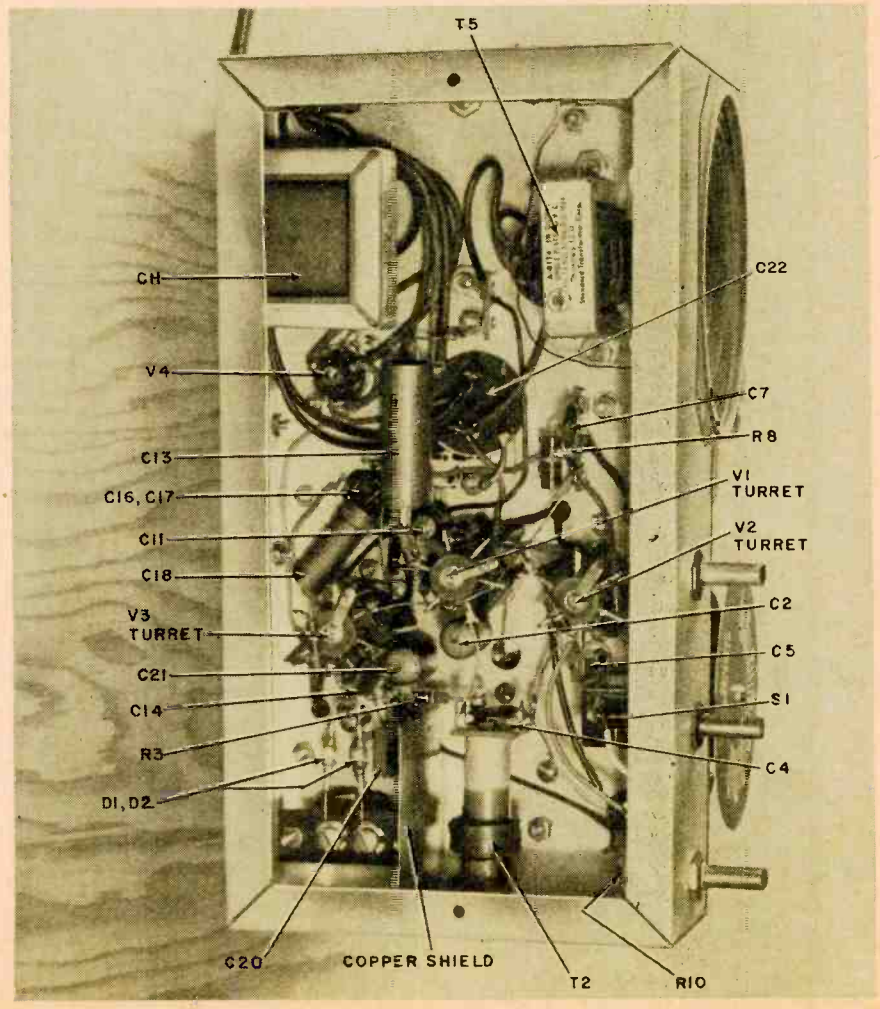
Alignment and operation

The Dynaflex is aligned in exactly the same manner as any other superhet. A 456-kc signal is fed to the lead to pin 7 of the converter and the trimmers on the two if transformers are adjusted for maximum agc measured at the junction of R19 and R20. This is the most accurate method. Entirely satisfactory results will be obtained, however, if a tone-modulated 456-kc signal is fed to the converter and the if transformers peaked for maximum loudness of tone in the speaker. In this case, set the volume control at maximum and keep the rf input signal low enough to make the tone barely audible.

With the if aligned, set the plates of the tuning capacitor fully meshed and feed a 550-kc modulated signal to the antenna terminal of the receiver. Adjust the slug in L1 until the modulating tone is heard in the speaker. Next, fully unmesh the plates of the tuning capacitor, set the signal generator at 1600 kc and adjust the trimmer on C1-b until the tone is again heard coming from the speaker. Go back and readjust the setting of the slug in L1 at 550 kc, then recheck the trimmer on C1-b at 1600 kc. Finally, adjust the slug in T1 at 625 kc and the trimmer on C1-a at 1450 kc for maximum output while rocking the tuning capacitor slightly. Rocking isn't really essential in this receiver but it's a good idea to follow this conventional method of adjustment just in case a small amount of external coupling exists between L1 and T1. If the receiver is to be used in a remote area requiring a 20- to 30-foot antenna, best sensitivity will be obtained if the slug in T1 and the trimmer on C1-a are adjusted with the antenna connected.

If the receiver breaks into oscillation and howls over the lower portion of the setting of the volume control, it is an indication that positive rather than negative feedback is being obtained through audio output transformer T5. The condition can be cured by reversing the secondary lead connections of the output transformer. If the volume control is advanced too far when receiving a strong station, the audio will tend to break up or "burble." This is characteristic of most reflexed receivers. However, the audio from the Dynaflex is more than comfortably loud before this condition sets in.

The drum type tuning capacitor gang was found on a bargain counter, and this appears to be the best source since such capacitors do not seem to be any too easily available elsewhere. If a drum type gang isn't available, the tuning knob and a pointer can be attached directly to the capacitor shaft. END



Underchassis view—note how turret type sockets permit extreme compactness.

Superior's New Model TD-55

TUBE TESTER

FOR { The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

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

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

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

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

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

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

$26.95 NET

Superior's New Model TW-11 STANDARD PROFESSIONAL

TUBE TESTER

● Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-miniatures, 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 standard 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 standard 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.

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Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

TESTING TUBES

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

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

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

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

TESTING TRANSISTORS

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

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

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

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USE APPROVAL FORM ON NEXT PAGE

Superior's New Model TV-60

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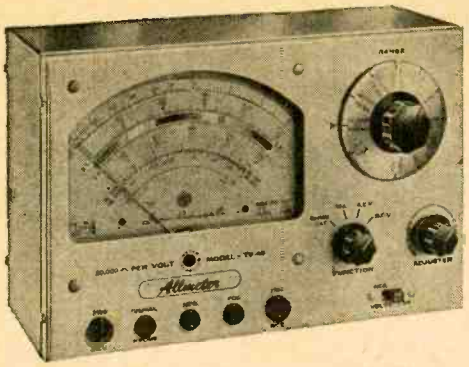


Includes services never before provided by an instrument of this type.

Read and compare features and specifications below!

FEATURES

- ✓ A sensitive, accurate Volt-Ohm-Milliammeter with *giant* meter and *mirrored* scale.
- ✓ An accurate direct-reading Capacity meter.
- ✓ A Kilovoltmeter.
- ✓ An R.F. Signal Tracer.
- ✓ An Audio Signal Tracer.
- ✓ Giant recessed 6½ inch 40 Microampere meter with *mirrored* scale assures accuracy and easy-reading. All calibrations are printed in large easy-to-read type. Fractional divisions are easily read with the aid of the mirrored scale.
- ✓ The line cord, used only when making Capacity measurements, need be plugged in only when using that service. It is out of the way, stored in its pliofilm compartment at all other times.
- ✓ A built-in Isolation Transformer automatically isolates the Model TV-60 from the power line when the capacity service is in use.
- ✓ Selected, 1% zero temperature coefficient metallized resistors are used as multipliers assuring *unchanging* accurate readings on all ranges.
- ✓ Use of the latest type of *printed circuit* guarantees maintenance of top quality standard in the production runs of this precise instrument.
- ✓ A new *improved* type of high-voltage probe is used for the measurement of high voltages up to 30,000 Volts. This service will be required when servicing color TV receivers.
- ✓ Simply plug-in the R.F. probe and convert the Model TV-60 into an efficient R.F. SIGNAL TRACER permitting the measurement of stage-gain and cause of trouble in the R.F. and I.F. circuits of A.M., F.M., and TV receivers.
- ✓ Plug in the Audio probe and convert the Model TV-60 into an efficient AUDIO SIGNAL TRACER. Measure the signal levels and comparative efficiency of hearing-aids, public-address systems, the amplifier sections of Radio & TV receivers, etc.

SPECIFICATIONS

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.

7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.

2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES: —6 db to + 58 db

R. F. SIGNAL TRACER SERVICE:

Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE:

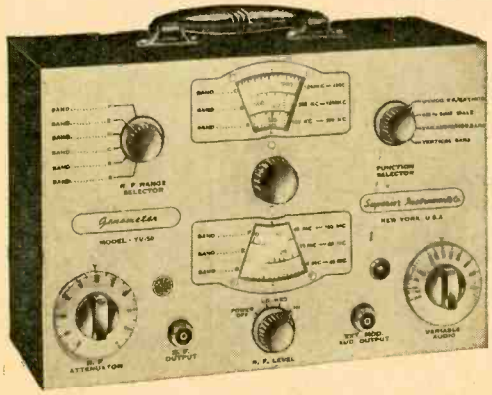
Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe, Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. Only

$52.50 NET

Superior's New Model TV-50

GENOMETER



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- ✓ 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.

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.

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THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only .....

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new Records

MONITOR

AARON COPLAND: ***Music for Radio***
Music for Movies
Music for the Theatre
Arthur Winograd and Izler Solomon and MGM Chamber Orchestra
MGM E-3367

My old readers know that I'm fond of Copland's music for test purposes. I can recommend this disc highly; even its faults are very useful. Copland's highly individual chording, his flirtation with dissonance and his highly unusual choirs and coupling of instruments present here, as in his other works, almost incomparable material for testing definition and distortion. If your system is really good, the sound (with exceptions noted below) may grate on your musical sensibilities but never on your physical ears. If it is actually painful to the ear, it is because your system is distorting the original material. On a really good system the unusual sound, the novel musical texture and the original tonalities should be entirely clear and capable of analysis. In any case, once one has become familiar with the detail on a fine system, there is material here to measure and test for almost any audible quality.

The bass is very fine and really terrific in the opening of *Movies*. There is plenty of opportunity to distinguish between the bass of viols, piano, drums and horn, for there are outstanding examples of each, including a short bass viol solo in the *Burlesque* section of *Theatre*. The brasses have a Bronx cheer raucousness in several spots. The music gives a good sampling of Copland's evolution, for the three pieces were composed between 1925 and 1942. There is a marked difference in acoustics between *Radio* and the other two pieces. *Radio* has considerable distortion in spots plainly recognizable in contrast to the cleanness of the other two. In *Theatre* there is a deep underlying rumble—perhaps air conditioning or tape flutter; in *Radio* there is a hum at least one and possibly two octaves higher.

WILLIAMS, VAUGHN: ***Fantasia on Greensleeves***
The Wasps
Fantasia on a Theme by Tallis
Boult conducting the Philharmonic Promenade Orchestra
Westminster W-Lab 7048

This is perfection in recording of its type but, considering the shortness of the works, rather expensive perfection. In *Greensleeves* that familiar and still lovely melody receives a beautiful orchestral treatment. *The Wasps* is very pleasant, has big and yet delicate drums and fine waspish buzzing. The *Fantasia on a Theme by Tallis* has a strong but not overwhelming bass and will present a severe test for wow; in fact, if your turntable is at all "wow-y," don't waste your money. Nothing spectacular, but a just about perfect job of performing and recording three very pleasant works.

LISZT: ***Hungarian Rhapsodies***
Alexander Brailowsky
RCA-Victor LM-6038 (two 12-inch LP's)

Here are all 15 of the piano versions of these favorite works. There are more fiery and bravura performances of some of them, but these are authentic and faithful enough. The recording of the piano is excellent.

Cook's Tour of Spain
Jose Valdes and his Ambassadors
Vox 25140

By far the best of the Cook's Tour series from a hi-fi standpoint and indeed would be absolutely topnotch except that (like almost all pops) it is needlessly overcut in spots and will rattle many pickups, including some of the very finest. The music is authentically Spanish and the recording provides a variety of Spanish transients, including plenty of flamenca heel tapping, finger snapping, hip slapping and foot stomping, all nicely recorded. It has a nice live presence and with the exception of the overcut distortion on a few peaks produces a very fine sound.

VIVALDI: ***Four Concertos and Two Sinfonias***
Solisti di Zagreb
Vanguard BG-560

Bach *afficionados* like myself will find the two concerti beautifully played and recorded. The triple concerto resembles the Brandenburg concerti (especially the fifth). The double concerto is a "reconstruction" of the version for two harpsichords. In any event both are very well done. The woodwinds are very fine and the strings are quite superb. The second movement of the triple concerto has a very delicate middle bass *continuo* of very low amplitude—almost as if somebody were humming under his breath—which should offer a very interesting test for wow, noise level and rumble.

The Vivaldi works share the very fine sound and performance. The bassoon concerto was especially delightful to me. Either of these has presence enough to bring the chamber orchestra right into a livingroom, provided it is well enough furnished with the fine speakers.

Intermission at the Mosque
Reginald Foorte at Mosque organ
Cook 1059X

Waltz and Ballet
Reginald Foorte at Mosque organ
Cook 1058

Previous recordings by this pair of man and instrument won well deserved popularity, especially at audio fairs; but these make the previous ones look pale and puny by comparison. 1059X is probably the finest recording of the organ pedal and 1058 isn't far behind. The superiority is principally in the cleanness and definition of the pedal bass. But on the 1059X the superiority is also in the amplitude which is advertised to offer an "extreme never before put on a commercial pressing" to "reproduce actual amplitudes of full organ pedal tones when played back on *equipment of the highest technical excellence.*" The final phrase is important because on anything less this is likely to be the most highly disillusioning recording of recent months. Very few pickups will track the pedal, and if there are more than a hundred speaker systems capable of living up to the intention in the whole wide world, I'd be very surprised. But on them that can deliver, the owner can bring a

$50,000 two-story organ right into his living-room.

The pedal is heaviest in *Laura, Blue Moon, Canadian Capers* and *Doll Dance* but is awe-inspiring (and house-shaking) throughout. There are some terrific peaks and the one in *Canadian Capers* will probably overdrive just about any system somewhere in its chain. *Deep Purple* presents an excellent test for intermodulation distortion with a good pedal under sustained middle and high basses. Don't try this one at all if you have any rumble—it will muddy up the pedal. *Waltz and Ballet* has the same pedal definition but with a somewhat less taxing amplitude and is likely to do better on the run-of-the-mill hi-fi outfit. The music on it is "popular classic" (eg, several sections of the *Nutcracker Suite*). The pair makes a nice addition to the organ section of the record shelf.

Fly—don't walk or run—to your nearest Westminster dealer and pick up at least one and preferably all three of the following samplers. If they aren't the biggest bargain in high fidelity, they'll do till the millennium comes along. Together they give you as nice a collection of superbly recorded, highly spectacular demonstration and test material I know of. All three share one very uncommon characteristic: very fine, perhaps the finest, bass definition I have heard. It would be impossible to cover all the notable features and there isn't too much to choose from between the *Classical Sampler* and the *Lab Sampler*.

Westminster Classical Sampler

Westminster XWN S-1 ($1.98)

Here are eight complete selections ranging from the second *Hungarian Rhapsody* to the *Waltz of the Flowers*, including a spectacular *Marche Slav*, a fine *William Tell Overture*, *Blue Danube*, *Danse Macabre* and *In the Halls of the Mountain King*. The bass is remarkable throughout and includes samples of every variety except the pedal organ and with, I repeat, superb definition. The string basses are sharp, gutty and dull of house-vibrating amplitude in spots. In *William Tell* there is a very big, very low drum, and it appears also in other spots. There are plenty of clean, sharp high highs as well. The presence is good throughout but especially marked in the *Danse Macabre*. The overall sound is mouth-watering on a first-class system and will be impressive as well as on lesser systems.

Westminster Lab Sampler

Westminster W-Lab S-1 ($2.98)

This has only five selections: *Light Cavalry Overture*, *Allegretto* from Haydn's *Military Symphony*, *Prelude to Carmen*, *Espana Rhapsodie* and *Ride of the Valkyries*, but these reflect just about the best of Westminster's lab quality. The final half of the *Allegretto* of the *Military Symphony* is one of the most spectacular demonstration pieces there is and has an incomparable definition in the bass, which incidentally is almost terrifying in its naturalness both in tone quality and in amplitude. All five selections are really superb and have the additional virtue of having musical appeal to almost anybody you can think of.

Westminster Pop Sampler

Westminster WP-S-1 ($1.98)

Though this is labeled *pop* it is not entirely pop song and dance. It includes a selection by the Deutchmeister Brass Band (wonderful big drum), an organ version of the lovely *Greensleeves* air and a semiconcert can-can, as well as some Hungarian wine-hall music and some American jazz, by band and organ and prepared pianos. The lot gives a fine and very-much-worth-listening-to variety of musical effects. Again we have excellent dull drums and bass, especially in *Caravan*, a fine theater organ pedal bass in a clever arrangement of *St. Louis Blues*, and in contrast the more highly damped pedal of a Hammond in *Limehouse Blues* and a delicate, nicely defined pedal in the version of *Greensleeves*. There is a piano duo with normal pianos and one selection of the prepared pianos from *Soundproof* (see below). There are also slapping guitars, fine string tone and an assortment of highs. —END

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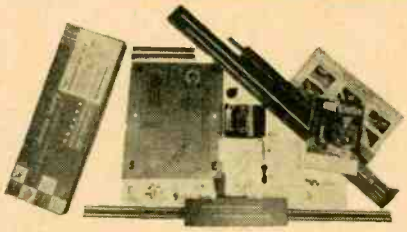

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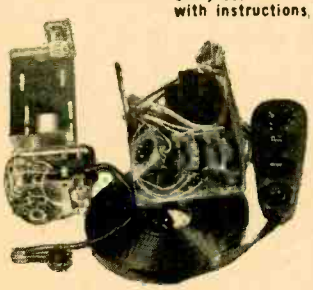

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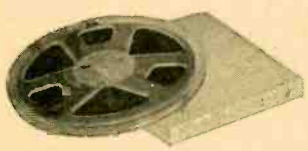

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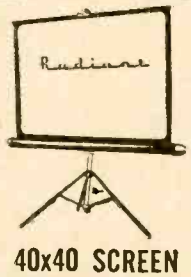

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UNHEARD-OF for $3.99! PLUS features are 1-year guarantee, all metal construction, ground and polished achromatic lenses, triple objectives. Ship. 3¼ lbs.

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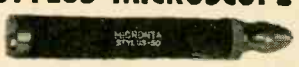

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- ★ For COLOR SLIDES
- ★ F3.5 LENS

$75 Value **$27.50**

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Projects a direct view image onto its self-contained 5⅝" sq. ground glass screen. Projects COLOR slides onto any light colored wall. Sharp focus 10 ft. sq. picture. The size of your wall is the only limit to the size of MICRONTA-VUE's picture! Semi-automatic 36 slide changer. Efficient convection cooling. Finest optical parts. F/3.5 lens. All-metal portable carry-case; 7x10x3½" D. Weighs only 4 lbs. With 100 Watt bulb, line cord, instructions. For 115V AC-DC operation. Ship. wt. 5 lbs.

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SEE ORDER BLANK ON LAST PAGE →

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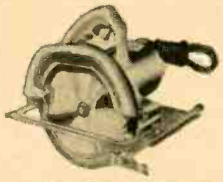
4 Pages of Mail-Order Bargains

SALE! RCA 45 rpm SLIDE-O-MATIC

FAMOUS MAKE 7" POWER SAW

1¼ hp



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Nationally-famous electric saw features FULL 8 AMPS, 5000 rpm saw arbor speed, helical drive gears, retractable saw guard, power cord at 45° angle. Operating controls are at rear of saw; air-stream blows dust away from saw line. A $60-$70 value in everyone's book. Ship. wt. 12 lbs.
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Reg. $12.95

$5.99

- Drop Forged
- Chrome Plated

Magnificent set includes: End Nipper, Diagonal Cutter, Round Nose, Flat Nose, Half-round Flat Nose. Has our Skilman brand. Ship. 1½ lbs.
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PRECISION MICRONTA LOG-LOG SLIDE RULE!

$25.00 Value

$11.95

Standard-size! Features 18 different scales. Graduations engraved in ivory-finished veneer body. Includes leather case. Ship. lb.
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POWERFUL GE 6 RPM DISPLAY MOTOR KIT

Worth $11.95

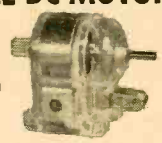
$3.95

Designed to continuously operate a 30 lb. load on GE's famous revolving shelf refrigerator. Can be adapted to serve a hundred useful functions in display work, hobby and industrial applications. Consists of very heavy duty AC synchronous motor with reduction gear assembly to 6 rpm, 2-3¼" pulleys with spring belt drive, line cord and light socket AC adaptor. Brand new packed in original GE Box. Ship. wt. 6 lbs.
Order Item D-4 .....**$3.49**

WILSON "TINY ATOM" REVERSIBLE DC MOTOR

Has Clear Plastic Case

Reg. $2.50 **$1.49**



Operates from 1 or 2 flashlight batteries. Ideal for model builders, hobbyists. Precision construction. Alnico V field. Brass sleeve bearings. Speeds from 3500 to 9200 rpm. Instantly reversible. Ship 4 oz.
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POWER DRIVE ACCESSORY KIT
Contains all the necessary parts for belt, direct connected, spur gear, and worm drives at a wide range of speeds. Hundreds of hard-to-get power drive parts. Wt. 2 lbs.
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$14.00 Value **$7.75**

Deluxe set of nickel-plated brass drafting instruments in velvet-lined case. Self-centering style construction. Ship. 1½ lbs.
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REMOTE CONTROL MODEL BOAT!

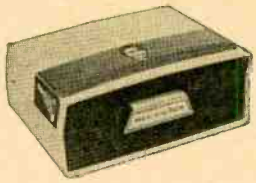
Remote Control Functions:
- Forward
- Reverse
- Left Rudder
- Right Rudder
- Running Lights

$7.99

Battery-Powered

WORTH $35.00 — 2-seater motor boat has all functions controlled by hand-held R/C unit. Built to scale of lightweight woods. Hand made and lacquered. NOT A KIT, but a 15½" long, 5" wide fully wired boat. Uses 3 standard flashlight batteries. Waterproof control cable. 4 lbs.
Order Item D-8 .....**Complete $7.99**

RCA "Victrola" Super-Sale



Reg. $14.95 **$6.99**

- Slide in 45rpm Disk
- Starts Automatically
- Stops Automatically
- For all the Family
- Safe for Children

Below DEALER cost at Radio Shack! Compact 4⅛" x 7⅝" x 10⅞", fully hi-impact plastic encased, has Miss Francis decal. Automatic single-play operation: slip in any 45 rpm disk, flip up Play Bar, concealed arm descends and disk starts automatically; stops automatically after playing! Plug into any amplifier, any radio or TV with phono input. Complete with AC plug, phono cord, RCA guarantee, in orig. Victor carton. Ideal for kids — they can't get at arm or motor, can't damage disk, can't get hurt — everything's enclosed. Sold everywhere for $14.95, it's over 50% off at Radio Shack. Ship. wt. 7 lbs.
Order Item D-9 .....**$6.99**

POWER SUPPLY KIT 400 VDC @ 150 MA.

$9.95 Worth $25.00

A complete sell-out the last time we advertised this great power supply kit! Designed for continuous operation at 400 VDC-150 MA with less than ½ of 1% ripple! Excellent regulation. Makes an ideal power supply for Williamson-type amplifiers and other equipment. Kit includes metal encased power transformer, 400-0-400 @ 200 ma., 5 V. @ 4 A., 6.3 V @ 5.4 A. 2-8 mfd. @ 600 VDC oil filled capacitors, 7 henry @ 150 ma open cased choke. 5T4 rectifier, 100 W. bleeder, line cord, switch, socket and 7x12x3" chassis. Complete with schematic and chassis layout. Ship wt. 18 lbs.
Order Item D-10 .....**$9.95**

COLUMBIA SALE!

22-RECORD 45-RPM PACKAGE—WORTH $20
With 2 45-EP Discs

$3.95

Famous Artists:
Frankie Laine
RoseMary Clooney
Buck Clayton
And Others!

20 Different hit-tune, jazz and other hi-fi 45 rpm discs featuring top Columbia artists! Sale has BONUS of 2 (Reg. $1.49 ea.) Columbia 45-EP discs! Ship. 3 lbs.
Order Item D-11 .....**Sale $3.95**

BACH'S MASS IN B MINOR

Reg. $11.90 **$4.99**

COMPLETE on 2 fabulous hi-fi VANGUARD 12" LP records in an album featuring the complete text in English and Latin. Ship. 2¼ lbs. **Order Item D-12**

RADIO SHACK CORP. 167 Washington St. Boston 8, Mass.

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	A-2			B-5			C-9	
	A-3			B-6			C-10	
	A-4			B-7			C-11	
	A-5			B-8			C-12	
	A-6			B-9			D-1	
	A-7			B-10			D-2	
	A-8			B-11			D-3	
	A-9			B-12			D-4	
	A-10			B-13			D-5	
	A-11			C-1			D-6	
	A-12			C-2			D-7	
	A-13			C-3			D-8	
	A-14			C-4			D-9	
	B-1			C-5			D-10	
	B-2			C-6			D-11	
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FREE RADIO SHACK 1957 CATALOG

RADIO SHACK
167 Washington St., Boston, Mass.

ABBREVIATIONS and Symbols

By CHARLES S. KIMBALL

(Continued from January, page 151.)

Q

Q	—The quantity of electricity in coulombs.
	—Ratio of reactance to resistance of coil.
	—A three-letter abbreviation system in which each abbreviation starts with the letter Q. An international system used in telegraphy.
	—Band of radar frequencies from 35,000–45,000 mc.
	—Impedance-matching arrangement for feeding nonresonant antenna by untuned transmission line.
QAVC	—Quiet avc.
QCW	—QCW signal: quadrature-phase subcarrier signal.
QPP	—Quiescent push-pull (amplification).
QUAD	—Quadrant.
	—Quadrature.

R

R	—Resistance.
	—A resistor.
	—In mathematics, radius, ratio.
	—In physics, gas constant.
RACMD	—Radio Countermeasures and Deception.
RADAR	—RAdio Direction And Ranging.
RADIAC	—Radio-Activity Detection, Identification And Computation.
R-C	—Resistance–Capacitance.
R/C	—Radio controlled.
	—Remote controlled.
RCDR	—Recorder.
RCDG	—Recording.
RCM	—Radar Counter Measures.
Rcvr	—Receiver.
RDF	—Radio Direction Finding (Finder).
RECT	—Rectifier.
REG	—Regulator.
regen	—Regeneration.
REP Unit	—Roentgen equivalent physical Unit. (X-ray).
rf	—Radio frequency.
RFC	—Radio frequency choke.
RFT	—Radio-frequency transformer.
Rho (ρ)	Greek letter for:
	—Resisitivity.
	—Resistance.
RHI	—Range height Indicator (radar).
RMI	—Radio magnetic indicator.
rms	—Root mean square.
rpm	—Revolutions per minute.
rps	—Revolutions per second.
RT	—Receiving terminal (radio).
RTB	—Range and true bearing (Radar; I-Scan presentation).
RTTY	—Radio teletype or teletypewriter.
RX	—Receiver (radio).
Ry	—Relay.
	In vacuum-tube terminology:
R_{g_1}, r_g	—Grid resistor.
R_k	—Cathode resistor.
R_e	—Plate load resistor.
R_s	—Series screen resistor.
r_{g2}	—Screen grid resistor.
r_{in}	—Input resistance.
r_{out}	—Output resistance.
r_p	—Plate resistance.

S

S	—Photocell sensitivity.
	—Secondary winding of transformer.
	—Switch.
	—In radio, letter designation for meter (S-meter) that indicates strength of received radio-frequency signal.
	—Band of radar frequencies extending from 1550 to 5200 mc.
	—U. S. Navy prefix (obsolete) to designate shipborne search radar. Example: SU-1.
SAM	—Surface-to-air missile.
Scapp	—Speech-clipper amplifier phone patch (radio).
scc	—Single cotton covered (wire).
sce	—Single cotton enameled (wire).
SCI	—Ship Controlled Interception (radar).
SCR	—U. S. Army (obsolete) prefix for Signal Corps radio and radar equipment. Example: SCR 584.
SD	—Simplex dropout (telephony).
SEC	—Secondary.
SEL (RECT)	—Selenium (rectifier).
SEP	—Separator.
SG	—Screen grid of a vacuum tube.
SHA	—Sidereal hour angle (Navigation).
SHF	—Super-high frequency (band).
SHM	—Simple harmonic motion.
Shoran	—SHOrt RAnge Navigation.
SIF	—Sound intermediate frequency (TV).
	—Selective identification feature (radar).
Sig	—Signal.
SIG GEN	—Signal generator.

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ABBREVIATIONS *(Continued)*

Sigma (Σ, σ)	Greek letter symbol for: —In mathematics, summation (capital). —Surface charge density. —Complex propagation constant. —Electrical conductivity. —Coefficient of leakage.
SLC	—Search light control (radar).
S/N	—Signal-to-noise power ratio.
SOF	—Sound on film
spdt	—Single pole double throw (switch).
SPKR	—Speaker.
spst	—Single pole single throw (switch).
SSB	—Single sideband (radio).
ssc	—Single silk covered (wire).
sse	—Single silk enameled (wire).
SSFM	—Single sideband FM (radio).
SSM	—Surface-to-surface missile.
SSPM	—Single sideband phase modulation.
SSV	—Ship-to-surface vessel (radar).
Stat	—Prefix used in names of electrostatic units.
STC	—Sensitivity time control (radar).
Strob	—Stroboscope.
SUM	—Surface-to-underwater missile.
Sup	—Suppressor grid of vacuum tube.
Superhet	—Superheterodyne (radio).
SW	—Shortwave. —Standing wave. —Switch.
SWI	—Shortwave interference.
SWL	—Shortwave listener.
SWR	—Standing-wave ratio.
sync	—Synchronism. —Synchronize. —Synchronous.
	T
T	—Trimmer. —Type of pad or attenuator. —Time required for completion of 1 cycle at given frequency. Period of that frequency. —Radar transmission-line junction. —Impedance matching arrangement for feeding center-fed half-wave resonant antenna with balanced open-wire transmission line. —In electronic circuits, transformer.
T_0	—In graphic presentation, symbol for time zero, or start of time base.
T_1	—In graphic presentation, beginning of first time interval after T_0. Similarly, T_2, T_3.
TACAN	—TACtical Air Navigation.
Tau (T, τ)	Greek letter symbol for: —Time constant. —Volume resistivity. —Phase displacement. —Transmission factor. —Density.
TC	—Time Constant.
TE	—In waveguide propagation, transverse-electric waves; sometimes called H-waves.
TELERAN	—TELEvision and RADAR Navigation (Air navigation and traffic control).
TELEG	—Telegraph.

TO BE CONTINUED

Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electric	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

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

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

Radio Controlled Mystery Ship, by Graser Schornstheimer, U.S.N.

Motion Pictures Via Radio, by Joseph H. Kraus.

Simplest Radiophone Receiver Contest, Honorable Mention Awards.

New and Odd Uses for Audion Amplifiers, by H. Winfield Secor.

Novel "Basket Weave" Coil Winding, by C. O. Walters.

Unique Indoor Aerial, by Rudolf F. Kahn.

How to Mount a Directional Loop Aerial, by C. F. Bohlig.

Radio for the Beginner, No. 12—Selectivity, by Armstrong Perry.

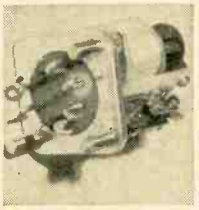
new Devices

REPLACEMENT PARTS. *Stancor Flyback A-8285* duplicates Capehart's 850285E-/D-1. For

use in 8 chassis and 38 models. *Stancor DY-21A* replaces RCA original deflection yoke part Nos. 76653, 78278, 971387-3, 971744-1 in the KCS68 and KCS81 chassis.—**Chicago Standard Transformer Corp.**, 3501 W. Addison, Chicago 18, Ill.

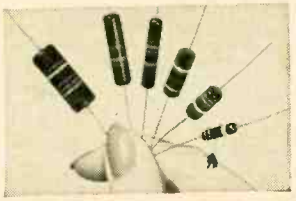
MINIATURIZED CERAMIC CAPACITORS for facile replacement on crowded transistorized chassis. Tough, moistureproof coating protects against short circuits, humidity and vibration. From .005–0.1 μf, 50 volts dc.—**Sprague Products Co.**, North Adams, Mass.

VG RELAY SERIES. Vibration rating at 15 g's from 55–2,000



cycles, shock rated at 100 g's. Temperature range −65°C to 85°C. Subminiature, less than ¾ cubic inch, 1.3 ounces, with dpdt contacts. 24–29 volts dc. —**Elgin National Watch Co.**, Elgin, Ill.

MOLDED PVZ CAPACITOR. For computers, missiles, telephone equipment and other



high-grade military and commercial gear. From −55°C to 125°C without voltage derating. Nine sizes available in 100-, 200-, 300- and 400-volt ratings. From .00047 to .022 μf in 400-volt range, from .00047 to 0.15 μf at 100 volts.—**General Electric**, Schenectady, N. Y.

RESISTOR. For use in test equipment, meters and high-frequency circuits. Layer of pure carbon deposited on a ceramic rod. Expansion-fitted,

silver-plated end caps. Non-hydroscopic ceramic tube encasing. Hermetically sealed with high-temperature solder. Fully insulated. Conforms to MIL-R-106509B spec. ¼-, ½-, 1- and 2-watt sizes. Tolerance ±1%, ±2%, and ±5% can be ordered. — **Continental Carbon**, Div. of Wirt Co., 13900 Lorain Ave., Cleveland 11, Ohio.

RESISTORS, *Vamistor. Models 9851, 9852 and 9853* from 0.5 to 1 watt. Special resistance alloy

fused into inner surface of moisture-sealed ceramic tube to create glass-hard resistance element to withstand abrasion, thermal shock and temporary overloads. — **Weston Electrical Instrument Corp.**, 614 Frelinghuysen Ave., Newark 5, N. J.

VIBRATOR, *series 1600.* Eliminates usual button contacts.

Vibrating reed and side arms made of special contact alloy act as contacting elements.—**P. R. Mallory & Co., Inc.**, 3029 E. Washington St., Indianapolis 6, Ind.

MAGNETIC TUBE GUIDE. For easy, quick insertion of 7- and

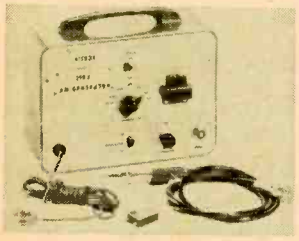
9-pin tubes in blind areas. Ceramic magnet with pull of 10 pounds.—**Altron Products**, PO Box 9038, Long Beach, Calif.

ANTENNA, *Ground-Master.* Like trellis; can be covered with climbing flowers or vines. Aluminum. Special covering on active

(Continued)

elements against moisture. 36x 72 inches.—**Trio Manufacturing Co.**, Griggsville, Ill.

AM GENERATOR, *model 290X.* 5 calibrated frequencies. Rf output modulated or unmodulated and variable from 2 to 200 mv.

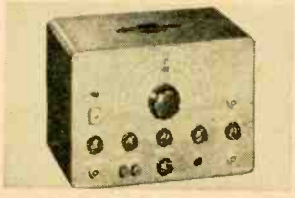


400-cycle audio output. Add crystal in special holder for peak accuracy. Instructions on back of case, test leads.—**Hickok Electrical Instrument Co.**, 10531 Dupont Ave., Cleveland 8, Ohio.

OSCILLOSCOPE KIT, *model OM-2.* Push-pull deflection amplifiers. Etched circuits in critical parts. 5BP1 C-R tube. External or internal sweep and sync, 1-volt peak-to-peak reference voltage, 3-position stepattenuated input and adjustable spot-shape control. Calibrated grid screen for face of C-R tube. Flat vertical response to over

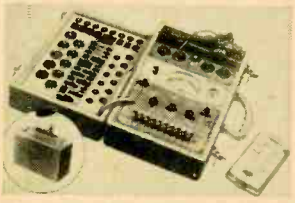
1 mc, down 1½ db at 500 kc. Sweep-generator multivibrator from 30 to 200,000 cycles.—**Heath Co.**, 305 Territorial Rd., Benton Harbor, Mich.

RF SWEEP GENERATOR KIT, *88YX 123.* Electromechanical wobbulator system. 300 kc to 250 mc on four fundamental ranges. Sweep variable from 0–13 mc. Agc keeps output voltage constant within 1 db throughout range. Crystal-controlled marker accommodates any two crystals; can use external marker. Rf sweep output in excess of 0.15 volt adjustable by step type and continuously variable output attenuaters. 5-volt, 60-cycle sinewave horizontal sweep voltage



for scope synchronization. Horizontay retrace blanking circuit. Complete with tubes, punched chassis, all parts, wire, solder, instructions and diagrams.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

TUBE TESTER, *model 107,* prewired panel mounted in front cover permits dynamic mutual conductance test on popular high-transconductance or amplifier tubes. Only filament voltage and load setting. Tubes can also be tested for cathode emission. Tube setup data on panel. Cur-



rent tube information in flip-chart. 11½ pounds. 13½ x 9 x 6 inches.—**Seco Manufacturing Co.**, 5015 Penn Ave. S., Minneapolis, Minn.

VIDEO GENERATOR, *Model TV-10.* Generates a 525-line

fully interlaced picture or test pattern with a usable frequency response of over 4½ mc. Contains a multiplier type phototube with high-voltage power supply, video amplifier and high-frequency compensator. Operates on low-band television channels.—**American Scientific Development Co.**, 336 S. Main St., Fort Atkinson, Wis.

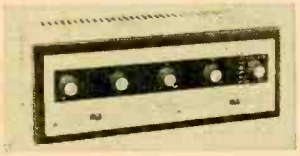
RECEIVER, *HQ-100,* 10-tube superhet with continuous tun-

ing from 540 kc to 30 mc. Automatic frequency range control tied in with audio gain control provides large bandwidth for high-quality local reception, higher selectivity for weaker distant stations. Variable selectivity provided by Q-multiplier circuit. Electrical bandspread tuning with direct calibration for 80-, 40-, 20-, 15- and 10-meter amateur bands. Optimum 20-meter bandspread permitted by separate switch position. Rf and oscillator coils individually shielded.—**Hammarlund Manufacturing Co., Inc.**, 460 W. 34th St., New York 1, N. Y.

ELECTRIC SOLDERING GUN, *Gregg 250.* Instant heat greatly increases tip life. Single pole with reach of over 5 inches. Replaceable tips unscrew and change with only finger pres-

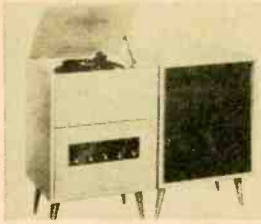
sure. Changeable barrel assemblies available in standard and other desired lengths.—**Gregg Electric Co.**, 2 S. Broadway, Lawrence, Mass.

AMPLIFIER, *model AA-903B. With preamplifier and tone controls.* Two EL84's in Williamson type circuit provide 14 watts,



peak of 28 watts. Dc filament supply to preamp tubes. Frequency response 20–20,000 cycles ±1 db. Harmonic distortion less than 1% at 14 watts; IM 1.5% at 14 watts. 21 db negative feedback. 4¾ x 13¼ x 9 inches. 17 pounds.—**Pilot Radio Corp.**, 37-06 36th St., Long Island City, N. Y.

CABINET ENCLOSURE. 32 inches high, including legs. 21 inches wide, 16 inches deep. *Model 30* a lift-top equipment cabinet with 2 compartments. 6 inches height above player board. Upper player compartment 19½ inches wide, 14½ inches deep; lower compartment 13 inches high, 19½ inches wide, 14½ inches deep. Mahogany or korina (blond mahogany) finish on birch. *Model 31*, matching bass-reflex enclosure, has 4.5-cubic-foot

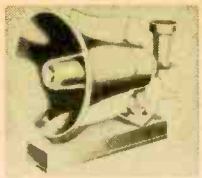


baffle area.—**G. & H. Wood Products Co.**, 99 N. 11th St., Brooklyn, N. Y.

FM TUNER, *S-3000.* Under 1 μv sensitivity for 20-db quieting. Tuning eye for sharp focus. Local–distance switch suppresses cross-modulation. Intermodulation below 1½% and 100% modulation by delayed agc. Automatic frequency control. Precision-calibrated dial. Cath-

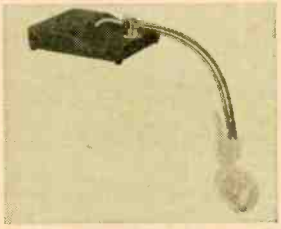
ode-follower out-put level control. FM multiplex output.—**Sherwood Electronic Labs., Inc.**, 2802 W. Cullom Ave., Chicago, Ill.

MEGAPHONE SYSTEMS. Powered by flashlight batteries with built-in switch. *Portable Powrpage model PP-1* (illustrated) uses 7 size-D 1½-volt flashlight cells. 7½ pounds with batteries.



Pistol Grip Powrpage model PP-2 megaphone system employs 6 1½-volt pencil-size AA flashlight cells. Jack accommodates external 6–12-volt dc supply. 4¼ pounds with batteries.—**University Loudspeakers, Inc.**, 80 S. Kensico Ave., White Plains, N. Y.

MICROPHONE SUPPORT, *Model SB-1.* For telephone

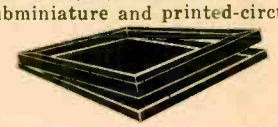


switchboard, dispatcher's office, desk, dias, banquet table, etc. 12-inch, chrome-plated gooseneck arm mounted on spring-loaded swivel. Feedthrough hole at mike end of gooseneck allows mike cable to be concealed within arm after entry under base of rear end.—**Atlas Sound Corp.**, 1451 39th St., Brooklyn 18, N. Y.

PREAMPLIFIER, *Micamp.* All-transistorized and impedance-matching. Permits direct use of low-impedance, low-gain cartridges and microphones with high-impedance tape recorders, amplifiers, PA systems, etc, 20–20,000 cycles ±1.5 db. Input impedance 50–250 ohms, output

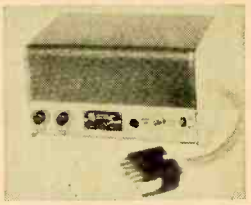
18,000 ohms.—**Madison Fielding Corp.**, 863 Madison St., Brooklyn, N. Y.

MINIATURE CHASSIS. For subminiature and printed-circuit



assembly, 22 sizes ranging from 1⅛ x 1 x ½ to 3 x 1¾ x ½ inch. Intervening sizes with depth up to 1¼ inches. Printed circuit chassis (illustrated) are made with shallow base and cap cover on bottom. ½-inch mounting lip for attachment of circuit board. —**Heeger, Inc.**, 1011 Venice Blvd., Los Angeles 15, Calif.

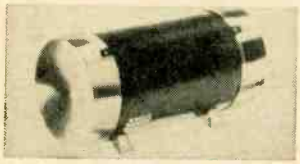
AUTOMATIC LIGHT COMPENSATOR. Electrically com-



(Continued)

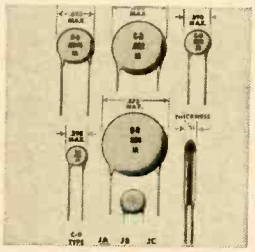
pensates for variations in video signal level as great as 150:1. Designed to be used with any Blonder-Tongue Observer *TVC-1* or *TVC-1A* television camera. Suited for outdoors and flame control in power, refining and processing plants. — **Blonder-Tongue Labs, Inc.**, 526–36 North Ave., Westfield, N. J.

ELECTRONIC TRAP, *Trap-Ease.* To increase receiving range of TV sets by clearing up reception from distant stations



otherwise blocked out by strong signals from adjacent channel. Mounts on rear or top of TV receiver.—**Jerrold Electronics Corp.**, 23rd & Chestnut Sts., Philadelphia 3, Pa.

DISC-CERAMICS, *types JA, JB, JC.* For applications requiring minimum change in capacitance at any temperature within operating temperature ranges. Insulated with phenolic and high-temperature wax vacuum

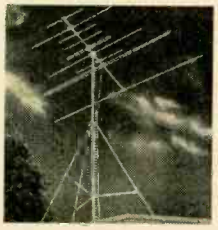


impregnation. High insulation resistance characteristics. Working voltage 600 dc. Available with No. 20 wire plug-in termination for printed wiring.—**Cornell-Dubilier Electric Corp.**, S. Plainfield, N.J.

FM TUNER, *model FM-90.* Variable afc and interchannel muting controls. Station selector locks into each station in turn as pointer travels across the dial

at touch. Full wide-band detector circuit for drift-free reception of weak signals. Two meters indicate signal strength and center of channel.—**Fisher Radio Corporation**, 21-21 44th Drive, Long Island City 1, N. Y.

OUTDOOR ANTENNAS, *Minute Mount.* Factory-assembled

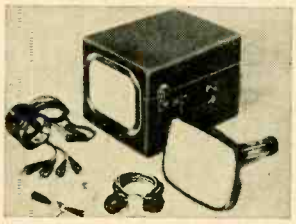


unit includes aluminum tower, antenna with factory-attached lead-in, insulators, ground wire, ground rod and lightning arrestor.—**Winegard Co.**, 3000 Scotten Blvd., Burlington, Iowa.

INDOOR ANTENNAS, *Vhf-Uhf Showman, Model No. 3905.* 19 inches long with no rabbit ears. Separate vhf and uhf leads connect with individual terminals

used in most all-channel sets, saving filter or divider cost. Uhf dipole extends range of antenna to channels 2–83. Operates as a folded dipole and reflector antenna on uhf, with vhf elements functioning as parasitic reflectors.—**Channel Master Corp.**, Ellenville, N. Y.

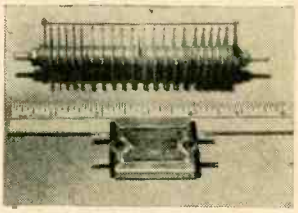
TELECHECK, for checking CRT and yoke faults. 8AXP4



requires no ion trap. Can be used with all sets, either in the kit or by direct substitution; Universal yoke wired and fused to eliminate possible damage to set. Universal service extension leads for CRT anode and yoke; Plastic mask and yoke support.— **Telematic Industries, Inc.**, 16 Howard Ave., Brooklyn 21, N. Y.

MINIATURE POWER RESISTORS, *series C7GL and C10GL.* Square body facilitates certain assembly and wiring. ⅜ x 11/32 inches cross-section. 7-watt rating 1⅝ inches long, from 1 to 6,000 ohms. 10-watt rating 1⅞ inches long, from 1 to 11,000 ohms.—**Clarostat Manufacturing Co.**, Dover, N. H.

FLAT SELENIUM RECTIFIERS. Mounted directly on chassis for drawing off heat. Can be



placed in corner of electronic unit without allowing for air circulation among plates. Variety of sizes detailed in Radio Receptor Semiconductor Division's Bulletin No. 237—*Radio Receptor Co., Inc.*, 251 W. 19th St., Brooklyn 11, N.Y.

ELECTROLYTIC CAPACITORS, *Pyra-Pak Kit,* metal tool box containing both tubular and twist-mount electrolytic capacitors, a tool kit, the TM Twist-Mount catalog and the TM Interchangeability Guide.—**Pyramid Electric Co.**, 1445 Hudson Blvd., Chicago, Ill.

All specifications given on these pages are from manufacturers' data.

Technicians' News

GUILD FAIR SUCCESS

The Electronics Fair held Dec. 6, 7 and 8 at the Long Island Agricultural and Technical Institute, Farmingdale, N. Y., was a greater success than some of its most optimistic sponsors predicted. The 28 exhibitors comfortably filled the institute's gymnasium in which the fair was held. At least two color receivers were in constant operation, with color test equipment being demonstrated a large part of the time. Another interesting color display was the closed-circuit medical color TV setup at the registration desk of the Long Island Radio & Television Guild, who organized and operated the fair.

Other than the color TV and TV test equipment, demonstrated probably most spectacularly by RCA Service Co., the highlights of the exhibit were the small TV camera setup of H. L. Dalis, metropolitan TV–radio components distributor, which permitted spectators to see themselves as others saw them, a number of hi-fi displays and some interesting TV accessories and test equipment. These included some neat small pieces by Wintronix and the new Kingston Absorption Analyzer, an instrument which promises to cut down servicing time by picking up waveforms electrostatically direct from the tube, without pulling chassis. RADIO-ELECTRONICS and other magazines also had booths.

More than 4,000 persons were counted as they entered the fair building, plus about a thousand high and vocational school students who toured the fair and the institute on Dec. 7. About half the 4,000 were friends, students at the institute and a few members of the general public, leaving an attendance of roughly 2,000 technicians.

The lecture program was not as fortunate as the exhibition. The comparative inaccessibility of the lecture rooms as compared to the exhibits, and possibly the lack of advertising for the lectures independently of the fair were probably the main reasons for a disappointing turnout. Even John Rider spoke to an audience of less than 40.

In spite of this and a few other rough spots due to inexperience, the Fair Committee was tremendously encouraged by the overall result and voted a 1957 fair immediately after the 1956 show was over.

DIVERSITY THE ANSWER?

John Rider, speaking before service organizations in Long Island and Staten Island, and at the fact-finding panel in New York Dec. 3, presented a new answer to captive service. Diversification is the way out, he said. The independent service technician should adapt himself to present-day conditions and so modify his activities as to be able to offer much better service than the best the factory could offer.

Among other things, the service technician should be in a position to service *all* the customer's electronic equipment. While the audio business is growing by leaps and bounds, servicing record players is getting away from the service technician and into the hands of music shops and other organizations. The customer is more and more tending toward the idea of a package deal, while the service organization is narrowing down. Some are even refusing to work on radios, though indications are that TV sets may in the future become a smaller part of the service business.

In addition to diversity, service must be *sold*, to compete with the factory, Rider said. More drastic steps might have to be taken, such as consolidation of several service shops to offer wider services. Some service technicians might even have to adopt a more philosophic view of the public to succeed under the new conditions. In any event, Mr. Rider warned, those who refuse to adapt to changing times and put their hope in legal redress for "restraint of trade" were very likely to be disappointed.

PHILCO ADVERTISES SERVICE

Reports from Boston, Mass., state that Philco Service Corp., a Philco subsidiary, is advertising on more than 100 billboards in subway stations. Theme of the ads is "Now in Boston—Philco Factory Service. All work guaranteed."

The service company has been in operation in Boston for several months and reports that the bulk of its business has been coming from nonservicing retailers. Old warranty cards were said to have been used in soliciting business, though it was stated that only warranty cards turned in by customers of nonservicing dealers were used for this purpose. Flat rate for television service —not including parts—is $5.95. Charge for appliance servicing is $6.95.

CAPTIVE SERVICE PANEL

Members of service associations, service companies and the trade press joined in a panel meeting in New York Dec. 9 to discuss the problems arising from the entry of TV manufacturers into the service field.

After short addresses by John Rider; Frank Moch, NATESA; John Wheaton,

Long Island Guild and Empire State Federation; Bert Bregenzer, Federation of Radio–TV Servicemen's Associations of Pennsylvania; Paul Wendell, *Service Management* magazine; Dan Creato, RCA Service Co.; John Miller, General Electric, and John Sheehy, Sylvania, questions were submitted by those present to the panel members, including the above and a number of editors and association figures. Queries were, however, practically all directed to Messrs. Creato and Miller, with a few to John Rider and Frank Moch.

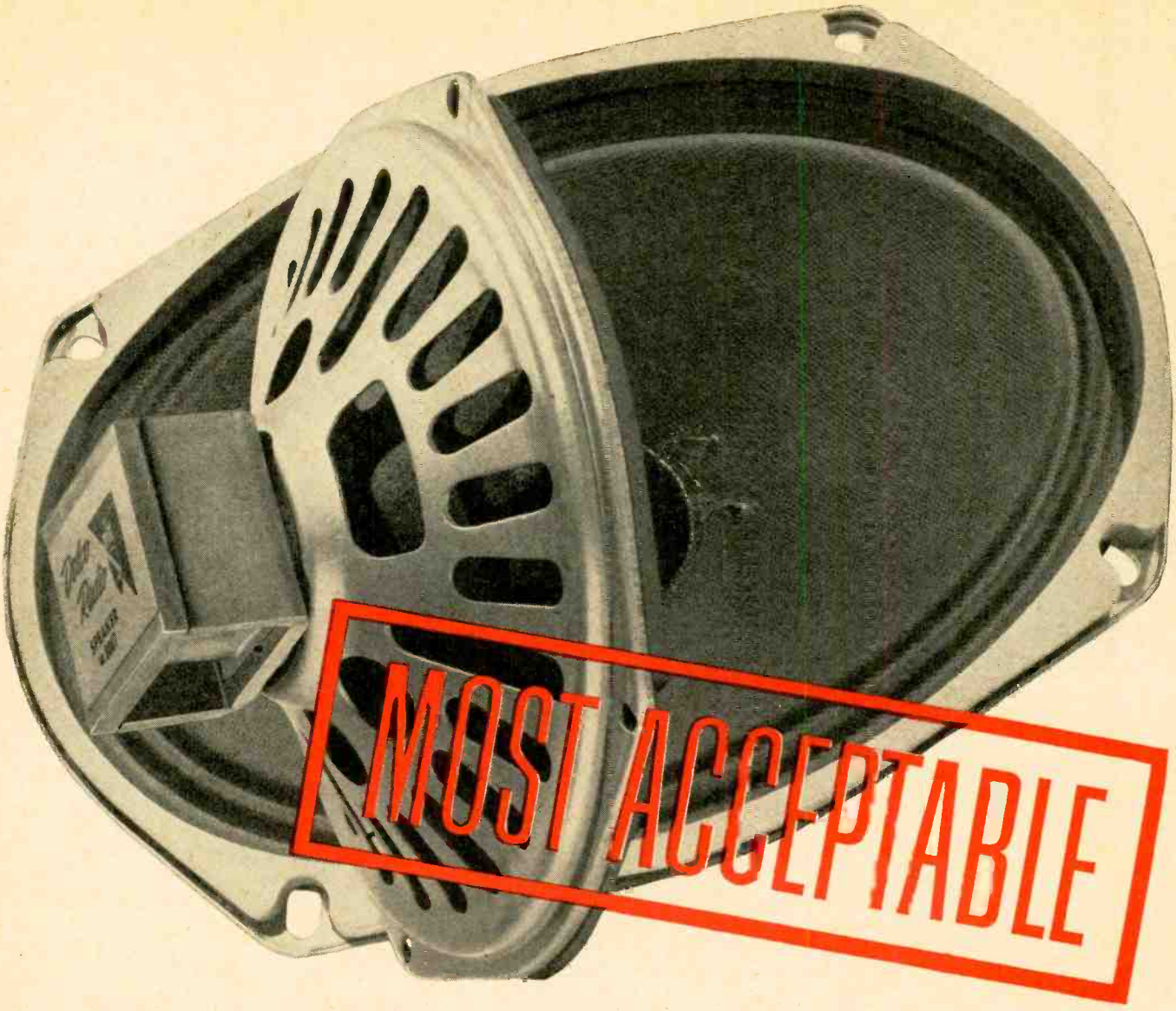
Captive service was not too well defined during any part of the meeting, and Dan Creato in particular pointed out that his operation was factory service rather than captive service, and that the RCA Service Co. was not making any efforts to capture the market, but was handling only about 10% of the RCA black-and-white TV receivers now being serviced. The percentage of color receivers would be much higher for a time, but it was expected that the independent service technician would soon take over a large part of that work. "The sooner that is done," he said "the sooner color will be launched." In answer to a question, he also stated that the RCA Service Co. does not have access to names of customers signing warranty cards and confines its solicitation of business largely to use of names of old customers.

The position of Mr. Miller was more complex, due to G-E's distribution and servicing setup. He pointed out that the general policy of G-E's service efforts was (as was also stated in somewhat different words by Mr. Creato) to provide set owners with "the kind of service that will give maximum support to our sales program on these products." General Electric has set up three service depots, at Columbus, Toledo and Fort Wayne, and G-E distributors vary in the amount of service they offer to the retailers in their area. An additional factor is that some of the distributors are owned by General Electric and others are independent, though policy-wise some of the company-owned concerns were more independent than the independents, Mr. Miller said.

Representatives of the service associations, in their opening addresses, deplored certain recent advertising. Some G-E ads, Jack Wheaton stated, rather implied that the customer has not been getting the best kind of service from the independent technician, while the Philco slogan "We Build It—We Know It Best" tended to foster the same conclusion. Bert Bregenzer reported that some of the ads appearing in the Pittsburgh press "tended to degrade the independent serviceman."

NEW GROUPS IN NATESA

Mineral Area Television Electronic Service has been formed in the Desloge, Mo., area. It is the ninth Missouri affiliate of the National Alliance of Television Electronic Service As-



FROM DELCO RADIO come the speakers with highest performance. You trust them...so do your customers!

Engineering skills of Delco Radio and General Motors combine to offer a full line of speakers for home and auto radios, phonographs, TV, and Hi-Fi. National advertising behind the Delco Wonder Bar Radio develops a bigger service market for you! For fast service call your UMS-Delco Electronics Parts Distributor.

14 Standard Models: Designed and built to R.E.T.M.A. standards with heavily plated metal parts and Alnico-V magnets. Precision felted cones give uniform response over full operating frequency range. All are fully dustproof and dependable.

Dual-Purpose Hi-Fi Model 8007: A superior speaker for custom-built audio systems and for replacements in AM, FM, TV and phonograph sets. Size 8″, 50 to 12,500 CPS frequency range; Alnico-V magnet; 10-watt power rating; 4.1 v.c. impedance; 1 3/16″ voice coil.

DELCO

WONDER BAR

RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

GM GENERAL MOTORS PARTS SALES

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

Distributed by Delco Electronic Parts Distributors

A complete line of original equipment service parts from the

WORLD LEADER IN AUTO RADIO

sociations. Edward Engel, Crystal City, is president of the new association; Melvin Declue, Potosi, vice president; Harold Ransom, Desloge, secretary, and Carl Warren of Flat River, treasurer.

Another recent affiliate is the Television Electronic Service Association (TESA) of South Central Missouri. Its officers are James Rathbun, Sparta, president; Hubert Montgomery, Sparta, vice president; W. A. Pryer, Mountain Grove, secretary-treasurer. Troy Branstetter, Mansfield and E. Carroll, Cabool, were elected directors.

NATESA also reports affiliation of the Radio–Television Technicians Guild of Florida–Dade County, with headquarters in Miami.

Printed on light card, the above mailing piece gets a story across that would be hard to impart in a long and serious piece of text.

TSA SEEKS LICENSE

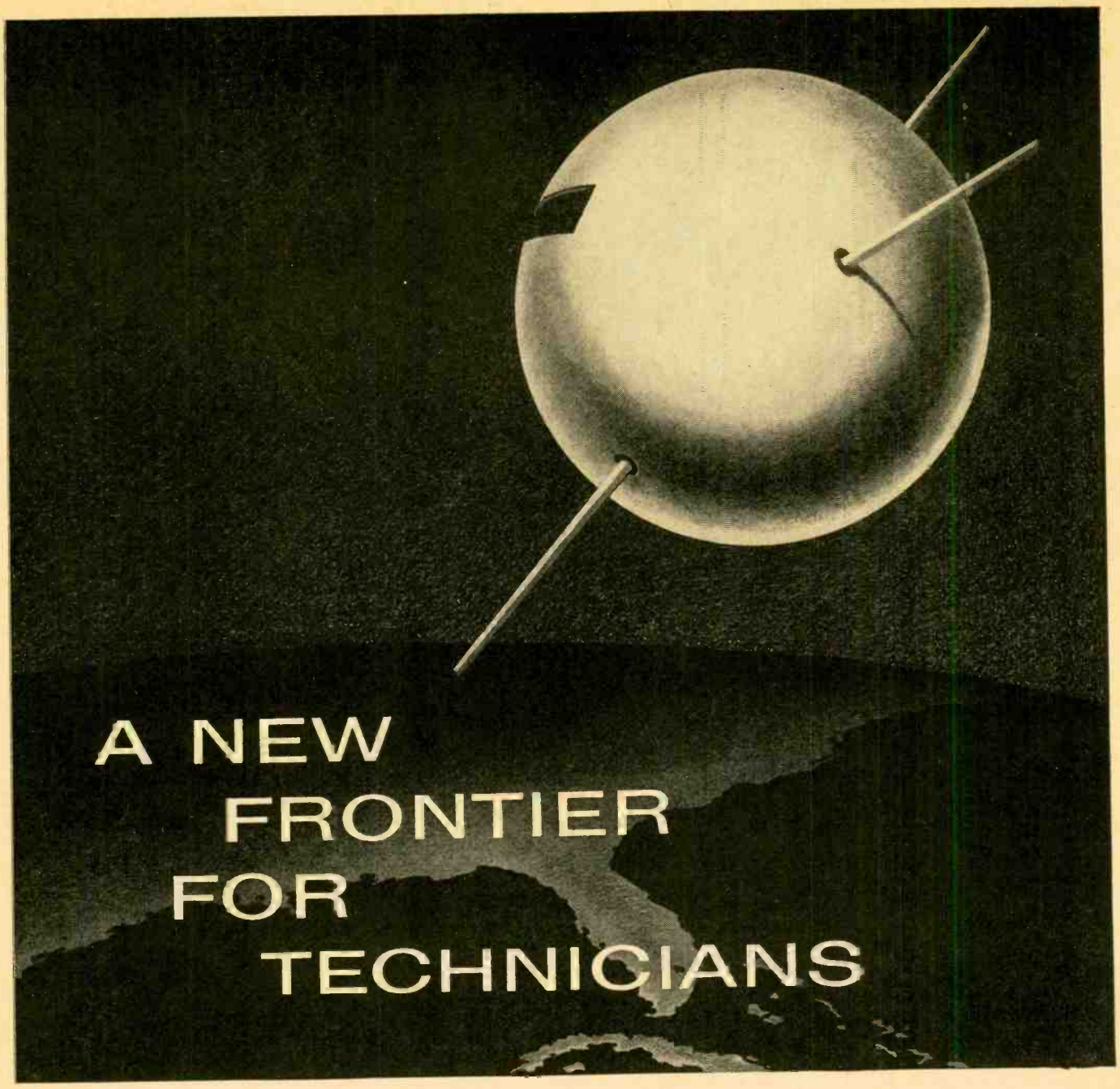
Regulation of the operations of TV service technicians will be sought by the Norwalk branch of the Television Service Association of Connecticut. The local association voted to request a meeting between the group and the City Council to work out details.

One cause of the action is victimization of TV owners by unscrupulous repairmen. The meeting which voted for licensing was one that had been called specifically to discuss the grievance of a customer who testified that he paid for a new picture tube which proved—on further examination of the set by another service technician—to be his old one. This was only one of a number of complaints received by the association's grievance committee.

WEST CENTRAL MEET

More than 100 delegates met at the West Central Region convention of NATESA held in Springfield, Mo., early in December.

Captive service held a prominent position in the discussions but the del-



RCA offers an opportunity for you to apply your technical skill to its Missile Test Project at Patrick Air Force Base, Florida—"Launching Site of the Satellite."

Here at the world's longest missile testing range, extending from Florida far across the South Atlantic, you can enjoy improved status with the recognized leader in Electronics. Unprecedented growth opportunities are offered in various phases of data acquisition, transmission and processing, including Radar—Communications—Optics—Computers—Timing—Telemetry.

At RCA's Missile Test Project you will enjoy technical advancement combined with famous Florida living. Your family will appreciate the ideal climate—allowing year 'round outdoor activities—and pleasant social surroundings.

Immediate assignments are available in Florida, the Bahama Islands, and aboard tracking ships in the South Atlantic. Attractive home leave policy and salary differential make the Bahama Islands and tracking ship assignments especially attractive for single men.

Let the Missile Test Project become *your* symbol of the future. Join in our assault on the frontier of space!

For complete information about this new and challenging field, write to:

Personnel Manager, Dept. N-15B
RCA Service Company, Inc.
Missile Test Project
P. O. Box 1226
Melbourne, Florida

RCA ® **RADIO CORPORATION of AMERICA**

egates took a far less serious view of it than has been the case in the East. An optimistic spirit prevailed and it was generally agreed that "the problem would be resolved in our favor."

Another important subject of discussion was the TV license legislation pending in the State Legislatures of Missouri, Texas and Louisiana. The convention's feeling was for licensing and most of the delegates also took an optimistic view of prospects in that direction.

Technical sessions were also included in the program. A talk on the role of electronics in the defense of the country was given by G. Pierson Ward of KTTS-TV at the closing banquet.

SEEK COOPERATIVE ACTION

A meeting of delegates from five States, meeting Sunday Dec. 2 in New York City, formed a cooperative group for the purpose of coordinating the activities of the organized service associations in the northeast United States regardless of their affiliations. Representatives of The Empire State Federation of Electronic Technicians, the Pennsylvania Federation of Radio and Television Service Associations, of the Television Electronic Service Association of Connecticut and of Massachusetts and New Jersey groups were present at the meeting.

The *modus operandi*, as laid down at the meeting, was to meet occasionally for the purpose of going over common aims and discussing coordinated action, wherever such might be possible. The name United Electronic Service Council was chosen for the group and Frank Silverman of Hartford was chosen president. The address of the new organization is at present the same as that of TELSA, P.O. Box 1711, Hartford, Conn.

OFFER COLOR COURSE

A complete correspondence color TV course has been offered to independent service technicians by Sylvania Electric products, Inc. The course includes 14 lessons, and was prepared by the Radio Television Training Association, a leading TV correspondence school. Each lesson carries an examination sheet, and all papers receive individual attention, it was stated.

WHAT IS CAPTIVE SERVICE?

A recent dealers' meeting in St. Louis brought to light that different members were speaking of altogether different things in referring to captive service. This—it may well be imagined—made discussion very much more difficult!

Some of the dealers felt that the term should apply only when a TV or appliance line can be serviced only through the factory organization and dealers must buy a service policy from the wholesaler for each item, whether

he wants it or not. This resembles John Rider's definition: "When the customer has no freedom of choice as to who shall service his equipment, that is captive service."

Others included in their definition the operations of all manufacturers who are in the service business and solicit it both on a local level and through national advertising, even though they authorize independent service companies to repair their products.

A third definition has been adopted by a number of service meetings called to discuss the subject:

"The term 'captive service' will hereinafter be defined as service or services offered to consumers on a fee or no-charge basis by television and/or radio receiver manufacturers, their subsidiaries, agents, or segments of receiver distribution other than the retail merchandiser."

Other statements, notably those suggesting that captive service is in restraint of trade, also indicate that captive service means many things to many minds. To some, the definition of captive service and that of factory service is identical. Others distinguish between the two. An official definition, possibly distinguishing between different grades of captive service, might be very useful, especially if it could be so drawn as to meet with approval from the great majority of the service groups.

SET DAMAGE CHARGED

A TV technician, Robert Pharris of Columbus, Ga., was arrested recently on charges of malicious mischief after a woman customer complained that he damaged her TV set.

Pharris told the court that the customer had paid only part of previous repair bills and that he had asked her to pay up before he left the set. When she refused, he disconnected the antenna and removed the knobs.

The customer stated that she thought the bill was too high and refused to pay until she had consulted the Better Business Bureau. Upon her refusal to pay, she said, the service technician removed the antenna and knobs and left. END

Do you need a Degree for success in Electronics?

"Not necessarily," says Dick Brani, 33-year-old Field Engineering Instructor in Project Sage at IBM—Kingston, New York. "Oh, sure—I'm aware of my limitations to design electronic equipment even though I am qualified to maintain it. That's the biggest advantage of a formal degree. The point is . . . there are many responsible management positions opening all the time in IBM for men like myself . . . and comparable positions elsewhere would probably require an engineering degree."

Some seven years ago, IBM took the initiative with respect to technical training within its own organization. It realized, even then, that a great number of intelligent and otherwise capable men were falling by the wayside merely because they lacked 4 years of college engineering. Statistics indicated that because of financial difficulty or improper high-school preparation, close to 50% of the potential engineers in the country became lost in the educational shuffle. While some people with less foresight ignored the fact or bemoaned it, IBM did something about it. Consequently, fellows like Dick Brani can now enjoy more satisfying, more rewarding work than ever before.

Great Interest in Mathematics. While Dick was attending Boys' High in Brooklyn, his principal academic interest was mathematics. And, like many other young fellows of that era, Dick was realistic about his future. He decided his best bet might be business accounting. When Dick graduated in 1940, he accepted a position with a New York banking firm. It was not until Dick entered the Army in 1943 that he had the opportunity to pursue a more advanced form of mathematics, an A.S.T.P. training program at Lehigh University. This all-too-brief experience convinced Dick that he should make his career in a field that was in some way related to electrical technology.

Postwar Education. Discharged with the rank of Staff Sergeant, Dick returned to Allentown, Pa., to marry a girl he had met while enrolled at Lehigh. During this period, he successfully supported his family and himself selling various lines of food. In the evening, however, Dick continued his study of radio, TV, and electronics at the Allentown Branch of the Temple Institute. In two years' time, he graduated and secured an F.C.C. license. His technical career was beginning to take shape.

IBM Looks Especially Good. Glancing through an issue of *Time Magazine* one evening, Dick happened to read an article about Thomas J. Watson, Jr., the president of IBM. The story emphasized Mr. Watson's great faith in the future of electronic computers . . . the wonderful promise it holds for the ambitious, intelligent young man. Some time later, Dick spotted a classified ad describing IBM's association with Project Sage. Phil-

Brani trouble shooting Magnetic Drum Frame.

Brani studies computer pluggable unit.

Dick explains computer logic to a Systems Class.

33-year-old Dick Brani feels that technicians can grow into more responsible positions.

adelphia was one of the work locations available after training. That was all Dick Brani needed.

Asked to Become an Instructor. When Dick was three-quarters of the way through his nine month computer systems course, he was invited to remain at Kingston as an instructor. "It was like a bolt out of the blue," he recalls. "I knew I'd enjoy teaching, but I always thought it was out of the question. I accepted all right, and I can't tell you how much I've enjoyed helping these fellows and watching them grow within the organization. For instance, there's a fellow in my class right now whose education is limited to correspondence school. He's in the top third of his class, and has a real future with IBM—all because he has the native talent and is willing to work."

What Does Dick Brani Teach? "Actually, I teach three separate courses for technicians in field engineering. One is computer systems testing, which is for the more advanced student. This training lasts for 33 weeks—a long time, perhaps, but it's well worth it. Another is a program of 24 weeks' duration that deals with computer input-output units. Finally, I teach a course in computer units displays. This also lasts for 24 weeks. Each one of these courses is an education in itself." Experience has shown that IBM's educational programing is most successful. Men accepted receive their training with no strings attached—no contracts. Upon graduation the road to success is wide open in *all* divisions of the corporation.

The World's Largest Electronic Computer. "This computer is really fantastic. It contains approximately 1,000,000 parts, and it's housed in a building 4 stories tall. Information is filtered in from Texas towers, picket ships, reconnaissance planes—even ground observers. Every object in the sky is analyzed. Then it checks each object against available traffic data and identifies it as either friendly or hostile. It can make suggestions, but it can't send a Nike missile against a 'baddie.' Only authorized personnel can make that decision."

What About Dick's Future? "Well, right now, I'm doing work that most technicians couldn't touch with a ten-foot pole. I know of few companies where technicians are actually doing engineering work. I guess it's a matter of approach. Both kinds of companies will get the job done, but IBM prefers to think in terms of the man, encouraging him to grow into more responsibility. You might say that IBM gets more out of the man, and in the final analysis, it seems a lot more efficient from the corporation's and employee's viewpoint. Personnel policy at all levels—management, engineering, or technical—is the same. The future is wide open."

Just recently, Dick bought a home in Saugerties, near Kingston, where his wife Betty and their three children, David, 9, Sharon, 7, and Paul, 3, enjoy a pleasant, contented life together. Occasionally, in the summertime, Dick plays softball with his co-workers. But his family is—and always will be—his predominant interest.

What About You? Opportunities in the Project Sage program of long-range national importance are still growing. If IBM considers your experience equivalent to an E.E., M.E. or Physics degree, you'll receive 8 months' training, valued at many thousands of dollars as a Computer Systems Engineer. If you have 2 years' technical schooling or the equivalent experience, you'll receive 6 months' training as a Computer Units Field Engineer, with opportunity to assume full engineering responsibility. *Assignment in area of your choice.* Every channel of advancement in the entire company is open. All the customary benefits and more. WRITE to: Nelson O. Heyer, Dept. 3102, IBM, Kingston, New York. You'll receive a prompt reply.

At the Maintenance Console.

At home Dick plays with one of his three children.

Customer Engineers: opportunities are also available, locally, for servicing IBM machines, after training with pay. Consult your nearest IBM office.

IBM MILITARY PRODUCTS

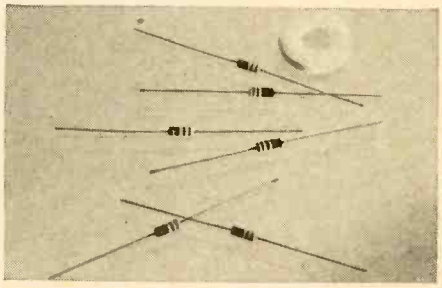
DATA PROCESSING
ELECTRIC TYPEWRITERS
TIME EQUIPMENT
MILITARY PRODUCTS

New Tubes & Semiconductors

This past month has provided us with a bountiful array of new units. Keeping pace with the growth of transistor types, are series of quick-recovery and high-voltage silicon diodes. Included also are several TV receiving types, a transistor and a European made rectifier and voltage regulator.

1N625, -6, -7, -8, -9

Hughes Products, a division of the Hughes Aircraft Co., has announced a group of new quick-recovery silicon junction diodes, the 1N625, 1N626, 1N627, 1N628 and 1N629.



They afford a combination of characteristics—high speed, high voltage, high temperature — not heretofore available in subminiature semiconductor devices. With significantly faster recovery characteristics than standard germanium computer diodes, these devices are capable of operating at high voltages and temperatures. They can, therefore, be used instead of vacuum or germanium diodes in most high-frequency or fast-switching circuits—flip-flops, modulators and demodulators, discriminators, clamping and gating circuits.

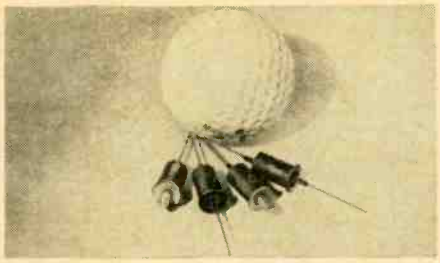
All types are packaged in a one-piece fusion-sealed glass envelope, impervious to moisture. The size of the diode glass body is 0.105 by 0.265 inch. The ambient operating temperature range is from −55°C to 135°C. Maximum power dissipation is 200 mw at 25°C. All types recover to a minimum of 400,000 ohms in 1 microsecond when switched from 30 ma forward to 35 volts reverse.

At 25°C maximum average rectified current for these transistors is 20 ma, maximum power dissipation is 200 mw. The reverse voltage at which a reverse current of 100 μa flows is: 1N625, 30; 1N626, 50; 1N627, 100; 1N628, 150; 1N629, 200.

1N588, -89, -90, -91

Four new silicon rectifiers (see photo) having a peak inverse voltage

rating of 1,500 have been announced by Texas Instruments. Ideal for use in cathode-ray-tube power supplies and similar high-voltage circuits, these units have forward current ratings to 125 ma and operate stably to 150°C.



The 1N588 and 1N589 are axial models, permitting point - to - point wiring. At 25°C, each of these grown-junction units has a 1,500-volt peak inverse rating. At this voltage and temperature the 1N588 permits an average rectified forward current of 25 ma, the 1N589 50 ma.

Stud models 1N590 and 1N591 provide maximum heat dissipation. They offer a choice of anode or cathode stud, eliminating the necessity for high-voltage insulation between stud and chassis. At 25°C, each rectifier has a peak inverse voltage rating of 1,500 and an average rectified forward current, at peak voltage rating, of 125 ma. The 1N590 uses a cathode stud, the 1N591 an anode stud.

These silicon rectifiers are 0.53 inch long and have a maximum diameter of 0.37 inch.

GZ34 low-voltage rectifier

Designed to improve audio amplifier power supplies, the GZ34, a cathode type rectifier tube, has been made available by Amperex. Developed by Amperex's European affiliate, Philips of the Netherlands, the tube is intended for the American high-fidelity market.

The GZ34 is an octal-base, indirectly heated, full-wave rectifier operating on a 5-volt heater drawing 1.9 amps. It has an output capacity of 250 ma and is characterized by low output impedance, exceptional internal insulation and small physical size.

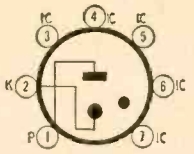
It replaces without circuit changes, in most amplifier power supplies, an entire line of popular heavy-duty 5-volt rectifiers, such as the 5U4G, 5V4G, 5T4, etc. The resultant benefits include better voltage regulation and greater linearity in non-class-A power stages due to lowered power-supply impedance, higher power output due to increased power-supply voltage, reduced ripple, cooler operation due to lower voltage drop and added protection of costly power output tubes as a result of delayed warmup.

75C1 voltage regulator

A new 75-volt regulator tube, the 75C1, has been developed by Mullard to give improved performance in any equipment and any application where low-voltage regulators are normally used.

NEW TUBES & SEMICONDUCTORS *(Contd.)*

The Mullard 75C1 (see base diagram) combines zirconium electrodes and the sputtered envelope technique pioneered by Mullard. This design gives a combination of high stability and good regulation which has never before been achieved in one tube.



75C1
IC=INTERNAL CONNECTION

Among the advanced features of the Mullard 75C1 are the special uranium oxide coating which ensures that the maximum striking voltage is 110 volts in both *daylight and darkness*. The Mullard 75C1 has a very wide current range of 2 to 60 ma with a regulation of only 9 volts. This tube is distributed by International Electronics Corp., representatives of Mullard Overseas, Ltd., 81 Spring Street, New York 12, New York.

2N269

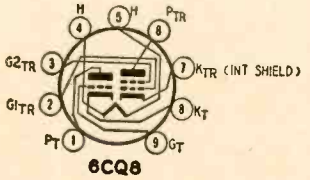
The 2N269 is a junction transistor of the germanium p-n-p type designed especially for use in low-level, medium-speed, on-off control circuits, particularly bistable (flip-flop) and gating circuits of electronic computers.

Developed by RCA, the 2N269 has a maximum emitter current and collector current of 100 ma, a minimum large-signal dc current transfer radio of 35 at a collector-to-emitter voltage of only −0.15, and a minimum alpha-cutoff frequency of 4 mc.

The 2N269 is heremetically sealed, utilizes an insulated metal envelope and has flexible leads which may be soldered or welded into the associated circuits. It is small—only 0.240 inch in diameter and 0.405 inch in body height.

6CQ8

A nine-pin miniature tube containing a medium-mu triode and a sharp-cutoff tetrode, the 6CQ8 may be used in a wide variety of applications in black-and-white and color TV receivers. It is especially useful as a combined oscillator and mixer tube in tuners of TV receivers that use an if in the order of 40 mc. The triode unit of this tube (see diagram) is not only useful as a vhf oscillator but also as an rf amplifier, phase splitter, sync clipper and sync separator. The tetrode unit is also useful as a sound or video if amplifier.



6CQ8

The RCA-announced 6CQ8 has a 450-ma heater with a controlled warmup time to minimize voltage unbalance during starting in series strings.

The tetrode mixer unit of the 6CQ8 features an I_p characteristic with a sharp knee at relatively low plate voltages. As a result, mixer operation with good linearity can be obtained. The low

grid-to-plate capacitance of this unit minimizes feedback problems encountered in mixer circuits operating at an if of about 40 mc—especially the troublesome feedback on channel 2 because of the small difference between the channel frequency and the if. In addition, the low output capacitance of this unit permits the use of a high-impedance plate circuit with resultant increase in mixer gain.

6AW8-A

A general-purpose high-mu triode–sharp-cutoff pentode of the nine-pin miniature type, the 6AW8-A is intended for a wide variety of applications in TV receivers. The pentode unit is especially useful as a video, video if, or agc amplifier. The triode unit may be used in sync amplifier, separator, and clipper and phase-inverter circuits.

The 6AW8-A, announced by RCA, is like the 6AW8 but features a pentode unit having a plate-current characteristic with a controlled knee to provide good linearity at relatively low plate voltage, and a high transconductance (9,000 μmhos). In addition, this tube is designed with a 600-ma heater having a controlled warmup time series heater strings.

The 6AW8-A supersedes the 6AW8 and is unilaterally interchangeable with it.

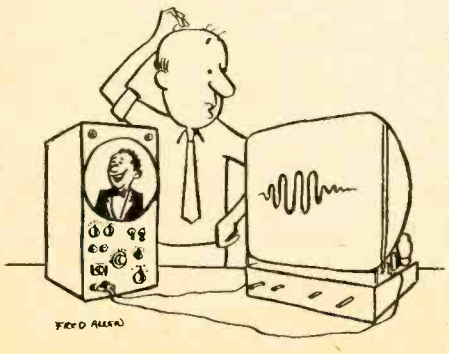
25CD6-GB

A high-perveance tube of the glass-octal type, the 25CD6-GB is designed for use as a horizontal-deflection amplifier tube in "transformerless" television receivers. The 25CD6-GB is smaller and more compact than the 25CD6-G and 25CD6-GA, but features a modified mount design to maintain the same high perveance and to permit operation at higher ratings.

This tube, announced by RCA, is designed with a 600-ma heater having a controlled warmup time to minimize voltage unbalance during starting in receivers utilizing series heater strings.

The 25CD6-GB is rated to withstand a maximum peak positive-pulse plate voltage of 7,000 and a maximum plate dissipation of 20 watts. These features in addition to low mu factor and a high operating ratio of plate current to grid-2 current enable this tube to provide adequate deflection for 90° picture tubes.

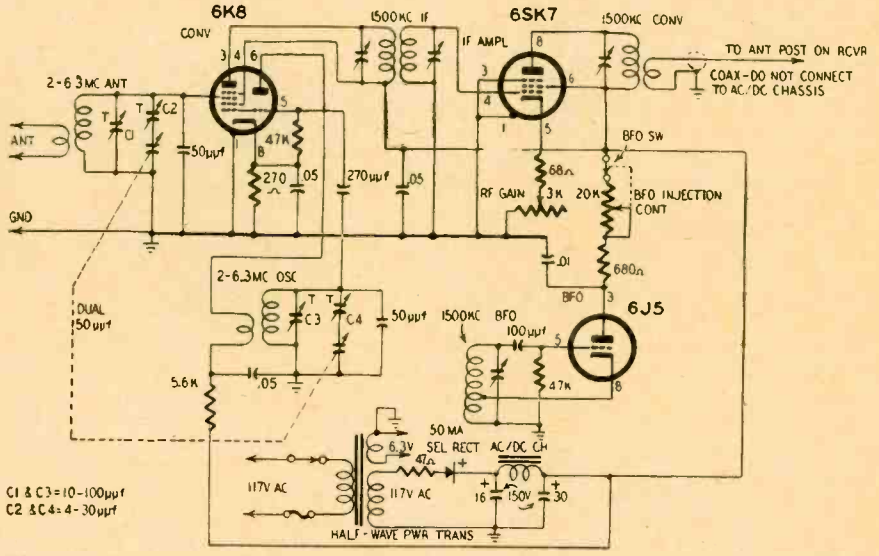
The 25CD6-GB is a replacement for the 25CD6-G and 25CD6-GA. END



Question Box

80-METER NOVICE CONVERTER FOR BROADCAST RECEIVERS

Please print a diagram of a converter that I can use ahead of a 5-tube broadcast set for reception on the 80-meter Novice band. Please use commercial coils and transformers if possible—J. C., Winston-Salem, N.C.



This converter includes a stage of 1500-kc if amplification to increase the sensitivity of the converter–receiver combination and a bfo to permit reception of CW signals. The antenna and oscillator coils may be any available type covering the 75- and 80-meter bands. You can select them from types made by Miller, Stanwyck or Meissner. We suggest that you use a slug-tuned oscillator coil to provide more accurate tuning with this bandspread tuning arrangement.

Connect the output lead to the input of the receiver tuned to around 1500 kc or adjust them for maximum output when receiving an 80-meter signal.

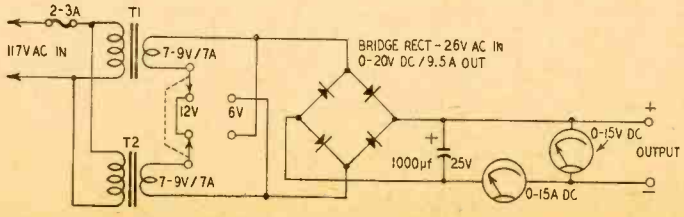
Trimmers C1 and C3 are adjusted to tune in the low end of the band with the 50-$\mu\mu$f tuning capacitor closed. Padders C2 and C4 (and the oscillator tuning slug, if any) are then adjusted to reach the high end of the band with the tuning capacitor almost fully open. Repeat the process several times for optimum tracking.

BATTERY ELIMINATOR

Please print a diagram of a battery eliminator for testing 6- and 12-volt auto radios on the service bench.—I. F., Kew Gardens, N. Y.

This dual-voltage battery eliminator was described in *Tips for the Serviceman*, published by International Rectifier Corp. Two 7-volt transformers (T1 and T2) are switched in series for 12 volts or in parallel for 6 volts output. They may be Triad type F-64U or equivalent, designed especially for this type of service. The secondaries supply 7, 8 and 9 volts at 7 amps. The rectifier is a 26-volt ac, 9.5-amp dc unit such as the International Rectifier type JD-512G. Carefully check the phasing of the secondaries before connecting them permanently.

Readers who have a 6-volt pack can build one for 12 volts only by replacing the switch and T1 and T2 with a single transformer delivering 17–18 volts ac at 6 amps or so. This transformer may be a Triad type F-48U or equivalent.



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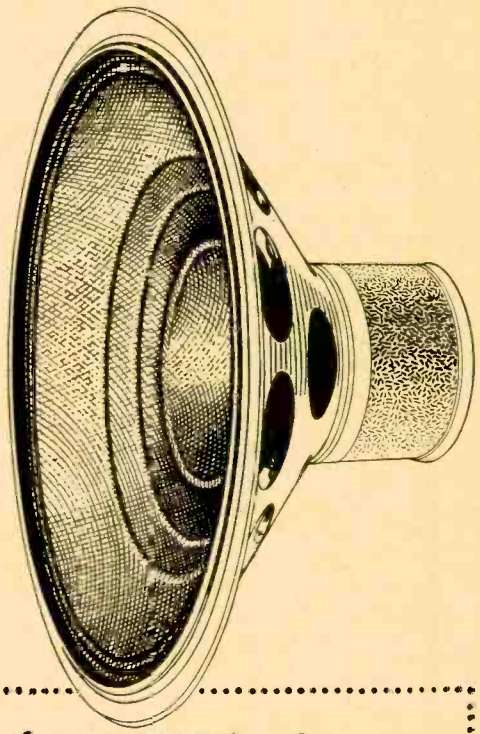
You will hear a remarkable difference in the clarity of Norelco *Full Response Speakers. In a single speaker, twin-cones reproduce low frequencies, middle range, as well as the higher frequencies extending beyond the audible range—without distortion.



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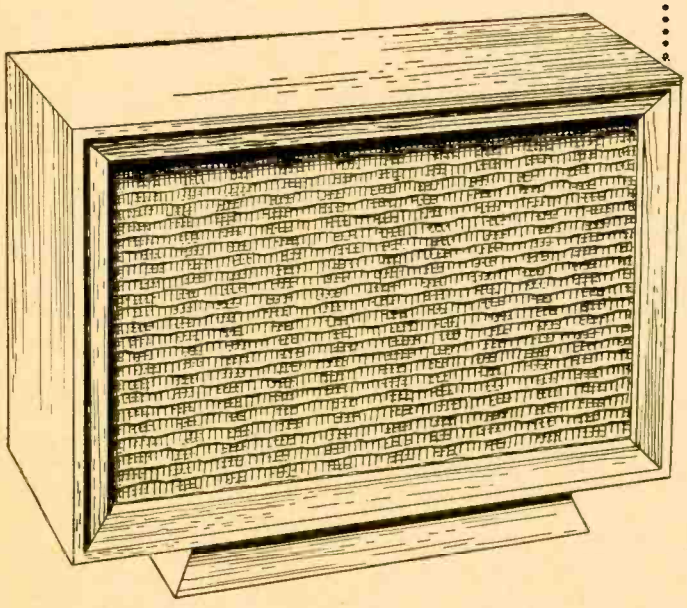

Norelco FRS Improved Bass Reflex Enclosures are available in three sizes; FRS Enclosures I, II and III. Priced from $33.75 to $119.95.

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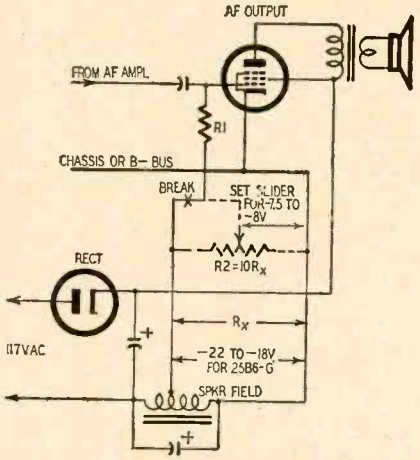
QUESTION BOX *(Continued)*

OBSOLETE TUBE REPLACEMENT

I need a replacement 25B6-G for an American Bosch model 809. Please tell me where I can obtain the 25B6-G or show how I can replace it with a 25L6-GT or similar type.—S. J., Hyde Park, Mass.

The 25B6-G and almost any other obsolete receiving tube that you can name (except the 25B8-GT) can be obtained from Grand Central Radio, 124 E. 44th St., New York, N. Y.

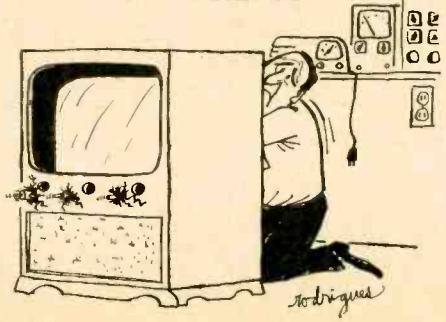
The heater characteristics and base connections of the 25L6 and 25B6 are the same and adapting a set for a 25L6 requires only a change of bias. Under the same typical operating conditions, the bias on a 25L6 is just about half that on a 25B6. We do not have a diagram of the model 809 but other sets of the same make and vintage usually operate with the output cathode returned to the B-minus bus or chassis and grid bias supplied from a resistance network or speaker field between the common B-minus bus and the negative leg of the power supply as shown.



To substitute a 25L6 in this circuit, measure the resistance (R_x) from the bias end of grid resistor R1 to the cathode of the output stage. Connect an adjustable 10-watt resistor (R2) of about 10 times the value of R_x from the bias output source to the cathode of the 25B6. Disconnect R1 from the bias supply and tie it to the slider of R2.

Set the slider to the C-minus end of R2 and plug in the 25L6. Turn on the set and adjust the slider for 7.5–8 volts between grid and cathode.

If the original circuit is biased by a cathode resistor (usually around 300 ohms), replace it with a 2-watt 180-ohm unit and insert a 25L6-GT.



Technotes

PICTURE-TUBE ARCING

The service call was put in for no picture, easily remedied by replacing a 6SN7. With the set back in operation, very strong interference appeared on the screen which looked exactly like ignition noise. The customer said that the interference had been there since she bought the set, had complained about it several times and was told it was the heavy street traffic outside.

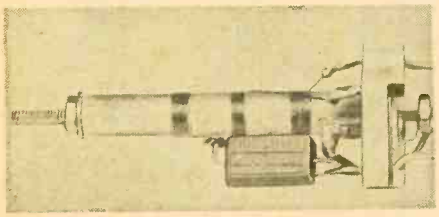
We weren't satisfied with the explanation, especially since there seemed to be no letup in the interference. On closer examination it was discovered that the condition was at its worst at top brightness level and that there was a slight but noticeable improvement as the brightness level was reduced.

This led us to believe that there was arcing in the high-voltage circuit which caused this peculiar condition.

A close check in the high-voltage compartment revealed nothing. On a hunch, the chassis was removed from the cabinet and the 16AP4 was relieved of its plastic insulating boot and ring. The copper high-voltage connector was rubbed down with steel wool and the metal picture tube was cleaned at the point of contact. On reassembly we made certain the connector was firmly planted against the tube. When the set was finally turned on, the customer saw her first interference-free picture in 3 years.—*Frank A. Salerno*

FM DISCRIMINATOR

The photograph shows an FM discriminator coil removed from its shield can. The small mica capacitor is the quadrature or phase-shift device. It is so oriented that its edge points to the



can. If turned about a quarter-turn from this position, the added capacitance to the can (which is grounded to the chassis) reduces the quadrature current. The result is some loss in sensitivity on relatively weak FM stations. This can be corrected simply by twisting the capacitor!—*Louis Sherman*

HICKOK 534 TESTER

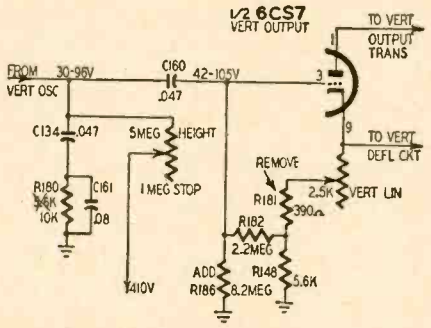
When excessive shorts suddenly show while testing a tube and remain after the testing, you seldom need to make

a search for shorted wires in the tester. The first item to check is the capacitor connected to and mounted on the "shorts" switch. If this component has gone bad, the neon bulb will indicate a short in all positions. Simply replace this capacitor.

Lack of meter response when testing nine-pin miniatures can often be traced to the connection of the lead from pin nine and the switch it ties to. This switch has several of its lugs (solder connections) bent from the deck they are built on toward the next deck and that deck has its lugs bent to meet them. The lugs are soldered together at their meeting point. But as they just barely meet, the connection is not any too strong. The lead from pin nine goes to a junction point, as described, and then is soldered in place. The two adjoining switch lugs may have had their connection with each other weakened if any solder ran off when the wire lead was put in place. If so, the two lugs may break apart just from regular use of the switch.—*Thomas Oda Miller*

CROSLEY CHASSIS 483, 484

On all of the above chassis stamped with code letter E or later, changes have been made to improve vertical



linearity. The diagram shows the circuitry used in chassis bearing the code letter D or earlier, and the changes made.—*Crosley Television Service Information*

SYNTEX FINISH CABINETS

Magnavox Syntex cabinet finishes are similar to conventional wood finishes in that the top coats are sealers and lacquers. The grain and color, however, are printed by applying the desired color ink in a suitable grain pattern to a pigmented base coat. This finish is subject to the same type of damage as wood finishes. Repairs can be made as follows:

Rub marks, abrasions, etc. Sand the mark lightly with 400 grit paper and oil. Polish with rubbing felt, soaked with rubbing oil and rotten stone.

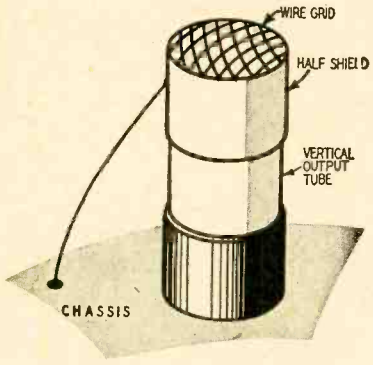
Deep scratches. Heat burn-in knife over alcohol flame, but do not get it too hot. Place knife point in stick shellac of the proper color. (Sometimes two or more colors must be blended to obtain the correct shade.) Force the shellac into the scratch or hole by passing the hot knife blade over the surface. Repeat until the shellac is built up slightly

higher than the surrounding surface. Reheat the knife and pass it over the patch to pick up all excess. Sand the patch with a sanding block using 400 grit paper and oil until the patch is even with the surrounding surface. Polish with rubbing felt, oil and rotten stone.

Large area bruises and deep abrasions. Burn in all defects and sand as outlined for deep scratches. Apply a coat of the proper base coat to the area affected. Allow 30 minutes to dry and sand lightly with 400 grit paper. All edges should be "feathered" out to a smooth, even surface. With a small brush and the proper color ink, grain in the surface to match the surrounding grain. Varying amounts of transparent ink should be blended with the colored ink to obtain the proper depth of color. After the ink has dried, apply one or two coats of clear lacquer to the patched area. If the area is larger, better results will be obtained if the entire top or side is relacquered. When dry, rub with 4/0 steel wool to obtain the desired sheen.—*Magnavox Service News Letter*

VERTICAL CIRCUIT BUZZ

On several occasions I have replaced the vertical output transformer where it appeared to be the obvious cause of buzz. However, a few hours later it proved to be a wrong analysis. This occurred on Admiral and Motorola receivers and the true trouble turned out to be radiation from the vertical output tube; placing the hand over the tube would stop the buzz.



After some experimenting with tube shields, I found the design shown in the diagram by far the most effective cure. The shield covers about 1–1½ inches of the upper section of the tube, with grid wire over the top for better heat dissipation. A ground wire is connected from the shield to chassis. *A full shield covering the entire tube will not work.* Most often the trouble has occurred with 6W6 vertical output tubes.—*Mel Fineburg*

RCA 65BR RADIO

Failure to operate on battery and a battery discharging rapidly are the symptoms of a short-circuited buffer capacitor (.002-μf 1,000 volts). Replace this component with a good-quality 1,500-volt unit.—*Louis Sherman* END

radio-electronic Circuits

BRITISH KEYED AGC

We generally visualize an age keyer as a pentode whose plate is driven by the horizontal output circuit. An article in *British Radio and Television* magazine describes two keyed age circuits developed for use with Britain's positive-polarity transmission system. The circuit in some Murphy TV sets takes the keying pulses from the vertical output circuit and some Ferguson sets use *diodes keyed by sync pulses. The basic circuits are shown.*

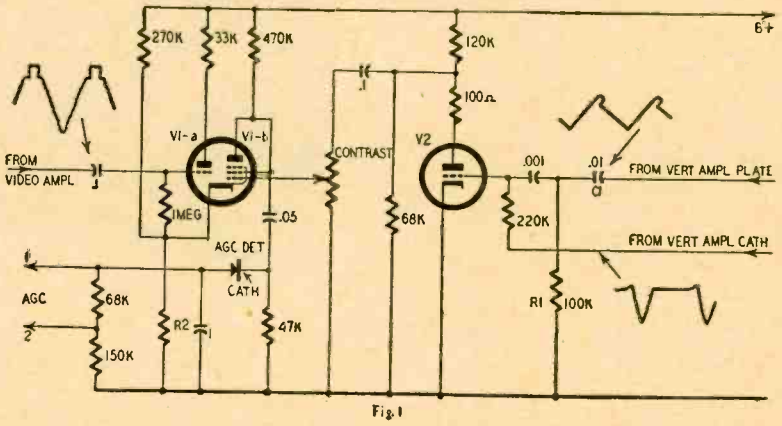


Fig. 1

In the Murphy circuit (Fig. 1), the age diode is coupled to the composite video signal through a switching circuit that is closed during the vertical retrace period. Flyback pulses are taken from the plate of the vertical amplifier, differentiated by C1-R1 and applied to the grid of V2. The negative portion of the differentiated signal occurs slightly later than the flyback pulse and coincides in time with the blank lines developed during the retrace interval. This negative-going signal makes V2's grid more negative and produces a positive pulse in the plate circuit. This pulse keys the age circuit.

A negative-going composite video signal is fed to the triode section of V1 and appears in the same phase across the cathode resistor common to the triode and pentode sections (V1-a and V1-b). The pentode section is cut off by a fixed B-plus voltage applied to its cathode and remains so regardless of the signal at cathode resistor R2. The pentode conducts only during the period that positive keying pulses from V2 reach the plate of V1-b simultaneously with the arrival of negative sync pulses on the cathode. The pulses fed from the plate of V1-b to the age diode vary in amplitude in accord with the blanking level of the incoming signal. The age voltage is filtered and split into two levels for the if and rf circuits.

Fig. 2 is the basic circuit used by Ferguson. The circuit is keyed by *sync pulses.* Sync pulses from the plate of the sync separator are differentiated by C1–R1 and fed to the grid of V2 along with composite video from a video amplifier. The amplitude of the signal on V2's grid is the sum of the video amplitude at the blanking level and the sync-pulse amplitude.

V2 is biased in its cathode circuit so it conducts only during the positive half of the applied signal. A negative-going

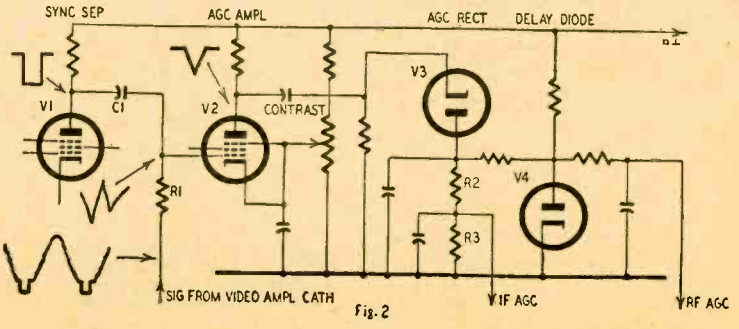
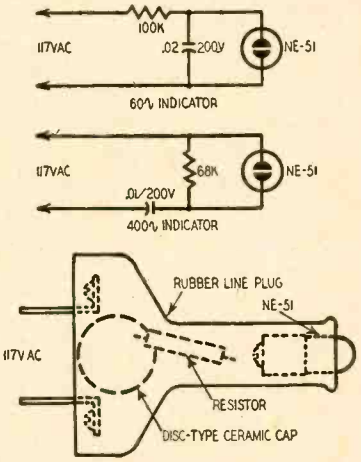


Fig. 2

pulse whose amplitude depends on the setting of the contrast control and the amplitude of the incoming signal appears at the plate of V2. This pulse is rectified by V3 to develop an agc voltage across R2 and R3. The rf agc voltage is delayed by V3. At low signal levels, the plate of V4 is positive so this diode conducts and effectively grounds the rf agc line. As the signal strength increases, V3's plate becomes less positive and some control voltage is permitted to reach the radio-frequency circuits.

FREQUENCY INDICATORS

Industrial electricians, laboratory workers and others who have more than one power-line frequency available may have use for these simple frequency indicators. These gadgets are used to determine whether the line frequency is 60 or 400 cycles; however, the principle can be applied to check



any pair of frequencies that are reasonably far apart—say a ratio of approximately 2 to 1.

While it is possible to combine both gadgets into one physical unit, experience shows that separate units prevent confusion and simplify construction. The total cost of both units is about $1.

In these gadgets the indicator is a neon lamp. Since the lamps light up or glow at approximately 50 volts rms, the circuits are arranged to provide either 25 or 85 volts to the lamp at appropriate frequencies. A resistance–capacitance voltage divider will accomplish this, because the voltage drop across a capacitor is low at high frequencies and high at low frequencies, varying with reactance.

All components of each unit are mounted inside a standard (long-handled) rubber ac plug. I used ½-watt carbon resistors, disc type 200-volt capacitors and NE-51 neon lamps. It was necessary to cut slots inside the plug so that the capacitor could be jammed into the plug body. The neon lamp just barely pokes out of the handle. Be sure to mark (red paint is good) each unit plainly with the frequency at which the neon lamp will glow.—*David H. Bryan* END

Patents

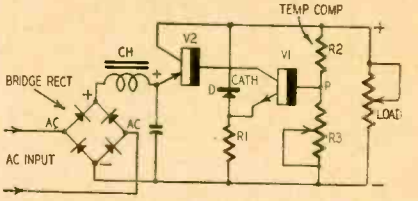
TRANSISTORIZED VOLTAGE REGULATOR

Patent No. 2,751,549

Fay H. Chase, Short Hills, N. J. (Assigned to Bell Telephone Labs, Inc., New York, N. Y.)

This regulator uses transistors instead of tubes. V1 is the control transistor which biases V2 in series with the load. For example, if the output voltage rises above normal, V2 is biased for greater resistance. This tends to reduce the output and return it to its normal voltage.

Two branches shunt the load. One comprises D and R1, to bias the emitter of V1. D is a junction *Zener* diode which maintains constant voltage drop over a wide range of current. The second branch, R2–R3, biases the base of V2. If the load voltage rises, the entire increase is applied to the emitter (since the voltage across D cannot change). Only a fraction of this increase appears across the base, however. Therefore the *emitter* goes more positive than the *base*. V1 is an n-p-n unit so its conduction is lowered. This smaller current is coupled into V2 to raise its



internal resistance. The result is less current from the bridge rectifier and the choke CH. The load voltage thus returns to normal.

R2 is used for temperature compensation. Its coefficient is positive so its resistance rises with temperature. This resistor offsets the temperature sensitivity of D which also has a positive temperature coefficient.

UHF MARKER GENERATOR

Patent No. 2,752,492

Harry R. Foster, Lake Valhalla, and Elmo E. Crump, W. Caldwell, N. J. (Assigned to Ohmega Laboratories, Pine Brook, N. J.)

The uhf TV band is so wide that it poses a big problem for the technician. With 70 channels, he needs 140 crystals to mark all the video and sound carriers in the band. This new method needs just a single crystal, a harmonic generator and a 2.25-mc amplifier, but it can provide all carrier markers through the band. (See Fig. 1.)

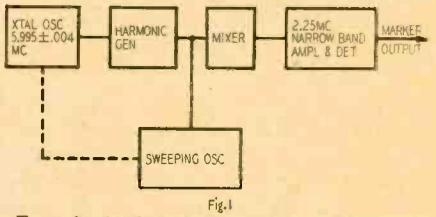


Fig. 1

To understand the method, a typical passband is drawn in Fig. 2. The lowest channel in the band, it is 6 mc wide. Midway between the video and sound carriers is a line indicating 473.5 mc, which is very close to the 79th harmonic of the crystal. When the sweep generator passes through either carrier, it sets up a 2.25-mc beat with the harmonic. This beat is amplified, making available a pip for the scope and marking *both* carriers.

A similar condition exists for the other channels. In every case a crystal harmonic lies very nearly midway between the sound and picture carriers, so the correct beat occurs when the carrier frequency is swept through.

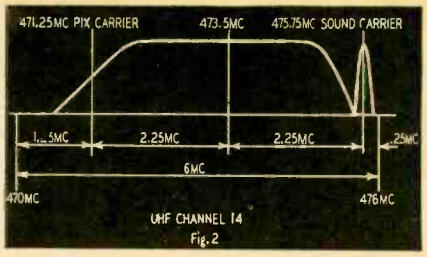


Fig. 2

Each channel is 6 mc wide so we might expect a crystal frequency of exactly 6 mc. However, 473.5 is not an exact multiple of 6 and therefore no other center frequency (between carriers) can be an exact multiple. Channel 49 has a center frequency of 683.5 mc which is practically equal to the 114th harmonic of 5.995 mc. Thus the markers are very accurate on this channel. A slight error occurs on channels at either side of channel 49. The maximum error occurs on channels 14 and 83. It amounts to approximately 0.17 mc.

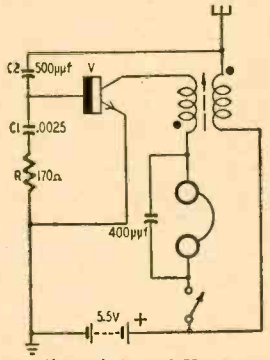
TRANSISTOR SUPERREGENERATOR

Patent No. 2,751,497

Robert S. Duncan, Orange, N. J. (Assigned to Bell Telephone Labs., Inc.)

The superregenerative circuit is the simplest and most sensitive radio receiver. This one uses a transistor so it is the most compact as well. It is designed for the broadcast band.

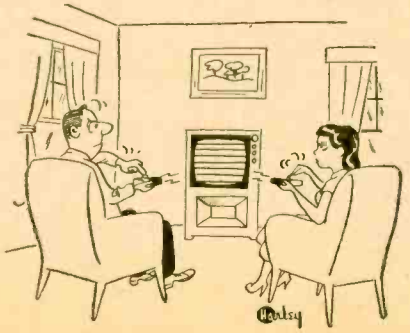
When the switch is closed, the n-p-n transistor V is energized by the battery. Output of V is fed back through the transformer to the base for required regeneration. Tuning is done by a pair of identical coils closely coupled and wound over the same adjustable core. R and C1 form a self-quenching network. Initially, V conducts and it oscillates. C1 begins to charge and its polarity is such as to oppose conduction. Finally the transistor gain drops too low to sustain oscillation.



C1 discharges through R and V, after which the transistor again begins to conduct and oscillate. With component values shown here, and a type M-1752 transistor (cutoff 3.5 mc) the oscillations are interrupted at an ultrasonic rate.

This superregenerator has all the features of a tube circuit. It receives only one station at any time (the strongest). Due to limiting action, this circuit reproduces nearly all signals with the same volume output. A single dial tunes in all stations and there are no ganging problems. Signals in the order of a few microvolts can be reproduced.

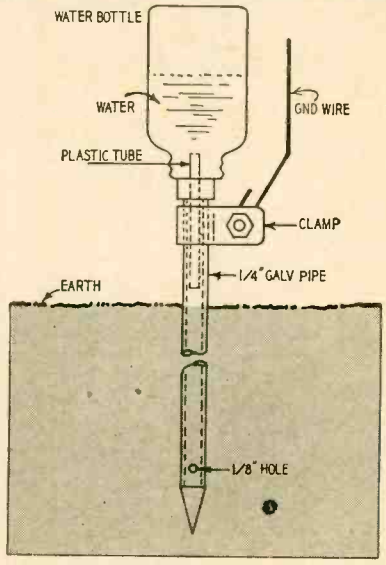
With proper choice of C1 and C2, the gain remains constant all over the band. This is because these capacitors form a voltage divider which feeds back more voltage at higher frequencies, compensating for the fact that all transistors show a response that droops at higher frequencies.



A LOW-RESISTANCE GROUND

A good ground is useful on many electronic devices—a necessity on dx radios. Where rain is infrequent, or the soil may be dry for other reasons, some kind of automatic soil moistener is needed. Such an attachment is easy to make. Into one end of a 5- or 6-foot length of common ¼-inch galvanized pipe drive a steel plug. This can be made out of about 3 inches of ½-inch diameter rod. The diameter should be ground down to about 3/16 inch for ¾ inch of its length so that it can be driven firmly into the piece of pipe up to the shoulder and leave about 2¼ inches projecting. Next grind this projection to a blunt point and drill a ⅛-inch drain hole right through the pipe just above the top end of the plug. This is a drain hole.

Drop a 3/16-inch hexagon-head machine screw into the opposite end of the piece of pipe. It should just slide in to make a driving head and protect the end of the pipe from mushrooming. Drive the pipe into the earth where the ground lead is desired. Drive carefully so as not to bend the pipe and leave about 6 inches projecting above the dirt level. Fill the pipe with a solution of copper sulphate in water. This deposits copper film on the inside of the pipe



where the galvanizing may not be so good and also increases the conductivity of the soil near the bottom of the pipe where the solution leaks out through the two holes.

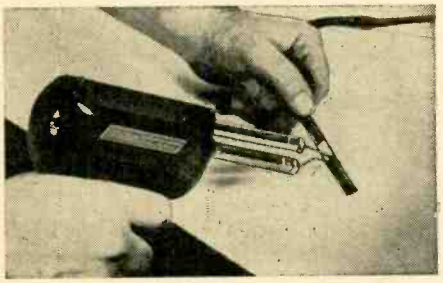
Fasten the ground wire to the pipe by a clamp. The ground is now ready for use but the earth must be kept moist by pouring more water into the pipe.

(Continued)

This can be made automatic by taking a bottle that holds around a half-pint or so and drilling a hole through its cork so that a 2½-inch length of ¼-inch outside diameter plastic tube can be forced in. Fill the bottle with water, put in the cork with the tube, invert into the pipe ground and the water will automatically feed into the pipe and thus keep the ground at the lower end moist and of low resistance. A sketch of the arrangement is shown in the drawing. The bottle should be filled once a month; I find that mine takes about three weeks to empty.—*George P. Pearce*

USE FOR SOLDERING GUN

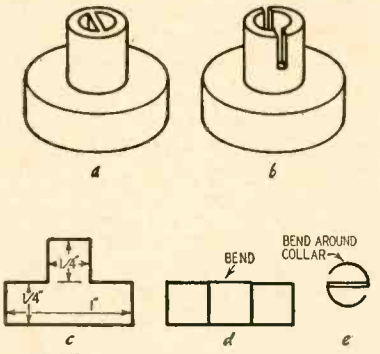
The electric soldering gun is useful in skinning ribbon type TV lead-in out of doors. A gun maintains a more constant heat. Other types of electric irons



cool more rapidly because of the larger surface exposed to the wind. The photo shows the technique of using a gun for stripping ribbon quickly and neatly.—*Joseph F. Whitaker*

G-E 613 PORTABLE RADIO

The knob operating the volume control and on–off switch is 3¼ inches in diameter and comes in a variety of colors so it is not easy to match exactly. This knob fits a slotted shaft (a) and the most common trouble is breaking of the center section which engages



the slot (b).

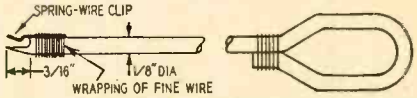
Put a slot in the remaining collar of the knob. This is easily done by heating a piece of metal cut from a tin can and pressing it down edgewise on the collar. The slot should be about ¼-inch deep.

Next, cut a piece of tin ¼ inch with a ¼-inch tongue in the middle (c). Bend over the tongue (d) and slip it in the slotted collar. Bend the ends of tin around the collar (e).

Similar repairs can be made on many hard-to-replace radio and TV knobs. Never cement a knob to a shaft. It's too rough on the next service technician.—*Paul Falk*

TURRET-SPRING TOOL

The drawing shows the construction of a simple tool that I made to grip drum springs when removing or installing drums in turret tuners. An 8-inch length of stiff wire (about No. 8) is bent and filed as shown. The spring clip



on the tip is made from a piece of brass paper clip fastened to the shank of the tool with a wrapping of fine wire. The handle is bent and the free end anchored with a similar wrapping of fine wire. —*Bruce E. Walther*

DIAL-STRINGING AID

A thick paste made by mixing powdered rosin and carbon tet is handy to have around when restringing dial cords. Where the dial cord is likely to slip off the drum or pulley before the job is completed, use a small gob of the paste to hold it in place. When the job is completed, use carbon tet to remove the paste. The rosin left on the cord will minimize the slippage in the future and make for a more positive hold. –*A. von Zook*

TRY THIS ONE

VTVM MEASURES RESISTANCE

The vtvm is an ideal instrument for measuring resistances as high as 100,000 megohms with accuracy of few percent. All you need, in addition to the vtvm, is an external power supply delivering approximately 100 volts or more.

Connect the unknown resistance in series between the power supply and the meter and calculate the value from the formula

$$R = \frac{(V1 - V2) \times R_m}{V2}$$

where R is the unknown resistance in megohms, V1 the supply voltage, V2 the voltage read on the meter with R in series with one of the leads and R_m the input resistance of the meter in megohms.

RESISTANCE MEASUREMENT TABLE

Meter reading (V2) 50 volts	Unknown resistance (R) megohms
50	11
33	22
20	44
10	99
5	209
4	264
2	539
1	1,089
0.5	2,189
0.3	3,652
0.2	5,489
0.1	10,989

(Continued)

The table gives sample values of V2 and R when V1 is 100 volts and R_m is 11 megohms. Multiply the meter readings in the table by 2 when V1 is 200 volts, by 3 when V1 is 300 volts and so on.—*George S. Carson* END

ANSWERS TO THE WRONG QUIZ

1. Choice d is *wrong*. The explanation, with replacement of the word *hard* with *soft* (meaning, containing gas) would have been correct. Blue glow in a tube generally must be studied in each case since it is normal in some cases, abnormal in others.

2. Choice b is *wrong*. While sparking between tube elements and red-hot plates specifically indicates excess current drain, where the tube is a rectifier, there are clear indications to suspect a shorted filter capacitor in all cases. It would be costly to replace the rectifier tube if the filter were shorted—the new tube would burn out right away.

3. Choice a is *wrong*. It is axiomatic that control grids are always negative, except in *trick* circuits. Use a vtvm for measurement since current in the grid circuit is generally so small that an instrument of lesser sensitivity would *load down* the circuit, giving an incorrect grid voltage reading.

4. Choice d is *wrong*. It's easy to blame the dealer or service technician when parts continue to fail. No dealer can long remain in business selling faulty components. (Some do under various names. Use a reputable concern.—*Editor*) Check every possible circuit fault before blaming the supply.

5. Choice d is *wrong*. In a series-fillament circuit when one filament goes out they all do. Be careful with small tubes which do not light brightly or get very warm. Do not mistake them for dead tubes.

Business

Merchandising and Promotion

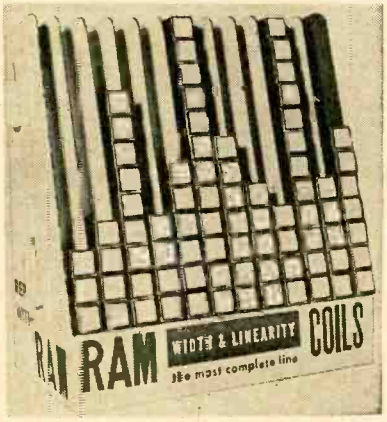
RCA tube Division, Harrison, N. J., prepared a brochure on its industrial tubes from a series of advertisements which are appearing in *Fortune* magazine.

Astron Corp., East Newark, N. J., has a new display kit the "Swing Bin

Baby" which holds 45 of its Blue Point capacitors in the 9 most popular models.

CBS-Hytron was presented with the Friends of Service Management Award of NATESA on a recent Garry Moore TV show, sponsored by CBS-Hytron.

Ram Electronic Sales Co., Irvington-on-Hudson, N. Y., designed a new dis-



tributor counter and wall display for its width and linearity coils.

Radio-Electronic Master, Hempstead, N. Y., shipped out its 1957 *Radio Electronic Master* with a three-color display unit.

RCA Institutes, New York, N. Y., produced a 16-mm color motion picture "Your Career in Electronics" for high-school showings.

Winegard Co., Burlington, Iowa, will promote the aluminum anodized protection feature of its Umbrella-Ease TV antenna during 1957.

BUSINESS *(Continued)*

International Electronics Corp., New York, N. Y., American representative of Mullard Overseas Ltd., England, re-

ports that the company is packaging its electronic tubes with blue plastic pin protectors to avoid damage in transit.

Electronic Chemical Corp., Jersey City, N. J., is shipping its no-noise volume control, contact restorer and

no-noise tuner tonic in colorful corrugated cartons which double as display units.

New Plants and Expansions

Triplett Electrical Instrument Co., Bluffton, Ohio, has broken ground for a new plant to be constructed in Oceanside, Calif.

Raytheon Manufacturing Co. opened a new Electronics Laboratory in Maynard, Mass.

Sylvania Electric Products, Inc. is building a 50,000-square-foot addition to its Electronics Division headquarters in Woburn, Mass. The company is also planning a multimillion-dollar research and development center in Amherst, N. Y., for its Electronic Systems Division. The Sylvania Radio & TV Division moved from Buffalo to Batavia, N. Y.

The **RCA Semiconductor Div.** is now located in new quarters in Somerville, N. J.

Daystrom, Inc., Elizabeth, N. J., has negotiated for the purchase of Ford Engineering Co., Inc., Upland, Calif., potentiometer manufacturer.

CBS-Hytron opened a new sales office and warehouse in Seattle, Wash., under the direction of Leo McCabe.

Sangamo Electric Co. opened a $5 million 200,000-square-foot manufacturing plant in Pickens, S. C.

Allied Radio Corp., Chicago, is now operating Voice & Vision of the same city, well known high-fidelity retail establishment, as a franchised store. Voice & Vision will get full advantage of Allied's extensive advertising and promotion campaigns.

RETMA expects to consolidate and move its Washington D. C., head-

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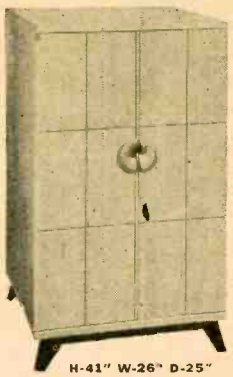

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21"—Rectangular	16⅛" x 21¼"	6.92
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Used in conjunction with safety glass

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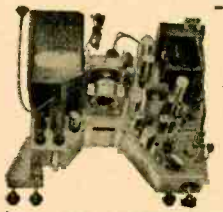
24"—Rectangular	21" x 26" 4.93
27"—Rectangular	21" x 26" 4.93

Mention type number of CRT used

TV SAFETY GLASS in HANDY SIZES

16" x 20" $2.94	*18" x 22½" $5.16
16" x 22" 3.97	*21" x 26" 5.87

*Available in new tinted grey 50c extra



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Fits All 12½" to 21" picture tubes

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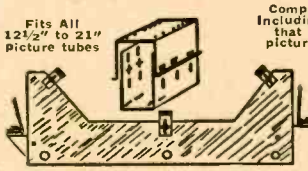

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200 – SELF TAPPING SCREWS #8 x 5/8"	$1
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35 – ASST. RADIO KNOBS screw and push-on	$1
100 – KNOB SPRINGS standard size 3/8" x ½"	$1
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50 – ASST. CERAMIC CONDENSERS.	$1
10 – ASST. VOLUME CONTROLS less switch	$1
5 – ASST. VOLUME CONTROLS with switch	$1
20 – ASST. PILOT LIGHTS #44, 46, 47, 51	$1
10 – PILOT LIGHT SKTS. bayonet type, wired	$1
50 – ASST. TERMINAL STRIPS 1, 2, 3, 4 lug	$1
10 – ASST. RADIO ELECTRO. CONDENSERS.	$1
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50 – 3.3Ω 1 WATT RESISTORS 10%	$1
50 – 3900Ω 1 WATT RESISTORS 10%	$1
50 – 15KΩ 1 WATT RESISTORS 10%	$1
50 – 27KΩ 1 WATT RESISTORS 10%	$1
50 – 120KΩ 1 WATT RESISTORS 10%	$1
50 – 150KΩ 1 WATT RESISTORS 5%	$1
50 – 470KΩ 1 WATT RESISTORS 10%	$1
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1 – TV SYNCHROLOC TRANSFORMER #208T8	$1
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1 – LATEST GOLD GRILL CLOTH 12" x 18"	$1
1 – LB SPOOL ROSIN CORE SOLDER 40/60	$1
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3 – TV ALIGNMENT TOOLS 7", 12", 18"	$1

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TELEPHONE COrtland 7-2359

BUSINESS *(Continued)*

quarters to a new building at 1721 De Sales St. in Northwest Washington, about Feb. 1.

Newark Electric Co., Chicago, announced an extensive expansion program for 1957, including plans for a 35,000-square-foot building in Inglewood, Calif., with occupancy planned for early fall.

Microtran Co. moved to a new plant in Valley Stream, N. Y.

Business Briefs

. . . **RETMA** launched an extensive drive to stamp out the growing tube counterfeiting racket. A standing committee was appointed to enlist the cooperation of the entire industry.

. . . **Service Instruments Corp.**, Addison, Ill., which was recently incorporated, changed its trade name from Senco to Sencore to eliminate confusion with other firms. The company also enlarged its production facilities.

. . . **Sylvania** Radio & Television Division will not enter the factory service field, according to an announcement by Robert L. Shaw, general manager.

. . . **Hughes Aircraft Co.**, executive Joseph S. O'Flaherty, manager of the Semiconductor Div., estimated that the sales volume of the semiconductor industry in 1956 totaled between $55 and $60 million. He anticipated that this would increase to $300 million by 1960.

. . . **1957 Electronic Parts Distributors** Show applications increased 35% over the same time the previous year, according to Kenneth C. Prince, general manager of the Show Corp.

. . . **RCA Institutes**, New York awarded diplomas to 177 graduates at commencement exercises in New York.

. . . **Elgin National Watch Co.** Elgin, Ill., reports that its Neomite relay is now stocked by leading distributors throughout the country.

. . . **Allen B. Du Mont** Laboratories, Inc., Cathode-Ray Tube Division, Clifton, N.J., has expanded its replacement TV picture-tube line through the addition of 13 new types, ranging from 12- to 24-inch diagonal sizes.

. . . **RCA** awarded 29 scholarships for the current academic year to university students majoring in science, industrial relations, drama and music. END

CORRECTION

Mr. Lipson, of Philmore Manufacturing Co., points out that the battery is reversed in the diagram of their transistorized receiver on page 134 of the January issue. We were misled by the manufacturer's use of a battery symbol opposite to that used conventionally. The longer lines of the symbol were used as negative. In this, and most other publications, the longer line indicates a positive plate or battery connection, and the polarity symbols were inadvertently drawn in to agree with the convention.

It was also noted that the switch was moved to the opposide side of the battery in the set in the photo. This change was made to simplify wiring.

People

James H. Owens (left) was promoted to advertising and market research manager of the recently created RCA Components Division, Camden, N. J. Associated with the company for a number of years, he has most recently acted as promotion manager of Elec-

tronic Components Marketing. **Joseph J. Kearney,** former equipment and parts promotion manager of the RCA Tube Division, was named manager–distributor and industrial sales of the new Components Division.

Walter E. Peek was named general sales manager of Centralab, a division of Globe Union Inc., Milwaukee, Wis. He has been sales manager of Centralab electronic mechanical products. He has a background of 20 years in the industry with such firms as Arvin Industries, P. R. Mallory & Co., Colonial Radio, and General Instrument.

Brig. Gen. David Sarnoff, chairman of the board of RCA, recently received a bronze plaque from the National Electronic Distributors Association (NEDA) in commemoration of his 50th

year in the industry. Photo shows **Joseph A. De Mambro,** left, NEDA president, making the presentation.

Thomas L. Dowell, field promotion manager for Alliance Manufacturing Co., Alliance, Ohio, was promoted to jobber sales manager of the company.

Donald B. Harris, General Electric Microwave Laboratory, was elected chairman of the 1957 Western Electronic Show & Convention (WESCON). **Norman H. Moore,** vice president of Litton Industries, was named vice chairman. Photo shows C. Frederick Wolcott, left, 1956 WESCON chairman, presenting the gavel to Harris.

Joe H. Morin, a veteran in the electronic field, was named to head the sales activity of the newly created Industrial Service Dept. of Howard W. Sams & Co. He has been with the firm since 1953.

Irvine D. Daniels, manager of the General Electric Receiving Tube Dept. plant, in Owensboro, Ky., was named general manager of the department.

Louis W. Selsor was named general sales manager of Electro-Voice, Inc., Buchanan, Mich. He comes to the firm from Jensen Manufacturing Co., where he had been the distributor sales manager.

Obituary

Charles Fenton, founder and president of Fenton Co., New York manufacturer of high fidelity and other industry products, and treasurer of the Institute of High Fidelity Manufacturers.

James P. Quam, chairman of the board and founder in 1930 of the Chicago firm, Quam-Nichols Co., manufacturer of speakers and various other electronic components, recently at his winter home on Casey Key near Venice, Fla.

Personnel Notes

. . . **Robert Beebe** has been named acting sales manager of Commercial Product Sales for the Electronics Division of Thompson Products, Cleveland, Ohio. He was formerly district sales manager for the divisions Superotor TV antenna rotator. He succeeds Larry Kline who resigned last December to open his own high-fidelity and sound equipment distributing firm in Cleveland.

. . . **William R. Johansen**, government sales coordinator of Simpson Electric Co., Chicago, was given additional responsibilities as assistant sales manager.

. . . **Henry Hirsch** joined Sylvania Electric Products, New York, from Batton, Barton, Durstine & Osborn advertising agency, as general manager of the Electronic Products Sales Dept. **Matthew J. Hughes** was appointed electronic product special sales representative for national accounts. He had been electronic product district sales manager in the company's Teterboro, N. J., sales office.

. . . **Harold S. Stamm**, advertising and sales promotion manager of the RCA Tube Div., Harrison N. J., announced the following advertising and sales promotion staff assignments: **G. G. Griffin** to manager–product advertising and sales promotion; **R. A. Huff**, manager of advertising and sales promotion, entertainment market; **F. X. Banko**, manager of advertising and sales promotion, industrial market; **A. J. Jago**, administrator–budgetary and cost controls; **E. B. May**, administrator–advertising and sales promotion; semiconductors; **J. J. Phillips**, administrator–shows and exhibits, and **H. M. Slovik**, administrator–publications.

. . . **William J. Halligan, Sr.**, founder and president of Hallicrafters, Chicago, a subsidiary of Penn-Texas Corp., was named a director of Pratt & Whitney Co., another Penn-Texas subsidiary.

. . . **Pat Malone**, former Chicago electronic parts distributor, joined Standard Coil Products Co., Melrose Park, Ill., in an advisory engineering capacity.

. . . **Hiram A. Prince**, Southwestern Division sales manager for Permo Inc., Chicago, was promoted to the newly created position of assistant general sales manager. He will assist with the administration of the sales policy for Fidelitone phonograph needles and accessories. **J. W. (Jim) Crudgington**, formerly with McGregor's Inc., Memphis distributor, replaces Prince.

. . . **Paul V. Galvin**, former president of Motorola, Chicago, became chairman of the board and continues as chief executive officer. His son, **Robert W. Galvin**, executive vice president was elected president. **William S. Wheeler**, former staff aide was named assistant to the president.

. . . **Harvey Williams** joined Philco Corp., Philadelphia, as president of Philco International Corp. He had been a vice president at Avco Manufacturing Corp. END

technical Literature

ELECTRONIC SUPPLIES

Catalog No. 300 describes and illustrates transistors, TV parts, optical, radio and public-address equipment and other electronic offerings of the maker.

Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

GENERAL EQUIPMENT

An assortment of supplies for radio, television, amateur, high-fidelity and industrial electronics needs is offered in *Catalog-Flyer No. 66.*

Newark Electric Co., 223 W. Madison St., Chicago 6, Ill.

SHORTWAVE LISTENING

In *Tuned to Tomorrow,* the reader finds an article on getting started in shortwave listening by Oliver P. Ferrell, managing editor of *Popular Electronics,* and various dx log sheets for practice.

National Co., Inc., 61 Sherman St., Malden, Mass.

HI-FI EQUIPMENT

This 1957 high-fidelity catalog deals with the space-saver as well as the deluxe system in four sections—amplifiers, tuners, record and speaker changers—each of which is prefixed by an explanation of that component's role in a hi-fi system.

Hudson Radio and TV, 48 W. 48th St., New York, N. Y.

MAGNETRONS AND TRAVELING-WAVE TUBES

RCA Magnetrons and Traveling-Wave Tubes, MT-301, describes the theory of operation of magnetrons and traveling-wave tubes, presents operating considerations and applications, and gives techniques for measurement of important electrical parameters. Illustrations show the structural parts of both tube types, typical performance characteristics, test methods and representative circuit applications. Data is given for four commercially available RCA magnetrons and one traveling-wave tube. An extensive list of references is also included.

Commercial Engineering, RCA Tube Division, Harrison, N. J.

RECTIFIERS

New assistance is offered the engineer in designing for fault currents, determining maximum forward current under various conditions, evaluating methods of cooling and making thermocouple measurements in a new brochure of application notes on the 4JA60 series of small high current silicon rectifiers. *ECG-148A* includes characteristic

TECHNICAL LITERATURE *(Continued)*

curves for power dissipation, instantaneous forward voltage drop, maximum allowable surge current at maximum rated load conditions and fin size requirements under various ambient conditions for both free convection and forced convection of air.

General Electric Co., Semiconductor Products Department, Electronics Park, Syracuse, N. Y.

LOUDSPEAKERS

Speaking About Loudspeakers combines text and cartoons in its 32 pages in its intent to answer basic popular queries of the manufacturer. Written at the layman's level, it provides a groundwork from which the general public and hi-fi enthusiasts can follow the operation of various type speakers in their appraisal of performance.

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y., 10c.

KITS

The specifications and applications of many test, amateur and hi-fi equipment kits are graphically illustrated with schematics and photographs in a 55-page catalog.

Heath Co., Benton Harbor 20, Mich.

REPLACEMENTS

A new manual of replacement transformers, yokes and coils arranges manufacturers' model and chassis numbers in alphabetical and numerical reference.

Rogers Electronic Corp., 43-49 Bleecker St., New York 12, N. Y.

RADIO & ELECTRONIC COMPONENTS

B5 contains condensed but comprehensive descriptions of the manufacturer's line of radio-electronic products, as well as engineering and electrical data. Parts are completely indexed, grouped by their uses, related items, dimension drawings, mounting diagrams, and illustrated.

Amphenol Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

CAPACITORS

C-455 simplifies the task of the service technician in ordering the right electrolytic, ceramic or paper tubular capacitor since it presents all the capacitors needed for radio-TV replacements in wall-calendar style for hanging near telephone or work bench.

Sprague Products Co., 81 Marshall St., North Adams, Mass., 10c.

GENERAL MIKE CATALOG

Microphone Catalog S-442 offers complete line of Astatic professional, general and amateur microphones, microphone accessories and cartridges with photographs and line drawings showing various applications and uses.

An entire section describes the new Futura series of dynamic microphones, their specifications, features and performance, plus architect's and engineer's specifications.

Astatic Distributors, or Astatic Corp., Conneaut, Ohio; attention: Director of Sales.

Books

TAPE RECORDERS AND TAPE RECORDING by Harold D. Weiler. Radio Magazines, Inc., Mineola, N.Y. 5½x8¼ inches, 190 pages. Paper bound $2.95, hard cover $3.95.

Many amateur recordists don't realize that they may miss half their opportunities by not learning more about their machine. Microphone placement, special sound effects, proper maintenance, all add up to better performance and more complete satisfaction. This book, for amateurs and semiprofessionals, is clearly written and well illustrated.

Starting with sound and human hearing, the author continues into microphone technique and acoustics. He describes approved methods for recording small orchestras, choirs and other groups, how to record from a phono or radio and how to add sound to home movies.

Other topics cover editing and splicing tape, checking machine speed and alignment of recording heads. One chapter will show you how to create special sound effects: rain, campfire, snapping of twigs, etc.—*IQ*

THE THEORY OF SOUND, by Lord Rayleigh. Dover Publications, Inc., 920 Broadway, New York 10, N. Y. 5½ x 8 inches. Vol. 1, 480 pages, $1.95; Vol. 2, 504 pages, $1.95.

These are the unabridged volumes by the famous Nobel Prize winner and pioneer in the field of sound. Vol. 1 begins with an historical introduction and account of Rayleigh's life. Then it proceeds into his mathematical theory of vibrations of strings, bars, membranes and plates. The last chapter (on electrical vibrations) considers bridges, transmission lines and other ac circuits. Vol. 2 goes into the theory of sound propagation through the atmosphere, pipes, chambers and apertures. Topics include singing flames, Doppler's principle, whispering galleries, speaking trumpets, the facts and theories of hearing.

Rayleigh was not only a skilled mathematician but an ingenious experimenter as well. His experiments with bells, musical instruments, singing flames, binaural hearing, etc. make very interesting reading. Readers will sympathize with the problems of 19th-century physicists. Needing an "interrupter" or ac generator for bridge experiments, Rayleigh devised complicated apparatus including a jet of fluid and a tuning fork to make and break a battery circuit periodically. Today a simple transistor oscillator would do.

ELECTRONIC MEASUREMENTS AND MEASURING INSTRUMENTS, by F. G. Spreadbury. Essential Books, Inc., Fair Lawn, N. J. 5½ x 9 inches, 459 pages. $8.

Progress in science is linked with the ability to make and duplicate precise measurements. Modern electronics has greatly influenced the techniques for measuring frequency, time, light and various electrical quantities. This book explains theoretical methods and describes practical instruments for making measurements. Since the accuracy of any instrument depends upon the stability of its components, the author also covers the characteristics of tubes, meters, photocells, bridges and power supplies. Equipment is illustrated with schematics, photos and basic equations.

A large portion of the book is devoted to tubes and tube meters. The treatment is complete and clear, and encompasses calibration, probes, rectification, zero setting, etc. Ample space is also given to oscillographs, stroboscopes, electron optics, bridges, oscillators and amplifiers. Less well known devices such as meters for measuring moisture, phase differences and short circuits are also included.

The book concludes with a chapter on transformer design, test-set construction, shielding and other topics of interest to the laboratory and maintenance technician.—IQ

ELECTRONICS IN INDUSTRY (2d Edition), by George M. Chute. McGraw-Hill Book Co., New York, N. Y. 431 pages. $7.50.

The second edition of an old reliable work covering most phases of industrial electronics, revised and brought up to date. Chapters have been added to include servomechanisms and non-electronic devices including transistors, thyrites, magnetic amplifiers and the like. More complete coverage has also been given to resistance welding.

Technical in scope without resorting to mathematics beyond the simple arithmetic needed for the problems used as examples. Most chapters conclude with such problems, to be used by instructors and home-study students.

MOST-OFTEN-NEEDED 1957 TELEVISION SERVICING INFORMATION (Vol. TV-12), compiled by M. N. Beitman. Supreme Publications, Highland Park, Ill. 192 pages. $3.

A compilation of set manufacturers' original diagrams and servicing information covering more than 800 TV receiver models and chassis made by about 20 of the leading makers. The data cover the so-called 1957 models and chassis released during the last four or five months of 1956.

OFFICIAL PRICING DIGEST. Electronic Publishing Co., Inc., 180 N. Wacker Drive, Chicago 6, Ill. 3¾ x 9¾, 247 pages. $2.50.

Have you ever had occasion to quote prices on a radio or TV repair job involving parts? Then you have felt the need for a book that prices components, record changers, TV tuners, tubes and transistors, etc. This book is small enough to be taken to jobs and may be shown to the customer. It is issued quarterly.

Listing is first by manufacturer, then subdivided by product category. A complete index determines the page at once. In most cases each part is properly identified by value, voltage, function, channel number, etc. in addition to code number. A few manufacturers confine their part description to code number, however. Therefore, if you need a simple, ordinary octal socket, you must in some cases first look up its code number somewhere (or consult the listing of another manufacturer).—*IQ*

END

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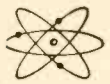

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ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

SCHOOL DIRECTORY PAGE 143

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FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., London E.C. 4. Australia: McGill's Agency, Melbourne. France: Brentano's, Paris 2e. Belgium: Agence et Messageries de la Presse, Brussels. Holland: Trilectron, Heemstede. Greece: International Book & News Agency, Athens. So. Africa: Central News Agency, Ltd., Johannesburg, Capetown, Durban, Natal; Universal Book Agency, Johannesburg. Middle East: Steinmatzky Middle East Agency, Jerusalem. India: Broadway News Centre, Dadar, Bombay #14. Pakistan: Paradise Book Stall, Karachi 3.

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- 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**

LT-10 —Completely wired..... Less metal case. ..... Net **52.50**

ML-100—Metal cage for above, shpg. wt., 3 lbs. ..... Net **5.00**

PROFESSIONAL TRANSCRIPTION TURNTABLE AND VISCOUS-DAMPED TONE ARM

THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE

PK-100A TRANSCRIPTION TURNTABLE

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 **15.00**

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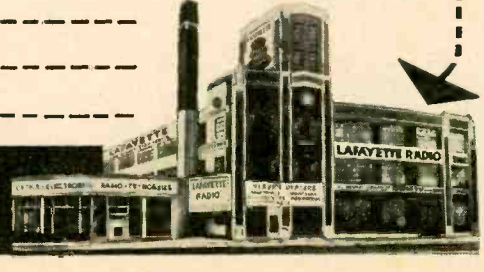
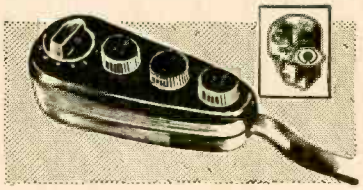


New RCA "MAGIC BRAIN" TV REMOTE CONTROL



For All KCS96, KCS97 and KCS66 thru KCS92 Series Chassis—Over 200 Different RCA Models!

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Bargain Special!

14.95

Control your RCA TV set from any remote spot in the room—up to 30 feet—without getting up or touching the receiver! Here is what the remote control can do: (1) TURN SET ON; (2) SELECT DESIRED CHANNEL; (3) ADJUST THE VOLUME; (4) ADJUST PICTURE; (5) ADJUST FINE TUNING; (6) TURN SET OFF. A single, compact unit gives you all this control from an easy chair. Flat, interconnecting cable easily concealed under carpet or along floor baseboard. Installation of all other components is made at receiver. Components include Relay Chassis, Motor Bracket Assembly, Remote Control Head and Cable, Switches, Mounting Straps, Terminal Board, Resistors, Capacitors and Neon Lamp. With instructions. Shpg. wt., 10 lbs. Quantity Limited!

TL-46—RCA 2714 Remote Control ..... Net **14.95**

LAFAYETTE SENSATIONAL VALUES! IN COMPLETELY WIRED TEST EQUIPMENT at LESS than the PRICE of KITS!

LAFAYETTE SIGNAL GENERATOR

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

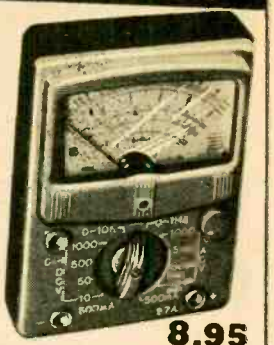
NEW POCKET AC-DC VOM MULTITESTER

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 8¼"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

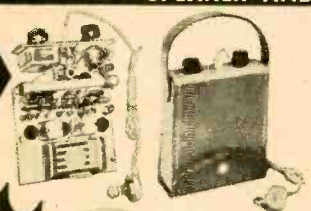
A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector 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

4 AND 6 TRANSISTOR SUPERHET KITS POCKET AND HOME RADIOS FOR SPEAKER AND EARPHONE OPERATION

POCKET SIZE: 4"L x 3-5/16"W x 1"D

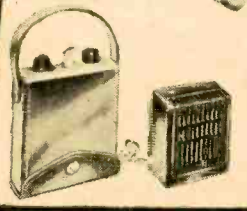
FIRST BUILD THIS



Completely self-contained, pocket size portable set which operates a miniature earpiece so only you can hear. The circuit uses 4 transistors (2 high frequency and 2 audio) plus a germanium diode, 2 IF stages and built-in high gain ferrite core and antenna. The result is a sensitive, stable and selective receiver covering the entire broadcast band. It requires no outside antenna or ground connection. The kit is supplied complete with transistors and all parts, including battery, and drilled and punched chassis. Pictorial and circuit diagrams are included with simple, easy-to-follow instructions. (Note: Earpiece and carrying case are not supplied.)

KT-94 —Complete Kit. Shpg. wt., 2 lbs. ..... Net 19.95
MS-311—Leather Carrying Case ..... Net 1.95
MS-260—Super Power Dynamic Earpiece ..... Net 3.95

THEN BUILD THIS

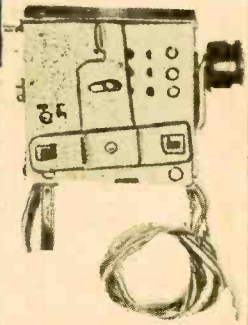


2-TRANSISTOR PUSH-PULL OUTPUT KIT WITH SPEAKER SELF-CONTAINED IN BEAUTIFUL PLASTIC CASE.

Converts 4-Transistor Kit KT-94 into a 6-transistor home radio with speaker. Transitorized push-pull audio stage plugs into 4-transistor kit, suitable for group listening. Performance equal or superior to commercially wired sets selling at much higher prices. Kit includes 2 transistors, 2 transformers, 2½" PM speaker, pre-punched chassis, speaker case (holds all components), battery, hardware, instructions and diagrams.

KT-96—Shpg. wt., 1 lb. ..... Net 11.50

RCA UHF SELECTOR



Adapts VHF TV sets for single channel UHF reception. Plugs into one of the tube sockets of receiver. Can be ordered for any one of the 83 UHF channels. If desired, selector can be reset for a different channel. Switch permits instant changeover from VHF to UHF or vice-versa. Comes complete with 6AF4 tube, crystal rectifier, cable with plug-in adaptor and instructions. 3-7/16" H, 4⅝" W, 2-3/16" D. Shpg. wt., 3 lbs.

Model U-1A. For sets with miniature 7 pin output tubes such as 6AQ5.

Model U-1B. For sets with octal base output tubes such as 6K6 and 6V6.

Either type—
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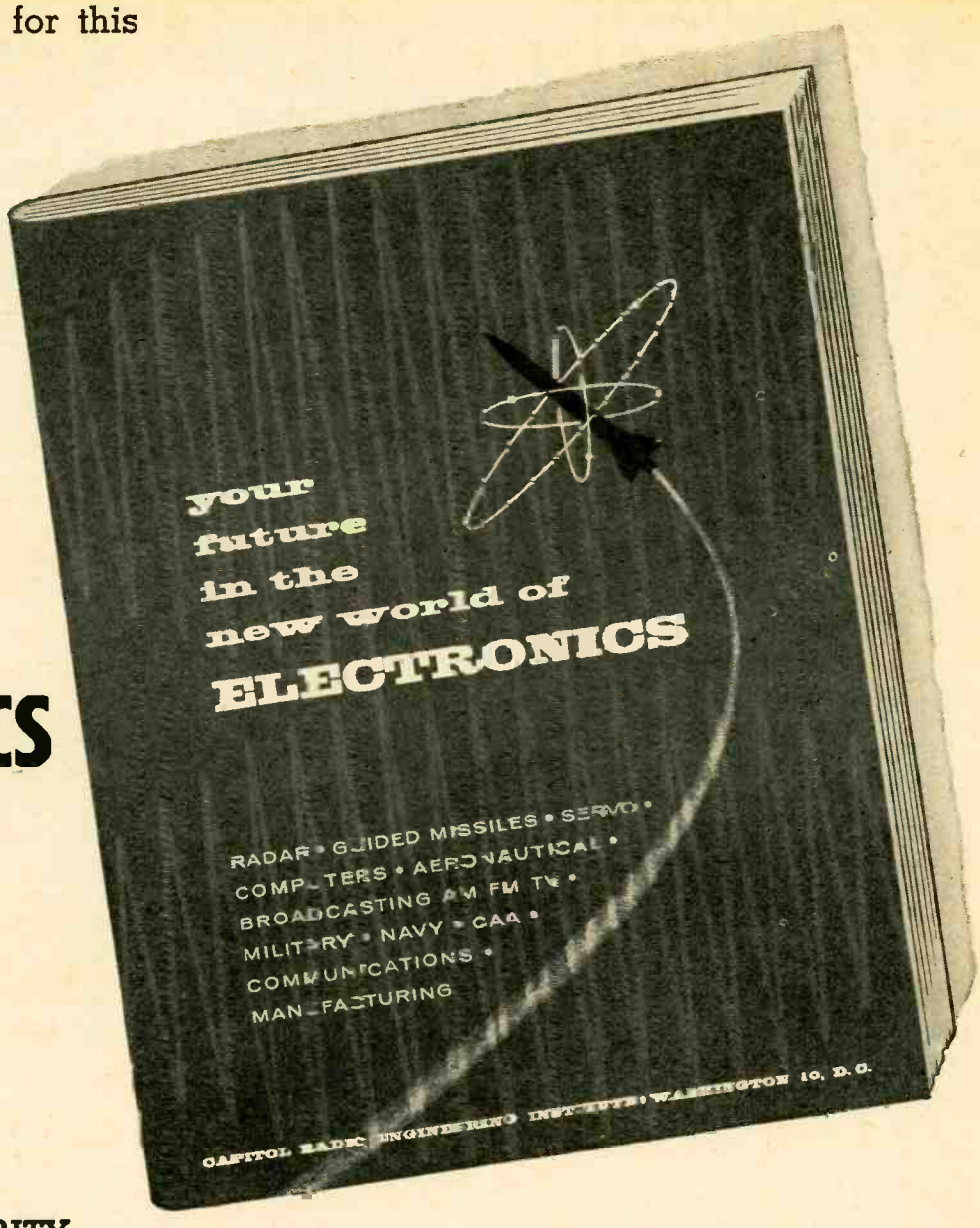

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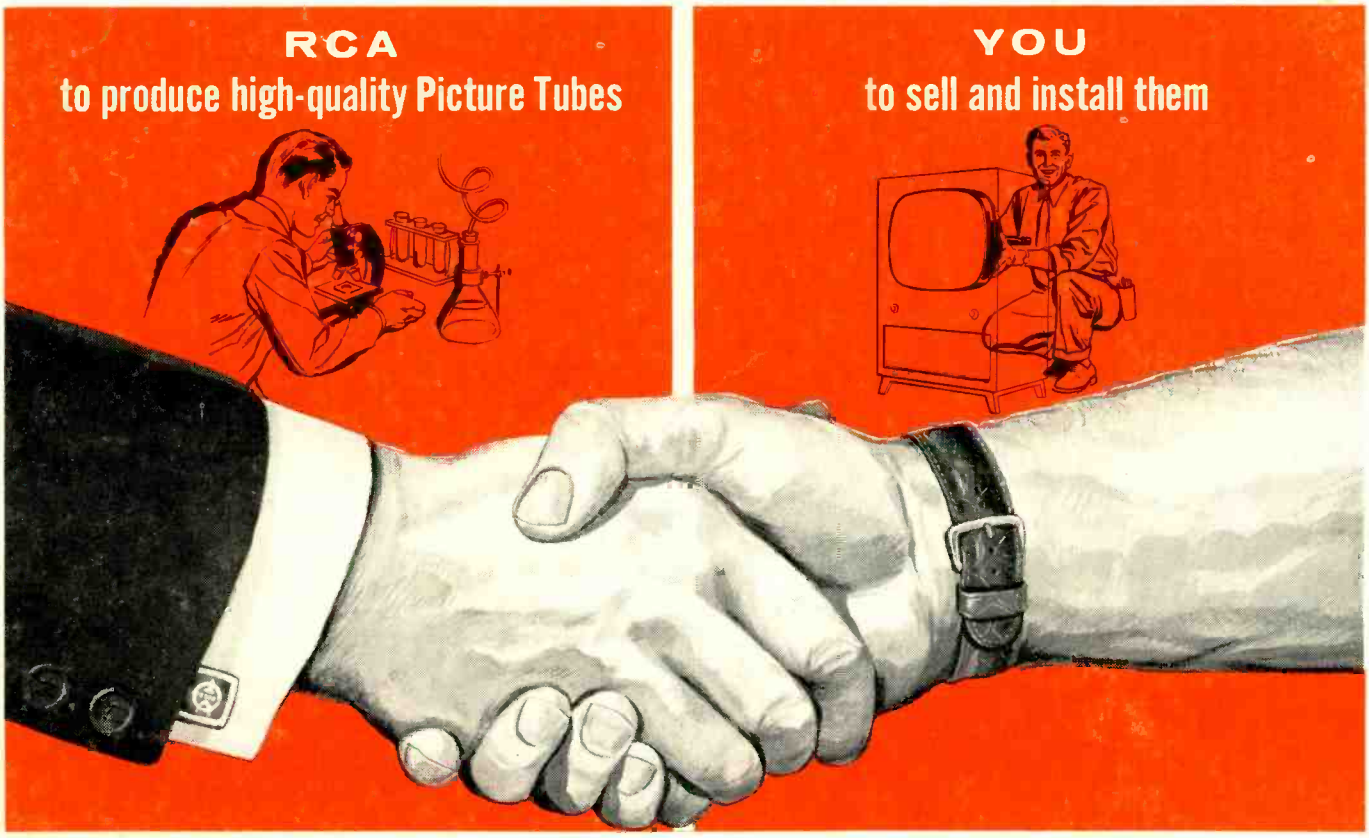
IT TAKES TWO:

RCA and YOU



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QUALITY Tell them how an RCA picture tube must pass well over 100 careful inspections before it's good enough for you—or your customer.

ACCEPTANCE Remind them that more people view TV shows on RCA picture tubes than on any other brand.

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