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FEBRUARY, 1957

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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, one 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 drop snout."

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.
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FEBRUARY, 1957
where he was elected to Phi Beta Kappa. His writing career started in 1897 as assistant editor of *The Scientific American*. In 1911 Mr. Kaempfert 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 1938, "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 on 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 integrity airplanes 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 worldwide 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:

- WLAL-TV, Raleigh, N.C., 4
- KNAC-TV, Ft. Smith, Ark., 3
- KICA-TV, Clovis, N.M., 7
- 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 non-commercial, of which 15 are uhf.

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

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

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Essentially therefore, the gadget reduces the risk of injury due to difference between pop music and the automatic constant. But shortening the time constant makes it harder to keep the voltage above the threshold. I thus thought it might be possible to get the device to operate between the two thresholds the anode from the cut-off limit to the other. I was correct (as is confirmed by the solid diagram). The 27,000-ohm resistor, R₁, was arrived at experimentally, provided it offered a long time constant. However, due to the cutting-off of the vocalist, the voltages do not have much chance to decay before the next pulse arrives.

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Paul Reichert, West Salem, Ohio  2nd  10 weeks
Harold Phipps, LaPorte, Indiana  1st  28 weeks
John H. Johnson, Boise City, Okla.  2nd  12 weeks
James Faint, Johnstown, Pa.  1st  26 weeks

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Bob Thompson
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James Glen:
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James S. Glen, Jr.
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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 pigtales 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 has 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 safer to reverse the wall plug and work in comfort.

C. L. Van Lieu
Raymond, Wash.

(Continued on page 16)
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MODEL SS-4 — 4 speed
2-pole motor

**MODEL D-10** — 4-pole shaded pole A.C. induction type for tape or disc recorders.

**THE GENERAL INDUSTRIES CO.**
DEPT. GR • ELYRIA, OHIO

---

**CORRESPONDENCE (Con't from page 12)**

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 the 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
Use RAYTHEON All-Set TV & RADIO TUBES 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

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

FEBRUARY, 1957
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.

Bell Telephone Laboratories
WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

*Dr. Bardeen is now with the University of Illinois, and Dr. Shockley is with the Shockley Semiconductor Laboratory of Beckman Instruments, Inc., Calif.
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N.R.I. TRAINED THESE MEN

Thanks N.R.I. for Good Start

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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.

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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.

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"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.

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"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix ear 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.

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, the better job, drives the better car and is respected for what he knows and can do.

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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.

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

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★ A DC LINE VOLTAGE VARIABLE SUPPLY
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FEBRUARY, 1957

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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.

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**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. 31, 1909, when, thanks to wireless operator hero Jack Bins’ 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.

Bins’ 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 auto-coherer. 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 Carbonudum, the peroxide of lead, the cartridge self-contained electrolytic, the gaiena, the iron pyrites and the Perikon to mention only a few.

While de Forrest’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 interfered 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 the technical 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 rauous loudspeaker. Commercial radio sets 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—made receivers will soon be here while the 10-cent type is a distinct possibility under mass production.

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.

Hugo Gernsback, Editor

FEBRUARY, 1957

*See also the account of "Operator Bins' Wireless Log," Feb., 1909, issue MODERN ELECTRONICS, the first Gernsback radio publication.*
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 unbreakable 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...
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 ¼-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 1 ¼ x 2-inch lateral strip.

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DARRYL WALTERS, 156 7 Ave., New York, N. Y.)

After the Celastic hardened

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as a form, I covered it with Celastic, a
celulose-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.)

available, but it improved 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 4-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 separa-

tor. 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 1 1/4 x 2-inch strips cut 9

feet long were screwed into the notches

in the back edge of the Novoply sepa-

rators 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 tem-

porary diagonal brace was nailed across

the front edges for rigidity and align-

ment. This assembly took place on the

livingroom floor. Erecting the

assembled dividers and sliding them into the

recess was a simple task. The hori-

zontal strips attached in the notches at

the rear of the separators were screwed

to the rear wall studs and the end sepa-

rators were fastened to the studs form-

ing the recess.

The next step was to install the Novo-

ply 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, be-

ing careful that the 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 ceil-

ing of the recess so all that remains

is the front panel. The louver for this

panel was 1 1/4-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. Be-

hind the wall at the back of the recess

is a cellar stairway and a closet. I

found that a good spot for locating this

make it myself. I had an old 21-inch

mask to which I added a 3/4-inch ply-

wood frame to make up the difference

in the size. I used this as a form, I

covered it with Celastic, a celu-

lose-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

in

as a form, I covered 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 William-

son circuit, and the National Criterion

AM-FM tuner with its Horizon 9 pre-

amplifier. I also use a Horizon 10 con-

verter with preamp so that, with my two

overhead speakers, we can enjoy the bi-

naural 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 discrimi-

nator 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 chanc-

ger rolls forward on slides. At the lower

left we inserted the compartment with

sliding doors which is the repository of

our entertaining supplies (liquor cab-

inet, to sit I you). Each door is

movable except the television set and

the Wharfedale speaker enclosure,

merely by sliding out the unit and re-

locating the shelf rests in the standards.

Flexibility unlimited!

The raw leading edges of the Novo-

ply separators were covered by gluing

on 1/4 x 3/4-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 suit-

able 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 sort of

policeless 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 we

were proud. But, just one of them was
told me to say "I’d like to have something
likethis. I'm not handy but if someone helped . . ."
Considerations in selecting the recorder; record-playback curves; principles and techniques

By NORMAN H. CROWHURST

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. 3. This is the playback response for a fairly good head.

Notice that the 6-db-per-octave rise

Fig. 1—Theoretical relationships required for flat overall frequency response.
**Audio—High Fidelity**

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 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 2,500 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, you must 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 broad points 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 uneconomically 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 standard 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 characteristic. This 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 in 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. 5 (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 preamplifier 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 your 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 be much to your liking. 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 $600.

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 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 phone 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 phone 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, turn-

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

ing 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.

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.

Audio—High Fidelity

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.

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 and are either 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 insensitive 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 or playback 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 multiplex 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 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.

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"Why didn’t I just call it Al’s Radio-TV?"

Suggested by

Jack Darr, Mentor, Ark.
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 cleaness 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 transcduction.

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
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.

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 power amplifier. This simple circuit (Fig. 5) 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.

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**Coming! In the MARCH**

**Radio-Electronics**

**Don't Be a Shock Absorber!**

By Cyrus Glickstein

**An All-Transistor Scintillation Counter**

Order Your Copy Now. On Sale Feb. 26
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. Zipertubing was developed by a Los Angeles firm, W. A. Plummer Manufacturing Co.

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 milliamperes-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-Cell 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.

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.

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.
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 areZenith’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-ke vibrations are picked up by a sensitive capacitor microphone built into the front of the receiver. The microphone output is amplified by a 40-ke 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 motor 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 ke 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 30.5 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...
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.**

![Zenith microphone and interior of Space-Command ultrasonic transmitter](image-url)

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

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

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 de 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 .025-uf 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 .1-uf 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 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-mv 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 rtf type with two rtf 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. 2—Motorola Th-74 one-transistor remote-control transmitter.](image)

![Fig. 3—The remote-control receiver. Loop antenna is electrostatically shielded.](image)
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 preselecled 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 3,029 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-mfd 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.

Fig. 4—Power supply and motorized tuner
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-ohm-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 and the badge 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 null 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 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.

Often 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 acf circuit can usually be checked for proper signals. In a typical receiver using phase-detector af, the technician can pull the tube and check pl non-chassis; 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 readings indicate 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 circuits. 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 with sync and burst. Signal tracing in chrominance circuits requires the presence of a color signal either from a transmitting station or from a colorbar 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.
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...
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 house for a reason. The technician climbs to the rooftop and goes to the cable 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 wires 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, tapping 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...
TELEVISION

(Fig. 1-5), 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

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 gying! 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-foot 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
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 50-80-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 1 1/4-inch TV mast stock which slip into each other, making a 29-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 1/2-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 sideways. 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 antennas seldom are forced to hang on the belt while working, as linemen have to do. The belt 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 unstrap 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 grab at anything within reach and some bad cuts on the hands, he broke the habit! Always exercise extreme caution when working at any height!

Fig 6—Using safety belt on tower.

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FEBRUARY, 1957
Horizontal sweep circuit in the Westinghouse V-2316 chassis.

**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 a/c 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 µF, 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 150 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 1/2-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 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, 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

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*Fig. 2—Output screen resistor was reduced to 6,800 ohms to increase width in RCA KCS92 chassis.*
inductance. The higher reactance of such a coil would dissipate less flyback power, except 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 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-µf 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 µf 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 µf 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 6US (Fig. 2-a). Both tubes are then shunted by a 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. Molar, 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 6US 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 6US 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 all 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 150,000 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.

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-µf capacitor in the multivibrator plate circuit with a unit of higher reactance. Probably, a capacitor of about 470 µf would do the trick. If there is still some interaction, try a capacitor slightly lower in value.

**TELEVISION**

Fig. 4—The sync separators in the RCA KCS83 television chassis.
PORTABLE TV PATTERN GENERATOR

Portable TV Pattern Generator

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

By EARL T. HANSEN

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 3/8-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 inept. 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 64th harmonic of the actual crystal fre-
TEST INSTRUMENTS

frequency, 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 close-wound of No. 30 cotton-covered or enameled wire on a ½-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 ¼ 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 55.75 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.

BE CONTINUED
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VTVM

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MULTIMETER

Simple circuit may operate with a 1-ma ammeter

By JOHN A. DEWAR

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 multimeter 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-lettrolytic 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

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

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

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

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

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

\[
R2 = \frac{27}{.000003} = 9,000,000 - 7,000,000 \text{ ohms (R1) = 2 megohms. The rest of the divider can be computed in the same manner. END}
\]
TEST INSTRUMENTS

transistorized

KiloVolter

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-2045 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 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 300) is exceeded.

**Generator construction**

All parts for the kilovolt are mounted on a perforated board measuring 2N255 AF 059

<table>
<thead>
<tr>
<th>R1</th>
<th>56 ohms, V1, 1/2 watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2</td>
<td>3.3 megohms, 1/2 watt</td>
</tr>
<tr>
<td>C1</td>
<td>2–0.1 μf, 1,000 volts, disc</td>
</tr>
<tr>
<td>C2</td>
<td>0.01 μf, 1,000 volts, disc</td>
</tr>
<tr>
<td>F</td>
<td>Filament transformer, 117 volts ct primary, 6.3 volts secondary (Merit P-2946 or equivalent)</td>
</tr>
<tr>
<td>V1</td>
<td>2N255 (Casil)</td>
</tr>
<tr>
<td>V2</td>
<td>CK108 (Raytheon)</td>
</tr>
<tr>
<td>SEL RECT</td>
<td>Selenium rectifier (see diagram)</td>
</tr>
<tr>
<td>BATT</td>
<td>Two 1.5-volt cells in parallel</td>
</tr>
<tr>
<td>Battery holder</td>
<td>Lafayette MS-178</td>
</tr>
<tr>
<td>Perforated board</td>
<td>Lafayette MS-305</td>
</tr>
<tr>
<td>Socket</td>
<td>9-pin miniature, for transistor</td>
</tr>
<tr>
<td>Switch</td>
<td>Switch, split</td>
</tr>
</tbody>
</table>

**Fig. 1—Schematic diagram of the transistorized kilovolt.**

The collector grid of the 2N255 transistor mounts on a socket, spst Switch, or allows a 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, a 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 working cell life is prolonged. A single No. 6 dry cell will last for hundreds of hours.

Although this generator provides a high-voltage 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.

**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 2% inches in length and is a low-cost unit. Average pulse amplitude (even at high counting rates) is over 1 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 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.

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**TEST INSTRUMENTS**

**MONEY**

Yes, our mail-order tube advertising policy has cost us substantial advertising revenue. But because it protects our readers, we are glad we established the policy.

RADIO-ELECTRONICS refuses all mail-order tube advertising unless the advertiser warrants that the tubes are:

- New and unused
- Not mechanical or electrical rejects
- Not washed or rewound

(See page 57 of the January 1956 issue.)

As far as we know, RADIO-ELECTRONICS is the only generally distributed magazine in the field to have set these high standards.

**FEBRUARY, 1957**

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**this is costing us MONEY**

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www.americanradiohistory.com
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 misread or unmarked capacitors. You have probably had trouble with capacitors in television horizontal oscillators 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 pf to 1 µf can be measured.

The bridge circuit (Fig. 1) is simple.

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 R6 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 R6. 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 R6 is 100 ohms, these numbers indicate capacitances of 0.1 µf, 0.2 µf, 0.3 µf, etc.; when R6 is 1,000 ohms, the numbers indicate 0.01 µf, 0.02 µf, 0.03 µf, and so on. This calibration will hold true for all ranges provided that each R6 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.
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—batter 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

the voltage between transistors.

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 transistors that could damage the transistor in an instant. When working on new equipment that uses other than low voltage, 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 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 reverse resistance similar to a method sometimes used for testing crystal diodes. A crude check may be made with a vtm. This method gives only an indication of opens and shorts. Using the ohmmeter, a 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 currents 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 open 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 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 sockets 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 a 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 set in a positive direction for forward cur-

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---

sockets have base and emitter pins spaced closer than base-to-collector spacing. 2. If the transistor is 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 or by multi-solder the transistor 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 test circuit. 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 voltage can be determined by the voltage drop 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 on the 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
high, about 0.5 ma, being limited by a resistor of 3300 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 readable 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 transistors may be tested in a similar fashion. The only difference between 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 by 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 junction 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 (R9) should be wired so that switch S4 closes and circuit resistance decreases with clockwise 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 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 output voltage to 1. One volt is equal to an alternating current of 10 μa at 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.

EXEMPLARY 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.

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

Fig. 4—Circuit diagram of the transistor beta amplification factor tester.
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 2.7 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 servicing shop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

1 FEWER DOLLARS BRING MORE REAL QUALITY.
- Factory-to-you sales eliminate extra profit margin.
- "Build-it-yourself" eliminates labor charge.
- Heath purchasing power cuts component costs.

2 PERSONAL SERVICE ASSURES CUSTOMER SATISFACTION.
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A FULL YEAR TO PAY
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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.

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Shop: 1 lb.

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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.

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HEATHKIT Etched Circuit

VACUUM TUBE

**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.

HEATHKIT Etched Circuit

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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 Shop. Wt. 1 lb.

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-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: No. 338-C Not required for the Heathkit V-7A VTVM. $5.50 Shop. Wt. 2 lbs.

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 3000 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, X10, and X100, resulting in center scale readings of 15, 150, 1500, and 15,000 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 microammeter, 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 Shop. Wt. 6 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. 334 $4.50 Shop. Wt. 2 lbs.

HEATHKIT Handi Tester 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 (10 ohm center scale) and 0-300,000 ohms (3000 ohms center scale). Uses a 400 microammeter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimenter, 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, pocket, or desk drawer. Top quality, precision components employed throughout. MODEL M-1 $14.50 Shop. Wt. 3 lbs.

**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, 50, 150, 500, 1500, 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.

HEATH COMPANY

A Subsidiary of Daysstrom, Inc.

BENTON HARBOR 20, MICH.
HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

* Brand new circuit for extended frequency response and added stability.
* Ten accurate ranges from 0-0.1 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. Employing a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding 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 0-0.1, 0.3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover 0 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.

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.

HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTM, 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 VTM ranges are 0.1, 0.3, 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.

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, 1, 3, 10, 30, and 100 percent full scale. Built-in VTM 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.

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 throughout 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.
HEATHKIT

Audio Generator Kit

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, .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.

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10Ω 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
$55.00
Shpg. Wt. 3 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 that can be selected by a rotary switch. Values range from 0.0001 mfd to 0.11 mfd (10,000 mfd) in 10 mfd steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1
$16.00
Shpg. Wt. 3 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.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.0001 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 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 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.

HEATH COMPANY
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BENTON HARBOR 20, MICH.
HEATHKIT Signal Generator Kit

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

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.

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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.

MODEL LG-1
$48.50
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 mutual stability. Covering channels 2 to 13, the LP-2 will produce 6 to 10 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.
Tube Checker Kit

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and locot types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4" 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.

HEATHKIT TV PICTURE TUBE TEST ADAPTER

MODEL 355

$4.50

Shpg. Wt. 1 lb.

HEATHKIT VISUAL-URAL SIGNAL TRACER KIT

MODEL T-3

$23.50

Shpg. Wt. 9 lbs.

HEATHKIT CONDENSER CHECKER KIT

MODEL C-3

$19.50

Shpg. Wt. 7 lbs.

HEATHKIT PORTABLE TUBE CHECKER KIT

MODEL TC-2

$29.50

Shpg. Wt. 12 lbs.

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

HEATHKIT DIRECT READING CAPACITY METER KIT

MODEL CM-1

$29.50

Shpg. Wt. 7 lbs.

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.

HEATHKIT

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 20, MICH.
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.

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-ampere, continuously, or 200 volt-ampere 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.

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, ±3%; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employ a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hoy 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.
Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that it 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 6L46 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 preharnessed. 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 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.

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 6DO6A final amplifier provides plate power input of 50 watts. A 6CL8 oscillator is employed, and a 3U4GB 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!
HEATHKIT PHONE AND CW

Transmitter Kit

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

MODEL DX-35

$56.95 Shpg. Wt. 24 lbs.

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

$99.50 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 microamperes 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 absorption-type wavemeter.

MODEL GD-1B

$19.95 Shpg. Wt. 4 lbs.
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 circuitry 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: Prazylin 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 PROFESIONAL 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 million counts 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.

* 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.

HEATH COMPANY
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BENTON HARBOR 20, MICH.

RADIO-ELECTRONICS

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
$79.95

INCLUDING NEW
EXCISE TAX

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
$115.00

Shpg. Wt. 3 lbs.
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.

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.

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 530 to 1600 kC. Incorporates a 10 kC whistle-filter and provides up to a 35 UV signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates A.V.C., two outputs, and two antenna inputs.

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, 1200, 2000, and 3500 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes inter-modulation 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 WA-P2
Shpg. Wt. 7 Lbs.

MODEL FM-3A
Including New Excise Tax
(With Cabinet)
Shpg. Wt. 7 Lbs.

$259.5

MODEL BC-1
Including New Excise Tax
(With Cabinet)
Shpg. Wt. 8 Lbs.

$259.5

MODEL XO-1
Shpg. Wt. 6 Lbs.

$189.5

FEBRUARY, 1957

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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

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Accro- sound Model TO-300 "ultra-linear" output transformer and uses 3881 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 1M 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 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 -1 1/2 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-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain.

MODEL A-7D
$17.95
INCLUDING NEW EXCISE TAX
$19.95

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 3881 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-4: 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 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 300 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency response 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. 22 lbs.

HIGH FIDELITY

Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is -1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and 1M distortion is less than 1% at 20 watts (60 and 3,000 CPS. 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8 1/8" D. x 8 4/5" 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 audiophile who owns one!
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.

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FEBRUARY, 1957
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.

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
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 $505 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.
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80
RADIO-ELECTRONICS
The WRONG Quiz
By DAVID GNESIN

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 not 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 sparkling 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.

   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 shorts 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)
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.

For enjoyable listening, especially at night, its selectivity had to be sufficient to separate adjacent stations; it had to have effective age 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 reflex 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 Cl-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 80)

Schematic diagram of the Dynaflex receiver. Sensitive unit operates well on 2-foot antenna. Switch S1 may be coupled to volume control.
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**KNIGHT-KIT LOW-COST GENERAL-PURPOSE 5" OSCILLOSCOPE KIT**

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 Millicolts 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 ±3 db from 0.5 cps to 1.5 mc (±5 db to 2.5 mc). Input controls are frequency-compensated. Rise time, 25 microseconds. Impedance, 3.3 meg. and 45 mmdf. 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-Check" construction manual with wall-size picture diagrams. Supplied with all tubes including CRT, all parts, graph screen, wire, solder. Size, 9½ x 13½ x 17½". Shpg. wt., 26 lbs.

Model F-146. Complete 5" Oscilloscope Kit. Net only...$49.50

- F-148. RF Demodulator Probe Kit. Net...
- F-147. Low Capacity Probe Kit. Net...

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NEW knight-kit VOLTAGE CALIBRATOR KIT

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, +0% on all ranges. Shunt capacitance only 15 mfd. 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, 7 1/2" x 5 1/4 x 4 1/4". Ready to build. Shpg. wt., 5 lbs.
Model F-135. Voltage Calibrator Kit. Net...$26.50

knigt-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 19,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4 PM speaker; single plug 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

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 12 x 4 3/4". Shpg. wt., 20 lbs.
Model F-129. Power Supply Kit. Net only...$37.95

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AC, scales for service.

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, 0-1-5-10-50-100-500-1000 (2000 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 -49 in 5 ranges. Uses 1½ precision resistors, 5-position function switch and 12-position range switch. Complete kit with bakelite case (8½" x 6½" x 3½"), battery, pre-cut wire, solder and test leads. Shpg. wt., 2½ lbs.

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

Model F-128 $16.95

1000 OHMS/VOLT VOM KIT

20,000 OHMS/VOLT VOM KIT

Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½ meter; accuracy ±3% of full scale; 50 microscopem sensitivity for 20,000 ohms/volt input resistance; AC/DC; front panel film panel switch. Complete kit with bakelite case (6½" x 5½" x 3½"), batteries, pre-cut wire, solder and test leads. Shpg. wt., 5 lbs.

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

Model F-140 $29.50

Model F-140

20,000 OHMS/VOLT VOM KIT

10,000 OHMS/VOLT VOM KIT

Model F-125 Printed Circuit VTVM Kit. Net only...

Model F-125 $24.95

Model F-125

Hi-Voltage Probe; extends DC to 60,000 Volts. $4.75

Model F-127. Hi-Frequency Probe; extends DC to 500 mc. $3.45

PORTABLE MODEL

An extremely stable, and highly accurate Lab 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 PM and TV work. Ranges: AC P-P volts, 0-4-1440-400-1400-4000; AC rms volts and DC volts, 0-1-5-15-50-150-500-1500; resistance, 0-1000-10K-100K ohms and 0-1-10-100-1000 megohms; db scale, -10 to +5. AC response, 50 cycles to 3 mc. Low-leakage switches and 1½ precision resistors. Balanced-bridge circuit, 4½ meter, 200 microamp meter. Polarity reversing switch. Input res., 11 mgs. Shpg. wt., 6 lbs.

Model F-125 $24.95

Model F-125

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Thrilling Short Wave and Broadcast

Famous 3-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 12A7T regenerative detector and audio amplifier, 50C6 power output, 35W4 rectifier, Six controls: Bandspread; Main Tuning; Antenna Trimmer; Bandswitch; Regeneration; Audio Gain. Complete with tubes and all parts. 7 x 10 1/2 x 6". Shpg. wt. 4 lbs.

Model S-243. "Space Spanner" Receiver Kit. Net only $15.95
S-247. Matching Cabinet for above. 2 lbs. Net. $2.90

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"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 $7.95
S-742. Short Wave, 1.6-470 kc. Net $4.15
S-743. Short Wave, 2-97.3 mc. Each $6.55
S-744. Short Wave, 7-175 mc. Each $6.55
S-744. Short Wave, 10.5-35 mc. Each $6.55

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Thousands have built and enjoyed the "Ranger" Broadcast Band Receiver. Carefully engineered for easy construction and powerful, sensitive performance. Latest Superhet circuit; tuners 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: 125A7GT converter, 125A7GT IF amp, 125A7GT detector, AVC audio; 504L6GT audio output; 3525GT 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

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LOW COST PHONO AMPLIFIER KIT

It's easy to build this fine-performing, low-cost compact phonograph 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 1 1/2-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 4 1/2 x 7 x 4 1/2"-fits into almost any portable phonograph case. Shpg. wt. 3 lbs.

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

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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 "babysitting", 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 (4 1/2 x 6 1/4 x 4 1/2"), 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.

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3-WAY PORTABLE RADIO KIT

A low-cost portable radio covering the full standard broadcast band from 535 kc to 1680 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: 125A7GT converter, 125A7GT IF amplifier, 125A7GT detector, AVCaudio, 50L6GT audio output; 3525GT rect. Complete with attractive portable case (7 1/2 x 10 1/4 x 5 1/2"), 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

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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 1/4 sec! 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 AC or AC supply listed below. Complete outfit with battery weighs only 3 1/2 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. $2.75
S-526. Battery for above (Burgess U-200) $8.47

FAMOUS knight-kit LAB KITS

6-IN-1 RADIO LAB KIT

Model S-770 $7.95

A fascinating and instructive kit. Enables you to build any of the following projects: Standard Broadcast Receiver; Wireless "Home Broadcaster"; Code Practice Oscillator; Code Practice Broadcaster; Signal Tracer; Single-Watt Receiver. 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
S-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

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 and pliers. Perfect for self-instruction in circuit fundamentals, and packed with practical applications. Kit includes mounting board, tube, all parts, hardware, microphone, and 13-page builders' manual. Shpg. wt., 10 lbs.

Model S-265. "10-in-1" Lab Kit. Net only $12.65
S-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" with 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 2 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 $5.95

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 3525GT rectifier. Complete with all parts, tubes and instructions. 4½ x 4½ x 4¾". Shpg. wt., 1 lb.

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

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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 tubes incorporating built-in preamp or with separate preamp. Incorporates latest Williamson-type circuit and has pots matched transformers. Delivers maximum output of 45 watts. Frequency response is ± 0.5 db at 1595 kHz, measured at 20 watts. Harmonic distortion is only 1.5% 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 —65 db below full rated output. Output impedance, 4, 8, 16 ohms. Input voltage for 25-watt output is 1.8 volts. Uses two 12AX7’s, two 6AS7’s, and a 584. 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. Handmade chrome-plated chassis, 14 x 9 x 2”. Overall height, 7”. A deluxe true hi-fi amplifier equal in performance to amplifiers selling at twice the price. Complete with all parts and tubes. Easy to assemble. Shpg. wt., 27 lbs.  
$44.50

**MODEL S-755, Basic 25 Watt Hi-Fi Amplifier Kit. Net only. $7.59. Metal enclosure for above; black finish. 3 lbs. Net. $4.25**

**LOW-COST TOP QUALITY KITS FOR THE HAM**

**Model S-255**  
**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 6AQ7 modified-Pierce oscillator takes crystal or VFO without circuit changes; bandwidth coverage of 80, 40, 10, 15, 11-10 meters; full-size 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- or brass-finished chassis and cabinet interior, filtering, shielding, bypassing, and coaxial 50-500 antenna system. 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. 8¾ x 11¾ x 8¾”. Shpg. wt., 18 lbs.  
Model S-255, 50-Watt Transmitter Kit. Net... $38.95

**Model S-725**  
**SELF-POWERED VFO KIT**

Complete with built-in power supply! Careful design and voltage regulation assure high reliability of oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandwidth: separate calibrated scales for 80, 40, 20, 10, 15, 11 and 10 meters. VOM calibration with Spot-Off-Transmit switch for “no swish” tuning. Extra switch controls for operating relays and other equipment. With all parts and tubes. 8 lbs.  
Model S-725, Self-Powered VFO Kit. Net... $28.50

**NEW knight-kit**  
**AMATEUR RF "Z" BRIDGE KIT**

*Model S-253*  
**Measures standing wave ratio (SWR) and impedance of antenna systems**

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 ohms/V. VOM Correction factor info supplied for other VOM’s. With coax input and output connectors. Measures SWR by means of a special circuit board and low-loss transformer. Calibrated dial gives direct indication of SWR. Precision input and bridge voltage. With null indicator. Connections are red and black. Meets all specifications for precise calibration adjustment. With all parts and handy plasticized SWH kit.  
Model S-253, "Z" Bridge Kit. Net only... $5.85

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100 N. WESTERN AVE., CHICAGO 80, ILL.

ALLIED RADIO CORP., Dept. O2-B-7 100 N. Western Ave., Chicago 80, III.

Ship me the following KNIGHT-KITS:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Model No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$</td>
<td>enclosed. For parcel post include postage (express is shipped collect).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Name  
Address  
City __________ Zone _______ State _______
![Image](https://www.americanradiohistory.com)
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 1/4 watt is available from the tube in the Dynaflex's reflected circuit before the audio begins to break up. And 1/4 watt of audio fed into an efficient speaker is more than adequate for most home-receiver applications.

A full-wave diode output audio transformer is used as T4 and germanium crystal diodes (D1 and D2) perform the dual functions of detection and developing the negative age potential. Full age is applied to V2 and about 9½ age is fed to V3 through the combined voltage-divider and diode load resistance (R15 and R16). Audio from the detector is reflected 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 reflected-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 sockets 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.

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**

<table>
<thead>
<tr>
<th>Component Socket Pin</th>
<th>Turret Lug</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>3</td>
</tr>
<tr>
<td>R2</td>
<td>A</td>
</tr>
<tr>
<td>R7</td>
<td>C</td>
</tr>
<tr>
<td>R11</td>
<td>E</td>
</tr>
<tr>
<td>R12</td>
<td>E</td>
</tr>
<tr>
<td>R13</td>
<td>E to Ground</td>
</tr>
<tr>
<td>C2</td>
<td>B</td>
</tr>
<tr>
<td>C9</td>
<td>Ground</td>
</tr>
<tr>
<td>C10</td>
<td>6</td>
</tr>
<tr>
<td>C11</td>
<td>D</td>
</tr>
<tr>
<td>Jumper1</td>
<td>A to C</td>
</tr>
<tr>
<td>Jumper2</td>
<td>4 and 5 to Ground</td>
</tr>
<tr>
<td>Jumper3</td>
<td>Center post lug to Ground</td>
</tr>
</tbody>
</table>

**TABLE II—ASSEMBLY OF TURRET V2**

<table>
<thead>
<tr>
<th>Component Socket Pin</th>
<th>Turret Lug</th>
</tr>
</thead>
<tbody>
<tr>
<td>R4</td>
<td>1</td>
</tr>
<tr>
<td>R5</td>
<td>A</td>
</tr>
<tr>
<td>R6</td>
<td>2</td>
</tr>
<tr>
<td>R7</td>
<td>A</td>
</tr>
<tr>
<td>R8</td>
<td>6</td>
</tr>
<tr>
<td>C6</td>
<td>B to F</td>
</tr>
<tr>
<td>C8</td>
<td>6 to Ground</td>
</tr>
<tr>
<td>C10</td>
<td>B to Ground</td>
</tr>
<tr>
<td>Jumper1</td>
<td>3 to Ground</td>
</tr>
<tr>
<td>Jumper2</td>
<td>Center post lug to Ground</td>
</tr>
</tbody>
</table>

**TABLE III—ASSEMBLY OF TURRET V3**

<table>
<thead>
<tr>
<th>Component Socket Pin</th>
<th>Turret Lug</th>
</tr>
</thead>
<tbody>
<tr>
<td>R14</td>
<td>9</td>
</tr>
<tr>
<td>R15</td>
<td>F to C</td>
</tr>
<tr>
<td>R16</td>
<td>F to Ground</td>
</tr>
<tr>
<td>R17</td>
<td>3</td>
</tr>
<tr>
<td>R18</td>
<td>A</td>
</tr>
<tr>
<td>R19</td>
<td>C to B</td>
</tr>
<tr>
<td>C12</td>
<td>F to Ground</td>
</tr>
<tr>
<td>C14</td>
<td>1</td>
</tr>
<tr>
<td>C21</td>
<td>B to Ground</td>
</tr>
<tr>
<td>Jumper1</td>
<td>1 to 7</td>
</tr>
<tr>
<td>Jumper2</td>
<td>4 to Ground</td>
</tr>
<tr>
<td>Jumper3</td>
<td>Center post lug to Ground</td>
</tr>
</tbody>
</table>

---

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

90  

**RADIO-ELECTRONICS**

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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. Age bypass capacitor C4 is connected across the transformer's terminals.

The oscillator coil assembly (L1 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. 29 stranded 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 3/4 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° F ambient temperature—through adequate ventilation provided by 1/4-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 3/4 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 de.

Alignment and operation

The Dynaflex is aligned in exactly the same manner as any other superhet. A 456-ke signal is fed to the lead to pin 7 of the converter and the trimmers on the two if transformers are adjusted for maximum age 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-ke signal is fed to the converter and 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-ke 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 1300 kc. Finally, adjust the slug in T1 at 125 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 even 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
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.

The busy TV Service Organization, which needs extra Tube Testers for its field men.

Sleeky, 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 test-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.

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

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.

EXTRAORDINARY FEATURE:

Superior’s New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

TESTING TUBES

 Star 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 directly 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.

ALSO TESTS TRANSISTORS!

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

$26.95

$47.50

$72.50

www.americanradiohistory.com
Superior's New Model TV-60

ALL METER

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

✓ The fine cord, used only when making capacity measurements, need be plugged in only when setting that service. It is out of the way, stowed in its pliable compartment at all other times.

✓ A built-in Transformer automatically isolates the Model TV-60 from the power line when the capacity service is in use.

✓ Selected, 1% zero temperature coefficient metalized 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 precision 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 phase relationship of hearing-aid, public address systems, the amplifier sections of Radio & TV receivers, etc.

Read and compare features and specifications below!

SPECIFICATIONS

8 D. C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15, 150-300, 750-1500, 15-30, 30-60 Volts.

7 A.C. VOLTAGE RANGES: (At a sensitivity of 2,500 Ohms per Volt) 0 to 20, 75-150, 300-600, 1000-2000, 2000-4000, 4000-8000 Volts

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 6-20 Megohms.

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

5 DC. CURRENT RANGES: 0.75 Microamps, 0 to 3, 10, 20, 50, 100, 200, 500, 1000, 1500, 2000, 2500 Microamps.

3 DECIBEL RANGES: -6 db to +58 db

R.F. SIGNAL TRACER SERVICE:

Endorse follow-up service by 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 family blame 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: rail standard test leads: high-voltage probe: detachable line cord: R.F. Signal Tracer Probe and Audio Signal Tracing Probe. Provision has for pit above accessories is also included. Price, complete, nothing else to buy."

$52.50

SHIPPED ON APPROVAL

NO MONEY WITH ORDER—NO C.O.D.

Try any of the instruments on this or the facing page for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. No Interest or Finance Charges Added! If not completely satisfied return unit to us, no explanation necessary.

ROSS ELECTRONIC DISTRIBUTING CO., INC.
Depl. D-329, 3848 Tenth Ave., New York 3, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. As the above is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

☐ Model TV-60
Total Price $52.50
$12.50 within 10 days. Balance $8.00
monthly for 5 months.

☐ Model TV-50
Total Price $47.50
$11.50 within 10 days. Balance $6.00
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$11.50 within 10 days. Balance $6.00
monthly for 6 months.

☐ Model TW-55
Total Price $57.50
$14.38 within 10 days. Balance $5.00
monthly for 4 months.

☐ Model TW-32
Total Price $72.50
$18.12 within 10 days. Balance $6.00
monthly for 5 months.

FEBRUARY, 1957

93
New Rondines are at your dealer. Step in... look one over closely. Lift the turntable free of the well, and listen for the "pop" that tells you here is the ultimate in machining and self-lubrication for lifelong balanced rotation. Underneath is a motor so smooth... soundless... you'll not find its equal in other turntables!

A Rondine for every budget!
Rondine Jr.—2-speed $59.95
Rondine—3-speed $84.95
Rondine Deluxe—3-speed hystereis synchronous motor $129.95

Slightly higher west of Rockies

See your dealer or write:
REK-O-KUT COMPANY, INC.
38-01 Queens Blvd., Long Island City 1, N. Y.

AARON COPLAND: Music for Radio
Music for Movies
Music for the Theatre
Arthur Wingrave and Izler Solomon
and MGM Chamber Orchestra

MGM E-3367

My old readers know that in 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 combination of instruments present clear test material for testing definition and distortion. If your system is really good, the sound (with the few exceptions noted below) may grade 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, 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 viola, 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 1935 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 cleanliness 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 perfection in recording of its type but, considering the shortness of the works, rather expensive perfection. In "Greensleeves" that familiar and lovely melody receives a beautiful orchestral treatment. The Wasps is very pleasant, has huge and clear 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 wood; in fact, if your turntable is at all "wobbly," don't waste your money. Nothing spectacular, but a just about perfect job of performing and recording these 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 hopeless the finest recording of the organ pedal is needlessly overcut in spots and will rattle many pickups, including some of the very finest. The musical bass of this recording provides a variety of Spanish transients, including plenty of flamenco heel tapping, finger snapping, his shopping and foot stamping, 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.

VIYALDI: Four Concertos and Two Sinfonias

Solisti di Zagreb

Vanguard BC-560

Each of these works by 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 Viyali 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 line speakers.

Intermission at the Mosque

Reginald Foote at Mosque organ
Cook 1059X

Walts and Ballet

Reginald Foote at Mosque organ
Cook 1058

Previous recordings by this pair of man and instrument won deserved popularity, especially at audio fairs; but these make the previous ones look pale and puny by comparison. 1059X is probably the best pressing available, but on the 1059X the superiority is in the amplitude which is advertised to offer an "extreme never before put on a commercial recording." But on the 1059X the superiority is also in the amplitude which is advertised to offer an "extreme never before put on a commercial recording." 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 handle 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 that they can deliver, the owner can bring a
NEW RECORDS

(Continued)

$0,000 two-story organ right into his livingroom.

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 bases. 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” (e.g., sections of the Nutcracker Suite). The pair makes a nice addition to the organ section of the record shelf.

Fly—not 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 running from the second Hungarian Rhapsody to the Willows of the Flowers, including a spectacular Marche Slav, a fine William Tell Overture, Blue Danube, Drame 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 strings bases 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 birds as well. The presence is good throughout but especially marked in the Drame Macabre. The overall sound is mouth-watering on a first-class system and will be impressive as well 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, Rhapsodie and Ride of the Valkyries, but these reflect just about the best of Westminster’s lab’s quality. The first 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 sound and dance. It includes a selection by the Westminster Brass Band (wonderful big drum), an organ version of the lovely Greensleeves air and a semiconcert can-can, as well as some Hungarian wine-bail 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 drum and bass, especially in Carmen, 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 clapping guitars, fine string tone and an assortment of highs.

FE 2 1 9 R Y A R, 19 5 7
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LEATHER BOUND TRANSISTOR BOOK RADIO

Sold for $29.95
$49.95

One of the most sensational money-savers we've ever run across. Fabulous CROSLEY TRANSISTOR BOOK RADIO looks too good to be true for $49.95! You save a clear $20.00 at RADIO SHACK. What's more, you get one of the most luxurious, hottest transistors ever built. Lift the cover and radio plays, close cover and radio automatically shuts off. Richly bound in durable top grain leathers with hand-sewn gold embossing. Latest combination transistor and subminiature circuit. Ships in outstanding performance and an amazingly long battery life. Has all of the most desirable electronic developments including printed circuits chassis, zincco V PM speaker, automatic volume control, built-in ferrite antenna, sensitive superhet circuit and push-pull transistor output for greater usable audio level than receivers using a tube in this stage. Shipped wt. 1 1/2 lbs. Order Item A-1
Order Item A-2 Batteries for Above $3.95

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Complete with:
$1.10 MERCURY BATTERY
$1.39 CRYSTAL EARPHONE
Reg. $22.44 $12.95
New powerful midget, 2 transistor portable to take with you everywhere. Step-by-step assembly includes chassis, parts. Ship wt. 1 1/2 lbs. Order Item A-3 Complete $12.95

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Reg. $39.95
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Compact jewel-like molded case holds a fine 3-speed record changer with an all-groove cartridge and a AM superhet radio. Ship 7 lbs. Order Item A-6 Complete $24.95

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GE RPX-050, RPX-050A

List $30.00
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NEW-type stylus assembly with slip-on diamond 0.015" LP tip and slip-on 0.035" 1/8" tip. Guaranteed 1st quality whole cone Ship 3/4 lb. Order Item A-8 Complete $10.40

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8-ohm voice coil type Shallow cone with shielded pot construction, magnet totally enclosed. 3/8" depth, 6/32 inch holes. Ship 1/4 lb. Order Item A-8 Complete $1.95

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For Transistor and Subminiature Use
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Just 3 oz in weight, wide range, sensitive Crystal earphone can be used as tiny make. Less plug and jack. Ship 1/4 lb. Order Item A-4 Complete $1.39

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* ALL WITH RUBBER LEADS, 3" METERS!
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* ALL ASTONISHINGLY LOWER PRICED!

NOW WITH 1% WIRE-WOUND RESISTORS

RADIO SHACK's answer to high quality at a sensible price. 3AC ranges to 1000 volts; 6DC ranges to 5000 volts. 4-DC current ranges from 50 μa to 500 ma; 4-resistance ranges to 10 megohms; 2-dc range to 36. Not a kit! Order Item A-12 Ship wt. 4 lb. $19.90 Only $11.90
Exquisite MICRONTA multimeter would cost at least twice our price if made in this country. Same ranges as above except DC current 4-ranges from 250 μa to 500 ma, 160 μa, jeweled meter. Bakelite case. Completely wired and tested. Order Item A-11 Ship wt. 4 lbs. $14.50

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RCP FLYBACKER

Reg. $39.75
$19.88
Fast, accurate, reliable tester has 3 direct-reading calibrated GOOD-BAD scales for high and low impedence. Illuminated meter. Operates dynamically. Ship. 8 lbs. Order Item A-13 Complete $19.88

FABULOUS TAYLOR WEATHER KIT!!

Exclusive Sale!
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$9.95

With $11.00 Mercury Column
Prepared under guidance of Encyclopedia Britannica

Over $30 Parts Value!
Builds 345/" Barmeter!
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48-Page Weather Book!

See Order Blank on Last Page
REALISTIC "AM" TUNER CLOSEOUT!!

SALE!! $59.95 RCA TV REMOTE CONTROL

Exclusive "Archir" Brand MIKE SALE! ‘LIPSTICK’ CRYSTAL

LIST $21.00

NEW 4½” long 3-OUNCE mike has h-r 50-10,500 cps response! Includes 10 feet of cable, stand attachment for 180° tilt. 100% detachable for handy mike use. TV gray and chrome. Ship. 2 lbs.
Order Item B-5 Sale $5.95

"BULLET" CRYSTAL

List $3.85

NEW imported mike has 85,7000 cps response and output 1000 c/s –40 db. New 105% less than I made here. TV gray, 15 feet of cable. Swivel neck. 5/16”-24 thread. Ship. 2 lbs. Order Item B-6 Sale $3.85

1st TIME EVER AT THIS PRICE!
ALL 1956 MODELS MUST BE SOLD

$39.95 $21.95

Radioshack's "FM" Buy of a Lifetime!

REALISTIC "FM" $39.95 HI-FI TUNER

Features Armstrong FM with Foster-Sexel discriminator, 5 uv sensitivity for 30 db quieting. double-tuner limiters, automatic frequency control (AFC), tuner RF stage, built-in AC power supply, 20,000,000 cps response ±0.5 db. pilot tight, slide rule dial, function switch. Solid state and pilot lights metal front panel. Output 1W for 100% modulation. 117V 60 cycle AC.

SUPER-SMALL SIZE 4½” H x 9½” W x 6½” D!
Order Item B-11 Ship. 8 lbs. Exclusive at $39.95

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$29.95 10W AMPLIFIER

Realistic "AF" 10 watt hi-fi amplifier, matches Realistic tuners in appearance. Features: 10 watts (1/8 peak). 15 db intro 20,000,000 cps. 1 watt level, built-in RIAA equalized preamp, treble control 18 db attenuation @ 18 kc. bass control 15 db boost @ 50 cps. hum 0.0 db below -10 db, output 4.0-16 ohms. Jack for direct feed to tape recorder, input for tuner or crystal pickup, magnetic pickup or high-imp. mike. Order Item B-12 Ship. 10 lbs. Exclusive at $29.95

NEW "REALISTIC" SUSPENSION CONE HI-FI SPEAKER

$19.95 COMPLETE IN FURNITURE-FINISHED WOOD ENCLOSURE!

- VERIFIED 50-12,000 CPS!
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- CASE FINISHED ALL 4 SIDES!
- EXCLUSIVE AT RADIO SHACK!
- LIST PRICE IS $41.50.

Here's compactness — 14½" x 13 x 10½" — for small space hi-fi systems, but fails stereophonic systems, for school or P.A. use! Here's quality! verified by Lafite tests and thousands of sales — plus cabinetry that's ours thru the audio handbooks: tuned, untuned, but face Helmholtz resonance. Includes leg rails for use of desired Solid wood case finished to harmonize either with walnut or mahogany, furniture-grade grilla cloth front. Sealed wood back with terminal strip connection. Heavy PM magnets speaker has come attached to super soft leather suspension rim for enhanced low frequency reproduction. An exclusive Radio Shack invention.

Order Item B-13 Ship. wt. 12 lbs. Realistic System Complete $19.95

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Ultra-Compact-and-Light
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Coated 13.5 Lens!
Same-waist-length
40mm Focal Length!
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PQ Flash Tip!
Save At Least 1/2!

Brand new, multi-feature 35mm MICONTA-guaranteed camera is one of Radio Shack's favorites for color or black-and-white! Solidly built, all metal camera has all the requirements you'd expect in a $40.00 camera. Takes as many as 36 pictures per roll! LENS: f/3.5-116, sharp from 3 feet to infinity. Has double-sprocket take-up accessory clip, removable back—NEWLY restyled for 1957. We believe there's no finer to give or receive at Radio Shack's dollar-stretching price. Shop. wt. 1/2 lbs.

ORDER ITEM C-3 $18.95

$70 35mm CAMERA Sale $37.50

PHOTO ELECTRIC EXPOSURE METER Most Sensational Meter In Our 34-Year History!
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Outstanding Features:
"Flick" For Incident, Reflective Reading
New LVS Synchro Compur Readings
One HAND Operation, Light and Compur
Aperture: f/3.5 8 sec. to 1/1000
Year Guarantee!

Preferred by professionals (and praised by amateurs). Meter has 7 motion speeds, push-button control allowing automatic changing of scale for incident reading. Full ASA and shutter ranges for all film emulsions for movies or still pictures, indoors or out. Highly accurate even in dim light. Has both standard and new Compur shutter speeds.

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Prisms of binoculars below our cost! 8 x 25

Never before so low—includes year guarantee! Hard-coated optics; fully color-corrected. Includes pigskin case. Individual focus. Shop. 2 lbs.

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4 Pages of Mail-Order Bargains

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167 Washington St., Boston, Mass. 230 Crown St., New Haven, Conn.
SHACK
SALE! RCA 45 rpm SLIDE-O-MATIC

FAMOUS MAKE
POWER SAW
7" 1¼ hp $29.95
Reg. $44.95 List

POWERFUL GE 6 RPM DISPLAY MOTOR KIT
Worth $11.95 $3.95
Reg. $14.95

5-PC. JEWELERS PLIER SET SALE!
Reg. $12.95 $5.99
$5.99

- Drop Forged
- Chrome Plated

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 ripple! Excellent regulation. Makes an ideal power supply for Williamson-type amplifiers and other equipment. Kit includes mini-encased powerv transformer, 400-0-400 @ 200 ma, 5 V @ 4 A, 6.3 V @ 4.2 A, 8-18 mfd @ 600 VDC oil-filled capacitors, 7 henry @ 150 ma open case choke, 54A rectifier, 100 W, bleeder, line cord, switch, socket and 7x125" chassis. Complete with schematic and chassis layout. Ship wt. 18 lbs. Order Item D-10 $9.95

RCA "Victrola" Super-Sale
Reg. $14.95 $6.99

POWER SUPPLY KIT
400 VDC @ 150 MA.
$9.95 Worth $25.00
With 2 45-EP Discs
$3.95

COLUMBIA SALE!
22-RECORD 45-RPM
PACKAGE—WORTH $20

BACH'S MASS IN B MINOR
Reg. $11.90 $4.99

REMOTE CONTROL MODEL BOAT!
Remote Control Functions:
- Forward
- Reverse
- Left Rudder
- Right Rudder
- Running Lights
$7.99

WORTH $35.00 — 2 Hp 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, 5½ wide fully wired boat. Uses 3 standard flashlight batteries. Waterproof control cable. 4 lbs. Order Item D-8 Complete $7.99

SHACK
SALE! RCA 45 rpm SLIDE-O-MATIC

FAMOUS MAKE
POWER SAW
7" 1¼ hp $29.95
Reg. $44.95 List

POWERFUL GE 6 RPM DISPLAY MOTOR KIT
Worth $11.95 $3.95
Reg. $14.95

5-PC. JEWELERS PLIER SET SALE!
Reg. $12.95 $5.99
$5.99

- Drop Forged
- Chrome Plated

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 ripple! Excellent regulation. Makes an ideal power supply for Williamson-type amplifiers and other equipment. Kit includes mini-encased powerv transformer, 400-0-400 @ 200 ma, 5 V @ 4 A, 6.3 V @ 4.2 A, 8-18 mfd @ 600 VDC oil-filled capacitors, 7 henry @ 150 ma open case choke, 54A rectifier, 100 W, bleeder, line cord, switch, socket and 7x125" chassis. Complete with schematic and chassis layout. Ship wt. 18 lbs. Order Item D-10 $9.95

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Remote Control Functions:
- Forward
- Reverse
- Left Rudder
- Right Rudder
- Running Lights
$7.99

WORTH $35.00 — 2 Hp 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, 5½ wide fully wired boat. Uses 3 standard flashlight batteries. Waterproof control cable. 4 lbs. Order Item D-8 Complete $7.99

FREE RADIO SHACK 1957 CATALOG
A complete single-unit sweep and marker generator specifically designed for visual alignment of modern black and white or color TV receivers. Provides strong harmonic output on UHF. Excellent attenuation and sweep linearity. Features all-electronic sweep with no moving parts to become inoperative. Amplitude modulation is less than 0.1 db per megacycle. Strong .25 volt RMS marker. Marker frequency accuracy is at least 0.5% at any setting. Built-in Crystal. Non Parallax knife-edge pointers assure highest reading accuracy.

Ask for a demonstration of the 615 today!

**ABBREVIATIONS and Symbols**

By CHARLES S. KIMBALL

(Continued from January, page 151.)

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>The quality of electricity in conduits.</td>
</tr>
<tr>
<td>R</td>
<td>Resistance.</td>
</tr>
<tr>
<td>-</td>
<td>A resistor.</td>
</tr>
<tr>
<td>A</td>
<td>In anatomy; radian, radius.</td>
</tr>
<tr>
<td>-</td>
<td>In physics; gas constant.</td>
</tr>
<tr>
<td>RACMD</td>
<td>Radio Countermeasures and Deception.</td>
</tr>
<tr>
<td>RADAR</td>
<td>Radio Direction And ranging.</td>
</tr>
<tr>
<td>R/C</td>
<td>Resistance-Capacitance.</td>
</tr>
<tr>
<td>R/C</td>
<td>Radio controlled.</td>
</tr>
<tr>
<td>RCDR</td>
<td>Remote controlled.</td>
</tr>
<tr>
<td>RCDO</td>
<td>Recorder.</td>
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<tr>
<td>RCM</td>
<td>Recording.</td>
</tr>
<tr>
<td>Rep</td>
<td>Radiometer Measures.</td>
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<tr>
<td>RFP</td>
<td>R.F. Receiver.</td>
</tr>
<tr>
<td>RFT</td>
<td>Radio-Frequency Transformer.</td>
</tr>
<tr>
<td>Rho</td>
<td>Greek letter: Ρ.</td>
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<tr>
<td>RHP</td>
<td>R.H.P. (hp).</td>
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<tr>
<td>Rho</td>
<td>Radio-frequency choke.</td>
</tr>
<tr>
<td>RHI</td>
<td>Radio harmonic indicator.</td>
</tr>
<tr>
<td>RMS</td>
<td>Root mean square.</td>
</tr>
<tr>
<td>rpm</td>
<td>Revolutions per minute.</td>
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<tr>
<td>rps</td>
<td>Revolutions per second.</td>
</tr>
<tr>
<td>RT</td>
<td>Receiving terminal (radio).</td>
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<tr>
<td>RTB</td>
<td>Ranges and true bearing (Radar; I-Scan presentation).</td>
</tr>
<tr>
<td>RTTY</td>
<td>Radio teletype or teleprinter.</td>
</tr>
<tr>
<td>RX</td>
<td>Receiver (radio).</td>
</tr>
<tr>
<td>Ry</td>
<td>Relay.</td>
</tr>
<tr>
<td>-</td>
<td>In vacuum-tube terminology:</td>
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<tr>
<td>Rrr</td>
<td>Grid resistor.</td>
</tr>
<tr>
<td>Rs</td>
<td>Cathode resistor.</td>
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<tr>
<td>Rf</td>
<td>Plate load resistor.</td>
</tr>
<tr>
<td>Rm</td>
<td>Screen grid resistor.</td>
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<tr>
<td>Rg</td>
<td>Plate resistance.</td>
</tr>
<tr>
<td>Rl</td>
<td>Output resistance.</td>
</tr>
<tr>
<td>R0</td>
<td>Plate resistance.</td>
</tr>
<tr>
<td>-</td>
<td>Phased-coil sensitivity.</td>
</tr>
<tr>
<td>-</td>
<td>Secondary winding of transformer.</td>
</tr>
<tr>
<td>-</td>
<td>Switch.</td>
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<tr>
<td>-</td>
<td>In radio, letter designation (or meter) (S-meter) that indicates strength of received radio-frequency signal.</td>
</tr>
<tr>
<td>-</td>
<td>Scale of radio frequencies extending from 1550 to 3200 mc.</td>
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<td>-</td>
<td>U.S. Navy prefix (obsolete) to designate shipborne search radar. Example: S-1.</td>
</tr>
<tr>
<td>SAM</td>
<td>Surface-to-air missile.</td>
</tr>
<tr>
<td>Sapp</td>
<td>Sweep Amplifier Pouch Patch (radio).</td>
</tr>
<tr>
<td>sec</td>
<td>Single crystal covered (wire).</td>
</tr>
<tr>
<td>ssc</td>
<td>Single crystal encased (wire).</td>
</tr>
<tr>
<td>SCR</td>
<td>Chip Controlled Interception (radar).</td>
</tr>
<tr>
<td>SCR</td>
<td>U.S. Army prefix (obsolete) for Signal Corps radio and radar equipment. Example: SCR 884.</td>
</tr>
<tr>
<td>SD</td>
<td>Simple dropout (telephony).</td>
</tr>
<tr>
<td>SEC</td>
<td>Secondary.</td>
</tr>
<tr>
<td>SEL (RECT)</td>
<td>Selenium rectifier.</td>
</tr>
<tr>
<td>SEP</td>
<td>Separator.</td>
</tr>
<tr>
<td>SH</td>
<td>System grid of a vacuum tube.</td>
</tr>
<tr>
<td>SHA</td>
<td>Sidereal hour angle (Navigation).</td>
</tr>
<tr>
<td>SHF</td>
<td>Super-high frequency (band).</td>
</tr>
<tr>
<td>SHM</td>
<td>Simple harmonic motion.</td>
</tr>
<tr>
<td>Shoran</td>
<td>Short Range Navigation.</td>
</tr>
<tr>
<td>SIF</td>
<td>Sound Intermediate Frequency (TV).</td>
</tr>
<tr>
<td>Sig</td>
<td>Selective Identification Feature (radar).</td>
</tr>
<tr>
<td>Sig</td>
<td>Signal.</td>
</tr>
<tr>
<td>SIG GEN</td>
<td>Signal generator.</td>
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</tbody>
</table>

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- who assures you—the independent service dealer—a complete, fresh selection of the finest replacement parts in the world.
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- who supports you in all his relations with the independent parts manufacturer.
- who stands alone...serving no other boss than you, one of the thousands of well-established independent service dealers.
- who, as an independent parts distributor, is able to supply you with ALL the exact replacement parts for ALL the sets you are asked to service.

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FEBRUARY, 1957

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chicago 50, illinois
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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-hygroscopic ceramic tube encasing. Hermetically sealed with high-temperature coating. Fully insulated. Conforms to MIL-R-10660B spec. -4° to +150° C, and 2- and 2.5-watt sizes, Tolerance ±1%, ±2%, and ±5% can be ordered. —Continental Carbon, Dept. 55-0, P.O. Box 15900, Cleveland 11, Ohio.

RESISTORS, Varistor. 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., 3020 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 side.

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attenuated input and adjustable spot-shape control. Calibrated grid screen for face of C-II tube. Flat vertical response to over

1 mc, down 1½ db at 500 kc. Sweep - generator multivibrator from 36 to 200,000 cycles.— Heath Co., 305 Territorial Rd., Benton Harbor, Mich.

OSCILLOSCOPE KIT, model Dupont Electrical Instrument Corp. 5calibrated 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., 18531 Dupont Ave., Cleveland 8, Ohio.

RF SWEEP GENERATOR KIT, Tri-X 12x. Electromechanical wobbulator system. 300 kc to 250 mc on four fundamental ranges. Crystal-controlled marker accommodates any two crystals; can use external marker. Rf sweep output in excess of 0.18 volt adjustable by step type and continuously variable output attenuators. 5-volt, 60-cycle sine-wave horizontal sweep voltage for scope synchronization. Horizontal retrace blanking circuit. Complete with tubes, punched chassis, all parts, wire, solder, instructions and diagrams.— Allied Radio Corp., 100 N. Western Ave., Chicago 80, III.

TUBE TESTER, model 107, prec. cover panel mounted in front. Tube tester 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. Current response of over 4½ mc. Contains a multiplier type photo-cathode 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 tuning 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 bandwidth tuning with direct calibration of 10-, 50-, 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. 33rd 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-
NEW DEVICES

sure. Changeable barrel assemblies available in standard and other desirable lengths.—Great Electric Co., 2 S. Broadway, Lawrence, Mass.

AMPLIFIER, model AA-902B. With preamplifier and tone controls. Two EL84's in Williamson type circuit provide 14 watts, peak of 28 watts. De filament supply to preamp tubes. Frequency response 20-20,000 cycles ±1 db. Harmonic distortion less than 1% at 14 watts; 1.1% at 14 watts. 21 db negative feedback. 4% x 13 1/4 x 9 inches. 17 pounds.—Pilot Radio Corp., 77-06 30th St., Long Island City, N. Y.

CABINET ENCLOSURE. 32 inches high, including legs, 21 inches wide, 16 inches deep. Model 39 a lift-top equipment cabinet with 2 compartments. 6 inches height above player board. Upper player compartment 19 1/4 inches wide, 14 inches deep; lower compartment 13 inches high, 19 1/2 inches wide, 14 1/8 inches deep. Mahogany or korina (blond mahogany) finish on birch. Model 60-B matching base-cabinet enclosure, has 4.5-cubic-foot battle area.—G. & H. Wood Products Co., 99 N. 11th St., Brooklyn, N. Y.


MEGAPHONE SYSTEM. Powered by flashlight cells with built-in switch. Portable Preamplifier model PP-1 (illustrated) uses 12 volt flashlight cells. 7½ pounds with batteries.

Pistol Grip Preamplifier model PP-2 megaphone system employs 6 1½-volt pencil-size AA flashlight cells. Jack accommodates external 6-12 volt dc supply. 4½ pounds with batteries.—University Loudspeakers, Inc., 80 S. Kencao Ave., White Plains, N. Y.

MICROPHONE SUPPORT, Model SB-1. For telephone switchboard, dispatcher's office, desk, bar, bar, table, etc. 12-inch, chrome-plated goose neck arm mounted on spring-loaded swivel. Feedthrough hole in base of goose-neck support to accommodate mike cable to be concealed within arm after entry under base of rear end.—Alas Sound Corp., 1451 30th St., Brooklyn 18, N. Y.

PREAMPLIFIER, Micamp. All-transistorized and impedance-matching design. Permits direct use of low-impedance, low-gain cartidges and microphones with high-impedance tape recorders, amplifiers, TV, and PA systems. etc. 20-20,000 cycles ± 1.5 db. Input impedance 50-250 ohms—Madison Fielding Corp., 803 Madison St., Brook-

MINIATURE CHASSIS. For subminiature and printed-circuit assembly, 22 sizes ranging from 1 1/4 x 1 1/4 x 3 1/2 x 1/2 inch. Interchanging sizes with depth up to 1 1/4 inches. Printed circuit chassis (illustrated) are made with shallower base and top cover on bottom. 1/4-inch mounting lip for attachment of circuit board. —Heeger, Inc., 221 West 16th St., Los Angeles 15, Calif.

AUTOMATIC LIGHT COMPENSATOR. Electronically controlled

(Continued)
NEW DEVICES pennates for variations in video signal level as great as 150:1. Designed to be used with any Blonder-Tongue Observer TVC-2 or TVC-TA television camera. Suited for outdoors and flame control in power, refining and processing plants. — Blonder-Tongue Labs, Inc., 52b-36 North Ave., Westfield, N. J.

ELECTRONIC TRAP, Trap-Case. 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. — Jerold 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, Min- ute Mount. Factory-assembled unit includes aluminum tower, antenna with factory-attached lead-in, insulators, ground wire, ground rod and lightning arrester. — 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 tochannels 2-8. 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 placed in corner of electronic unit without allowing for air circulation among plates. Variety of tubes detailed in Radio Receptor Semiconduktor Division's Bulletin No. 237 — Radio Receptor Co., Inc., 251 W. 19th St., Brooklyn 11, N. Y.

FLAT SODIUM RECTIFIERS. Mounted directly on chassis for drawing off heat. Can be 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., 1145 Hudson Blvd., Chicago, Ill.

ELECTRONIC BRAIN ENTERPRISES, Inc., 1015 Atkin Ave., Salt Lake City, Utah.

Another reason why today's fastest selling high fidelity record changer is Collaro Accurate speeds —

factory pre-set and tested for less than 0.25% rms wow and flutter content measured at 33 1/3 rpm. Specifications unmatched in the field.

For other features and popular price, see your hi-fi dealer or write Dept. TL-4

ROCKBAR CORPORATION 650 Haistead Avenue, Mamaroneck, N. Y.

MINIATURE POWER RESISTORS, series 75OL and 100KL. Square body facilitates certain assembly and wiring. 1/4 x 1/2 inches in cross-section. 7-watt rating on 1/2 inch long, from 1 to 6,000 ohms. 10-watt rating 1% inches long. — Clarostat Manufacturing Co., Dover, N. H.

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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, which 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 non-servicing 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,
...here's how to LEARN SERVICING R-I-G-H-T!

Complete training in modern professional methods...only $13...3 months to pay!

**FIX ANY RADIO OR TV SET EVER MADE...easier...better...faster**

Radio & TV Receiver TROUBLESHOOTING AND REPAIR
by Ghirardi & Johnson
822 pages, 417 illustrations
Price $7.50
(see special offer in coupon)

This big, 822-page book brings you the kind of PROFESSIONAL training that helps you handle the toughest radio-television-electronic service jobs as slick and as accurately as you now do the easy ones.

For service beginners, Radio & Television Receiver TROUBLESHOOTING AND REPAIR is a complete, easily understood professional training course. For experienced servicemen, it is the ideal way to "brush up" on specific jobs; to develop better troubleshooting methods and shortcuts; and to find quick answers to puzzling service problems.

Step by step, it takes you through each service procedure...from locating troubles quicker and with less testing to repairing them faster and better.

**LEARN BASIC CIRCUITS....and watch service "headaches" disappear!**

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by Ghirardi & Johnson
669 pages, 417 illustrations
Price $6.75
(see special offer)

It's amazing how much easier you can repair radio and television sets and even industrial electronic equipment when you know all about its circuits. You locate troubles in a jiffy because you know what to look for and where to look. You handle jobs lots faster, better...and more profitably.

Radio & Television Receiver CIRCUITRY AND OPERATION gives you a complete understanding of basic circuits as well as their variations. It teaches you to recognize them...to understand their peculiarities...to know their likely "headaches"...and how to eliminate guesswork and useless testing.

Throughout, this new book brings you the kind of above-average professional training that fits you for the bigger, better-paying jobs. Covers all circuits used in modern television and radio receivers, amplifiers, phone pickups, record players, etc.

Price only $6.75...or see money-saving combination offer in coupon, 10-day FREE examination.

10-DAY FREE EXAMINATION...Pay as You Learn!

**Save $1.25!**

Make your training library complete. Have ALL the latest data at your fingertips. Get both these books at only $13.00 for the two...YOU SAVE $1.25.

**TECHNICIANS' NEWS (Continued)**

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 Rider and Frank Moeh.

Captive service was not 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 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 public policy of G-E's service efforts was (as was also stated in somewhat different words by Mr. Creato) to provide service 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, although 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 recent advertising, some of which claimed certain services as standard. 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 fasten 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 state of West Virginia, with H.P. Frank, of Institute; SF Johnson, of the John Miller Co., and John Sheehy, of Sylvania, as first officers.

**RADIO-ELECTRONICS**

108
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\(\frac{1}{2}\)" voice coil.

DELCO RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

A complete line of original equipment service parts from the WORLD LEADER IN AUTO RADIO

FEBRUARY, 1957

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE
Distributed by Delco Electronic Parts Distributors
TECHNICIANS’ NEWS  (Continued)

associations. Edward Engel, Crystal City, is president of the new association; Melvin Declue, Potosi, vice president; Harold Banks, DeSoto, 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. Pryor, Mountain Grove, secretary-treasurer. Troy Brinter, 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.

DON’T BE FooLED
by
the Joker in the Deck!

Printed on right 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-
A NEW FRONTIER FOR TECHNICIANS

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.

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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-158
RCA Service Company, Inc.
Missile Test Project
P. O. Box 1226
Melbourne, Florida

FEBRUARY, 1957
Look inside the brand new Mallory 1600 series vibrator. There are no contact buttons!

This completely new approach to vibrator design means a big advance in performance. The extra-large spring-leaf contact area gives you up to 100% longer life than ever before... reduces arc erosion.

Sticking of contacts is eliminated, to assure you positive starts. The simpler design makes possible absolute uniformity of every vibrator. And thanks to lighter vibrating mass and noise-stopping design, they're the quietest vibrators you've ever installed.

Be sure to get your stock of the new Mallory 1600 vibrators from your distributor. He carries them in ratings for all auto radios... at the same price you would pay for an ordinary vibrator.

TECHNICIANS' NEWS (Continued)

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—Kings- ton, 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. Phili...
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.

**Customer Engineers:** opportunities are also available, locally, for servicing IBM machines, after training with pay. Consult your nearest IBM office.

---

At the Maintenance Console. At home Dick plays with one of his three children.
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Meter Movement Protection up to 500 times overload is provided by a rectifier network.

The 555A Measures: AC Current, DC Current, AC Voltage, DC Voltage, Output, Resistance

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Complete with Probes and Batteries at your Parts Distributor $44.50

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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 50 ma, maximum power dissipation is 200 mw. The reverse voltage at which a reverse current of 100 µa flows is: 1N625, 30; 1N628, 50; 1N627, 100; 1N628, 150; 1N629, 200.

IN588, -89, -90, -91

Four new silicon rectifiers (see photo) having a peak inverse voltage...
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 ma. 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, ST4, 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.
USE LOW COST

IMPEDANCE MATCH ACCESSORIES

with coax cable

Improve reception as much as 6 db

Eliminate Signal Losses, Smear, Ghosts and Other Picture-Degrading Conditions Resulting From Antenna-to-Line or Line-to-Set Mismatch.

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.

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 ratio of 35 at a collector-to-emitter voltage of only -0.15, and a minimum alpha-cutoff frequency of 4 mc.

The 2N269 is hermetically 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.

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 L4 characteristic with a sharp knee at relatively low plate voltages. As a result, mixer operation with good linearity can be obtained. The low

B-T BALUN

model MB

Mounts on antenna mast or strut. Provides exact impedance match between 75-ohm unbalanced line and 300-ohm balanced line or antenna. Has 75-ohm coax fitting and 300-ohm screw terminals. Built into weather protecting cowl housing.

B-T TV SET MATCH

model TM

Used at TV receiver to match 75-ohm cable to 300-ohm TV set input. Cable plug and jack permit quick, easy disconnect. Has heavy duty, 300-ohm output leads.

At electronic parts distributors. For complete accessory catalog, write to Dept. 58-3

BLONDER-TONGUE LABS., INC.
9-25 ALLING STREET, NEWARK 2, N. J.
NEW TUBES & SEMICONDUCTORS (Contd.)

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 age 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 amhos). 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.

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FEBRUARY, 1957

Radio-Electronics

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RADIO ELECTRONICS

80-METER NOVICE CONVERTER

Please print a diagram of a con-
verter that I can use ahead of a 5-tube
broadcast set for reception on the 80-

meter Novice band. Please use com-
mercial coils and transformers if pos-

sible—J. C., Winston-Salem, N.C.

This converter includes a stage of
1500-ke amplification to increase the
sensitivity of the converter—receiver
combination and a bfo to permit re-
ception 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 ar-

rangement.

Connect the output lead to the input
of the receiver tuned to around 1800 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-µuf tuning capacitor closed.

Padlers 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 Service-
man, published by International Rec-
tifier Corp. Two 7-volt transformers
(T1 and T2) are switched in series for
12 volts or in parallel for 6 volts out-
put. 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

This converter includes a stage of
1500-ke amplification to increase the
sensitivity of the converter—receiver
 combination and a bfo to permit re-
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and oscillator coils may be any available
type covering the 75- and 80-meter
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You can have the finest sound reproduction throughout all frequency ranges without distortion

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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They have incorporated a number of technical refinements which are evident the moment you listen. The air gap has been made long so that the coil is completely enclosed in an even magnetic field at all times. A copper ring has been fitted into the deep air gap to keep the voice coil impedance constant over the whole frequency range; this avoids incorrect matching. High flux densities are obtained through the use of "Ticonal" magnet steel.

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I need a replacement 25BG-G for an American Bosch model 809. Please tell me where I can obtain the 25BG-G or show how I can replace it with a 25L6-GT of similar type.—S. J., Hyde Park, Mass.

The 25BG-G and almost any other obsolete receiving tube that you can name (except the 25BG-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 25BG-G. We do not have a dia-

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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 setup 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

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TECHNOTES (Continued)

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 on stick shellac of the proper color. (Sometimes two or more colors must be blended to obtain the correct shade.) Push the shellac into the scratch or hole by passing the hot knife blade over the surface. Repeat until the shellac is built up slightly.  

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Two ink should be used. If the ink is 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 can be matched by 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 1/2 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 6V6 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

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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.

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 IF 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
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RADIO-ELECTRONIC CIRCUITS (Continued)
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 ac voltage across R2 and R3. The rf age voltage is delayed by V3. At low signal levels, the plate of V4 is positive so this diode conducts and effectively grounds the rf age line. As the signal strength increases, V9'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 %-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

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Dynaco Output Transformers

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Specifications:

Power Rating: 40 watts max. max. 6 cps to 60 kc. Power Curve: Within 1 db 20 cps to 20 kc. Square Wave Response: No ringing or distortion from 20 cps to 20 kc. Permissible Feedback: 30 db.

Dynaco Output Transformer Specifications:

- Models:
  - A410 10 watts 4.5 kHz, 6550, EL-34
  - A420 25 watts KT-66, 5881, EL-34
  - A430 50 watts 6550, EL-34, 6CA7
  - A440 100 watts 6550
  - A450 100 watts PP, 6550

- Amplifiers:
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- Additional data on Dynakit and Dynaco components available on request including circuit data for modernization of Williams-type amplifiers to 50 watts of output and other applications of Dynaco transformers.

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- 11 1/2 x 6W, green, ivory, or black tins.
- 11 1/2 x 6W, ivory, with white, Reg. $2.
- 11 1/2 x 6W, black, with white, Reg. $2.
- 11 1/2 x 6W, white, with white, Reg. $2.
- 11 1/2 x 6W, black, no windows, Reg. $2.
- 11 1/2 x 6W, white, no windows, Reg. $2.
- 11 1/2 x 6W, ivory, no windows, Reg. $2.
- 11 1/2 x 6W, white, no windows, Reg. $2.
- 11 1/2 x 6W, ivory, no windows, Reg. $2.
- 11 1/2 x 6W, black, no windows, Reg. $2.
- 11 1/2 x 6W, white, no windows, Reg. $2.
- 11 1/2 x 6W, ivory, no windows, Reg. $2.
- 11 1/2 x 6W, black, no windows, Reg. $2.
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- 11 1/2 x 6W, ivory, no windows, Reg. $2.
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- 11 1/2 x 6W, ivory, no windows, Reg. $2.
- 11 1/2 x 6W, black, no windows, Reg. $2.
- 11 1/2 x 6W, white, no windows, Reg. $2.
- 11 1/2 x 6W, ivory, no windows, Reg. $2.
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- 11 1/2 x 6W, ivory, no windows, Reg. $2.
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- 11 1/2 x 6W, ivory, no windows, Reg. $2.
- 11 1/2 x 6W, black, no windows, Reg. $2.
- 11 1/2 x 6W, white, no windows, Reg. $2.
- 11 1/2 x 6W, ivory, no windows, Reg. $2.
- 11 1/2 x 6W, black, no windows, Reg. $2.
- 11 1/2 x 6W, white, no windows, Reg. $2.
- 11 1/2 x 6W, ivory, no windows, Reg. $2.
- 11 1/2 x 6W, black, no windows, Reg. $2.
- 11 1/2 x 6W, white, no windows, Reg. $2.
- 11 1/2 x 6W, ivory, no windows, Reg. $2.
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

COYNE QUALITY TELEVISION
RADIO - COLOR TV
Home Training
at Unbelievably Low Cost

The future is YOURS in TELEVISION!
A fabulous field—good pay—fascinating work—a prosperous future in a good job, or independence in your own business!

Coyne brings you MODERN-QUALITY Television Home Training; training designed to meet Coyne standards at truly lowest cost. Pay for training only—no costly "put together kits." Not an old Radio Course with Television "tacked on." Here is MODERN TELEVISION TRAINING including Radio, UHF and Color TV. No Radio background or previous experience needed. Personal guidance by Coyne Staff, Practical Job Guides to show you how to do actual servicing jobs—make money early in course. Free Lifetime Employment Service to Graduates.

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Home Training Division
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Dept. 27-HT4
Send Free Book and details on how I can get Coyne Quality Television Home Training at low cost and easy terms.

Name
Address
City State

TRY THIS ONE

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 P. 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. Walkter

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 with the power supply and the meter and calculate the value from the formula

\[ R = \frac{(V_1 - V_2)}{V_2} \times R_m \]

where \( R \) is the unknown resistance in megohms, \( V_1 \) the supply voltage, \( V_2 \) 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

<table>
<thead>
<tr>
<th>Meter reading (V2)</th>
<th>Unknown resistance (R) megohms</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>11</td>
</tr>
<tr>
<td>33</td>
<td>22</td>
</tr>
<tr>
<td>20</td>
<td>44</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>6</td>
<td>290</td>
</tr>
<tr>
<td>4</td>
<td>264</td>
</tr>
<tr>
<td>2</td>
<td>539</td>
</tr>
<tr>
<td>1</td>
<td>1,090</td>
</tr>
<tr>
<td>0.5</td>
<td>2,180</td>
</tr>
<tr>
<td>0.3</td>
<td>3,652</td>
</tr>
<tr>
<td>0.2</td>
<td>5,489</td>
</tr>
<tr>
<td>0.1</td>
<td>10,989</td>
</tr>
</tbody>
</table>

The table gives sample values of \( V_2 \) and \( R_m \) when \( V_1 \) is 100 volts and \( R_m \) is 11 megohms. Multiply the meter readings in the table by 2 when \( V_1 \) is 200 volts, by 3 when \( V_1 \) is 300 volts and so on.—George S. Carson

### 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 shoted 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 is 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 one.) Check every possible circuit fault before blaming the supply.

5. Choice d is wrong. In a series-filament 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.

---

**miracles with your microvolts**

**Super “40” Broad Band TV AMPLIFIER**

WITH 4 SEPARATELY CONTROLLED INPUTS

EQUIVALENT TO AT LEAST FOUR 38 DB STRIP AMPLIFIERS

IDEAL FOR HOTELS, MOTELS AND APARTMENT HOUSES

**PRICE**

**$115.00**

Suggested User Net

FREE SERVICING AID

Astron offers a wide variety of materials to help you service better . . . send for your copy of handy, pocket-sized Replacement Catalog AC-40 . . . it will save you time!

**ASTRON CORPORATION**

255 GRANT AVENUE E. NEWARK, N.J.

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(Continued)
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 NATEESA on a recent Garry Moore TV show, sponsored by CBS-Hytron.

Ram Electronic Sales Co., Irvington-on-Hudson, N. Y., designed a new distributor counter and wall display for its width and linearity coils.


RCA Institutes, New York, N. Y., produced a 16-mm color motion picture "Your Career in Electronics" for high-school showings.

Vineland Co., Burlington, Iowa, will promote the aluminum anodized protection feature of its Umbrella-Ease TV antenna during 1957.

FEBRUARY, 1957
BA’s NEW 1957
172 PAGE FREE CATALOG
COMPLETE GUIDE TO EVERYTHING IN RADIO, TV, ELECTRONICS
100’s OF BRAND NEW ITEMS LISTED HERE FOR THE VERY FIRST TIME
INCLUDES 23 PAGES OF AMAZING BARGAINS NOT FOUND IN ANY OTHER CATALOG
SEND FOR IT TODAY!
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Send Free BA Catalog No. 81.
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CITY
STATE.

RAOONETTE
TELEVISION - SERVICING - HIGH FIDELITY
Build Your Own Set
"...the only solution is to use one of the new wide-range crystal pick-ups. I selected the Ronette To-284-P which combines the virtues of smooth frequency with extremely low intermodulation distortion.
...the response curve of the Ronette shows a very gentle rise to about 5 Kc and then a gradual slope to about 10 Kc.
...Output voltage from the Ronette cartridge is enough to drive the amplifier without the preamplifier stage...
George L. Augspurger, November 1956 Issue
Your distributor has a complete line of Ronette cartridges and microphones.
See him today.
Ronette Acoustical Corp.
190 Earle Avenue, Lynbrook, N. Y.

MUST MOVE OUR WAREHOUSE
Set Builders - Experimenters
GIANT SURPRISE KIT $4.15
25-30 lbs. of brand new RADIO PARTS...too junk...Transformers, Filter and Bypass Condensers, Resistors, Wirewound, Carbon, Volume Controls, Sockets, Wire, Var- iables, Chassis and Gang Switches. Parts that every Service Man, Experi- menter or Ham needs. Express or Freight Shipments Only. No C.O.D.
NEWARK SURPLUS MATERIALS CO.
224 PLANE ST., Newark, N. J.

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YOUR FUTURE CAREER IN PEACETIME ATOMIC ENERGY
NOW PREPARE YOURSELF FOR THE UNLIMITED OPPORTUNITIES OFFERED BY THE NATION’S FASTEST GROWING INDUSTRY - ATOMIC ENERGY!
SEND TODAY FOR FREE INFORMATION CLIP AND MAIL TO
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CITY ZONE STATE.
Send information on ISS Group Study Plan.

RADIO - ELECTRONICS

International Electronics Corp., New York, N. Y., American representative of Mullard Overseas Ltd., England, reports 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
Triplet Electric Instrument Co., Bluffton, Ohio, has broken ground for a new plant to be constructed in Oceano- side, Calif.
Raytheon Manufacturing Co. opened a new Electronics Laboratory in Maynard, Mass.
Sylvania Electric Products, Inc. is building a 56,000-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 Divi- sion. 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.
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 290,000-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-
CUSTOM-BUILT CABINETS & FACTORY YOU

WESTCHESTER $88.70

MANHATTAN $53.43

GEM $35.91

GEM also available for 24" or 23" picture tube $59.54

H-20" W-24" D-12'

H-41" W-36" D-25'

H-39" W-35" D-25'

$79.22

21" TV CONVERSION KIT

Build your own SUPER DE LUXE 31-TUBE $630 TV CHASSIS

#620 SUPER DELUXE 31-TUBE TV KIT

OPERATES 21" and all 70" PICTURE TUBE Types. Conver for Horizontal and Vertical scans. Includes transformers to convert 21" picture tube to Any 70" size. TUNER, PHASED DEFLECTION, SPEAKER, CONDENSERS, RESISTORS, TRANSFORMERS. List Price $9.75

Your Price $13.98

Included CONVERSION MANUAL with step-by-step instructions & diagrams. Complete set of original parts includes matched set of Todd 70" COSINE DEFLECTION YOKE and TODD HLV FLATBACK TRANSFORMER, FOCALIZER, 20KV FILTER, DRIVE TRIMMER, LINEARITY COILS, CONDENSERS, RESISTORS. COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 70" COSINE DEFLECTION YOKE and TODD HLV FLATBACK TRANSFORMER, FOCALIZER, 20KV FILTER, DRIVE TRIMMER, LINEARITY COILS, CONDENSERS, RESISTORS. Instructions for mounting TV on flush mount wall extending into garage, closet or wall recess included.

"...slowed to $99.99" and "...slowed to $15.97"

TV CRYSTAL-CLEAR LUCITE MASKS

TV PLASTIC OPEN MASKS

Used in conjunction with safety glass.

TV SAFETY GLASS in HANDY SIZES

Brooks Radio & TV Corp., 84 Vesey St., Dept. A, New York 7, N.Y.

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y.

February 1, 1957

135

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New!

ARKAY Model FL-30 Hi-Fi AMP-PRE-AMP

Featuring a transistorized front end for use with a reluctance pick-up, this engineering masterpiece assures the finest in Hi-Fi reproduction. Record evaluation for more than 50 labels (LP, RIAA, & EUR). Complete with rose gold panel and black cabinet.

$49.95

FREE! Get the new, big catalogue & specifications of the remarkable ARKAY line—Now at your local dealer! Prices 5% higher West of the Mississippi!

ARKAY - 120 Cedar Street - N.Y.

Keep up with new developments!

Read Gernsback Library Books

BASIC AUDIO COURSE—No. 66  $2.75
TRANISTOR TECHNIQUES—No. 61  1.50
RAPID TV REPAIR—No. 68  1.50
SERVICING RECORD CHANGERS—No. 59  2.00
MAINTAINING HI-FI EQUIPMENT—No. 58  3.00
THE V.T.V.M.—No. 57  2.50
HIGH-FIDELITY CIRCUIT DESIGN—No. 56 hard cover only. 5.95
SWEEP AND MARKER GENERATORS FOR TELEVISION AND RADIO—No. 55  2.50
PROBE—No. 54  1.25
RADIO CONTROL HANDBOOK—No. 53  2.25
THE OSCILLATOR—NO. 52  2.50
TRANSISTORS—THEORY AND PRACTICE—No. 51  2.00
TV REPAIR TECHNIQUES—No. 50  1.50
RADIO & TV TEST INSTRUMENTS—No. 49  3.00
HIGH-FIDELITY DESIGN, CONSTRUCTION & SERVICE—No. 48  1.50
RADIO & TV ELECTRONICS—No. 47  2.50
RADIO TUBE FUNDAMENTALS—No. 45  1.00
RADIO & TV—No. 44 hard cover only  2.25
MODEL CONTROL BY RADIO—No. 43  1.00
On sale at all better parts distributors

See advertisement on page 128

(Continued)

ARKAY

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 Senc 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 Division, reported that the sales volume of the semiconductor industry in 1956 totaled between $50 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 Neomaite relay is now stocked by leading distributors throughout the country.

... Allen B. Du Mont Laboratories, Inc., Cathode-Ray Tube Division, Cliff- ton, 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 25 scholarships for the current academic year to university students majoring in science, industrial relations, drama and music.

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 opposite side of the battery in the set in the photo. This change was made to simplify wiring.

BUSINESS
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 Electronic 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.

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.

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.

FEBRUARY, 1957
Crystal sets to satellites...only decades away from the first primitive experiments looms today's giant 12 billion dollar radio-electronics industry. Now, all 4 floors of New York City's Coliseum are needed to display one year's growth!

The purpose of The Radio Engineering Show is to bring new and stimulating ideas in radio-electronics to engineers. To achieve this more than 200 papers will be presented by 22 professional groups at the Convention's 56 technical sessions. Over 800 new ideas in radio-electronics engineering will also be presented by 834 exhibitors representing more than 80% of the productive capacity of the industry.

Yes, it's big in size, big in scope. Whatever your special interests, attending this Convention can cut weeks off your "keeping informed" time. Plan now to be there.

FROM A "CAT'S WHISKER" TO A COLISEUM!

LEARN TELEVISION - RADIO - COLOR - TV ELECTRICITY IN THE GREAT SHOPS OF COYNE TRAIN QUICKLY! OLDEST, BEST EQUIPPED SCHOOL OF ITS KIND IN U.S. Veterans and Non-Veterans—Get practical training in this rapidly growing field. Prepare now for a better job and a real future. Advanced education or related experience not needed. Employment service to graduates.

Enroll NOW—Pay Later
Finance Plan and Easy Payment Plan. Also Part Time Employment helps for students. Student in Refrigeration and Electric Appliances can be included.

FREE BOOK Clip coupon for Big Free Illustrated Book. No obligation and No Salesman Will Call. Act NOW.

START THIS CONVENTION:
- Save time; a whole year's productive effort seen in days! See all that's new in radio-electronics products, developments, and engineering—meet the men responsible! Hear the best technical papers about your specialty! Meet old friends, make new ones, enjoy association and social events!

REGISTRATION
IRE Members $1.00
Non-members $3.00

MARCH 18-21
The IRE National Convention Waldorf-Astoria Hotel and The Radio Engineering Show Coliseum New York City

1 East 79th Street, New York 21, N.Y.

The Institute of Radio Engineers

SENCORE TUBE and CAPACITOR LEAKAGE CHECKER

MODEL LC-2

A highly accurate tester for detecting leakage between tube elements. "Two Tests in One."

Only $2495

DIABLO NET $19.95

Checks 70 Critical Tube Types

A reliable instrument for indicating capacitor leakage with 50 volts applied. Quickly indicates Grid to cathode leakage, Grid emission, Heater to cathode leakage, Grid—Cathode, Dopp tube.

A must for servicing grid circuits.

SENCORE PRODUCTS

- Transistor Tester
- Leakage Checker
- Filament Tester
- Voltage
- Resistance
- Bias Supply

SENCORE INSTRUMENTS CORP.
171 OFFICIAL RD., ADDISON, ILL.

END

PEOPLE

(Continued)

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; F. X. Banko, 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; semiconduclors; J. J. Phillips, administrator—shows and exhibits, and H. M. Slowik, 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.


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 Ayco Manufacturing Corp.
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