MARCH

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor-in-chief

NAVY CAREERS IN ELECTRONICS

The Armed Forces offer the alert and intelligent young electronics enthusiast many opportunities for education and advancement. What you can do in the Navy is outlined here—possibilities in other branches are parallel.

PINPOINT COLOR TV FAULTS

Finding where the trouble in a TV set is can be even more important than in the older black-and-white. Sometimes the fault isn't even in the color section. Once you have located the trouble, the rest is usually simple.

SIMPLEST SIGNAL INJECTOR

Atomic-age version of the noise injector, this little unit looks like an ordinary probe, contains its own batteries and two transistors. "Of immense value for all forms of servicing."

USING THE TV CHECK TUBE

Can you use one check tube for all TV sets? And if so, which of the at least four types now on the market should you use? This story tells you, and shows how it can be done.

50c

Closed-Circuit TV In the Photo Studio

NEW CALLBACK-PROTECTION WELDED INTO EVERY

SILVER SCREEN 85 TV PICTURE TUBE

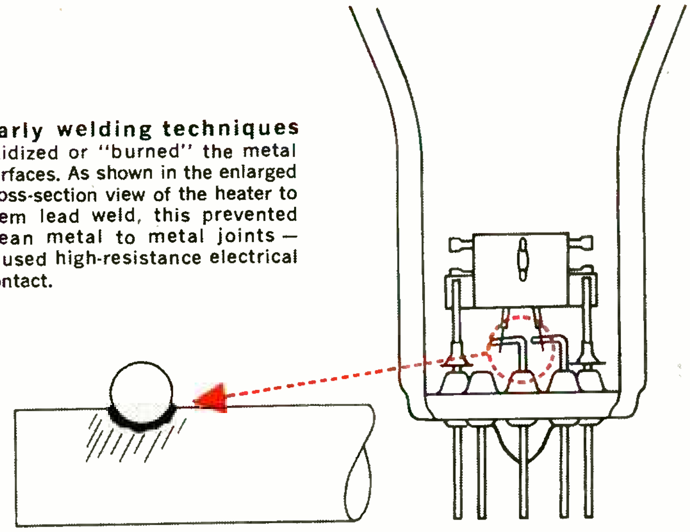
Sylvania technique eliminates tube failures caused by open heater or cathode lead welds. Protects your profits.

Sylvania . . . the leader in picture tube improvements . . . now gives you another built-in plus – "Controlled Atmospheric Welding"! Engineering investigations revealed that in the welding of picture tube gun parts something more than automatic controls, skilled operators and careful inspection was needed. The uncontrolled factor was the degree of oxidation occurring at the time of welding. The answer – control the atmosphere surrounding the weld at the instant it is made!

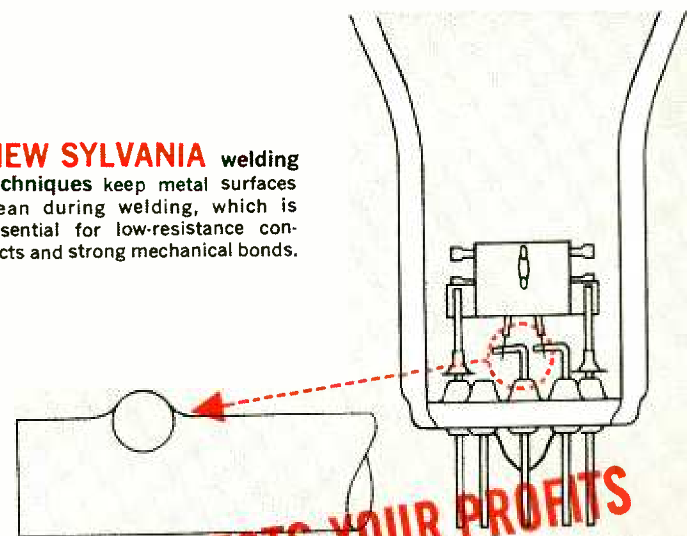
Now... through "Controlled Atmospheric Welding" Sylvania Silver Screen 85 TV picture tubes give you maximum assurance against callbacks. Common field problems of intermittent, poor, or open connections due to oxidized welds have been eliminated. Every year hundreds of thousands of TV picture tubes are replaced with Silver Screen 85. No wonder. It's more profitable in the long run.

Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, New York 19, New York.

Early welding techniques oxidized or "burned" the metal surfaces. As shown in the enlarged cross-section view of the heater to stem lead weld, this prevented clean metal to metal joints – caused high-resistance electrical contact.



NEW SYLVANIA welding techniques keep metal surfaces clean during welding, which is essential for low-resistance contacts and strong mechanical bonds.



PROTECTS YOUR PROFITS

SYLVANIA

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GENERAL SYSTEM

Hermon Scott could make this new kit for $30 less, If . . .

Hermon Scott faced a basic choice . . . bring out his new LK-48 amplifier kit at $124.95 or make it to sell for $30 less like many other amplifier kits. All his engineering department had to do was make a few compromises.

The LK-48 is rated at 48 watts. By using a smaller power supply, ordinary output transformers, and pushing the output tubes to their limits, the amplifier might still produce 48 watts at 1000 cycles where many amplifier kits are rated. But measured at 20 cycles, where Scott engineers feel power is really important, output would be down considerably. No compromise was made. The LK-48 *actually* produces 28 watts per channel at 20 cycles, and delivers full power throughout the audio range.

Many kits use a one color instruction book. Hermon Scott decided to continue to use full color to insure factory-built performance, even at the hands of a novice.

Important Scott engineering extras like the all-aluminum chassis, DC operated preamp heaters and unique hum-null balancing could have been eliminated. Hum would have been audibly higher and distortion at levels normal to many kits, but Hermon Scott felt that the kit builder was entitled to the same performance he has come to expect from Scott factory-wired units.

Yes . . . Hermon Scott could have made the LK-48 to sell for $30 less . . . but it would have meant compromising life-long standards. This is something he would never do. You can choose any Scott kit with complete confidence — the LK-48, the LK-72 80 watt complete stereo amplifier, the LK-150 130 watt stereo power amplifier, the LC-21 professional preamplifier, the LT-110 multiplex tuner, LT-10 FM tuner or the LM-35 multiplex adaptor. These superb kits have all the features and performance you've come to expect from the world's leader in audio engineering.

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Radio-Electronics

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on the cover

(Story on page 41)

Electronics-minded photographer David Ugent gets ready to shoot. The girl posing can see the results on the monitor of the closed-circuit TV system before the shutter is snapped.

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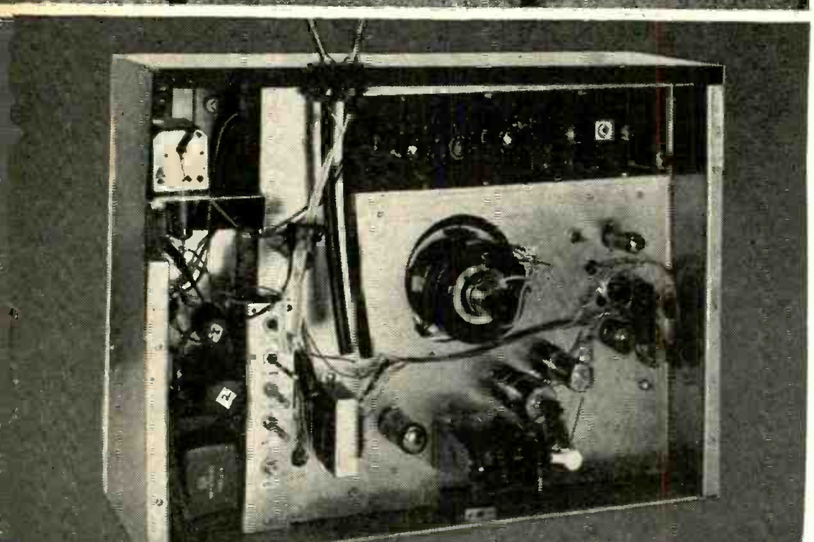

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News Briefs

Trans-Atlantic TV Tests

The National Aeronautics and Space Administration plans to use an electronically equipped communications satellite for experimental telecasts to France and Britain some time in 1962, according to a NASA spokesman.

Two such satellites are under construction now. The satellites will be fired at Cape Canaveral, Fla., into orbit 300 to 600 miles from the earth. Thor-Delta rockets will supply the power.

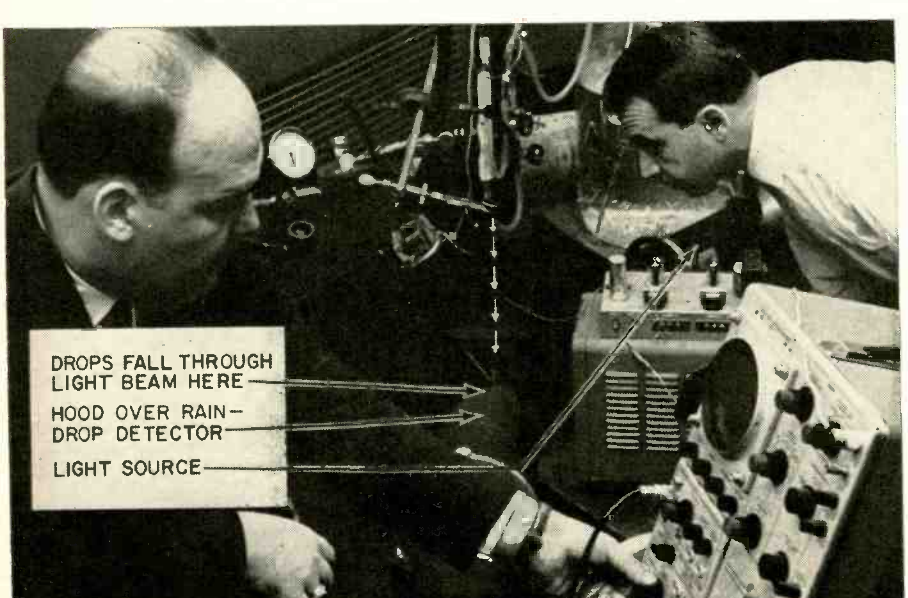
The date is uncertain, said the NASA spokesman, but the telecasts will not take place before summer of 1962.

Electronics Counts Raindrops

An electronic device that counts and measures the raindrops falling within a 1¼-inch-square section is reported by New York University College of Engineering and the Army Signal Research and Development Laboratory, Fort Monmouth, New Jersey.

An optical viewer projects images of the falling drops in the area onto a series of 14 horizontal windows, separated vertically from each other by gaps of varying sizes. When a raindrop falls through the light beam, its image moves across the set of windows. When the image reaches a space that is as wide or wider than itself, the drop is counted and its size recorded in a memory unit. The system is large enough to record the number and sizes of drops falling over a period of several hours.

The information thus obtained is useful to the military, the weather researchers, soil scientists and aircraft designers.



Laser Is Used In Eye Surgery

A laser (optical maser) has been used to treat a tumor in a patient's retina at the Presbyterian Medical Center in New York City. The laser device used is called a "retina coagulator," and its action is somewhat similar to that of a spot welder. It produces, for a very short period of time, intense heat, which burns out a tiny and precisely located piece of tissue. Somewhat similar work has been done in the past with an extremely powerful xenon arc beam, but the laser can do the job in less than one-thousandth of the time, delivering less total heat to the eye.

Police Move to Outlaw Highway Radar Warning Units

Devices used by motorists to detect the signals of highway radar equipment have been declared illegal in Chicago, Connecticut and the District of Columbia. These are the little gadgets designed to warn the driver of the radar's presence and cause him to drive at the legal speed while approaching a radar unit.

In several states where police traffic officials do not have authority to rule in such situations, they are pushing for legislative action to outlaw radar warning devices. This move is being supported by large numbers of traffic safety organizations. Joseph J. Cavanagh of the Chicago Motor Club said, "We condemn this new gadget, which appears to be mainly for motorists who want to speed with immunity from radar detection." Presenting the opposite viewpoint, manufacturers represent that the radar detector is an aid to safe driving, and helps the driver to maintain legal speed (at least in the vicinity of highway radar). It has also been pointed out that the device might possibly violate that section of the penal law which prohibits motor vehicles from being equipped with radio sets capable of receiving signals sent on frequencies assigned to police transmitters.

New Property Found In Bismuth Crystal

Dr. Leo Esaki, who invented the tunnel diode, has discovered a new characteristic in bismuth, an interesting semi-metal which changes its resistance with a change in the magnetic field surrounding it.

Dr. Esaki applied strong electric and magnetic fields at right angles to each other across a single crystal of ultra-pure bismuth at temperatures close to absolute zero. Under these conditions he found that the semi-metal did not follow Ohm's law but, instead, an abrupt change or "kink" appeared in its characteristic conduction as the fields reached a certain strength.

This kink had never before been observed—and its origin is still to be determined. Dr. Esaki and his associates believe the kink is caused by an interaction between tiny sound waves and electrons inside the semi-metal. If a method can be found to control these electrons, a new class

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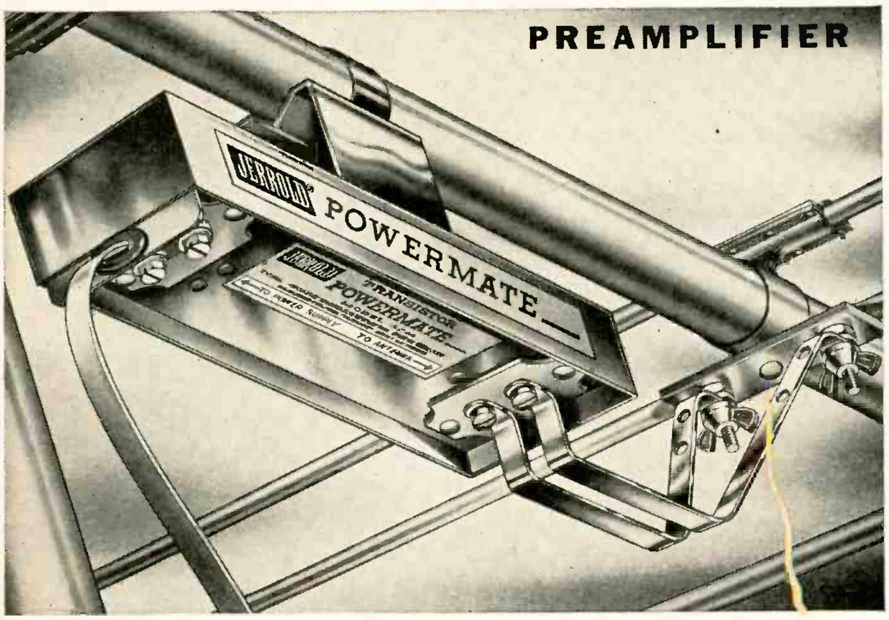

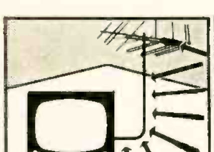

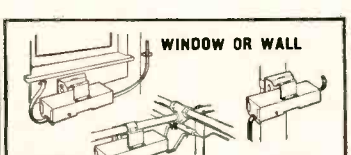

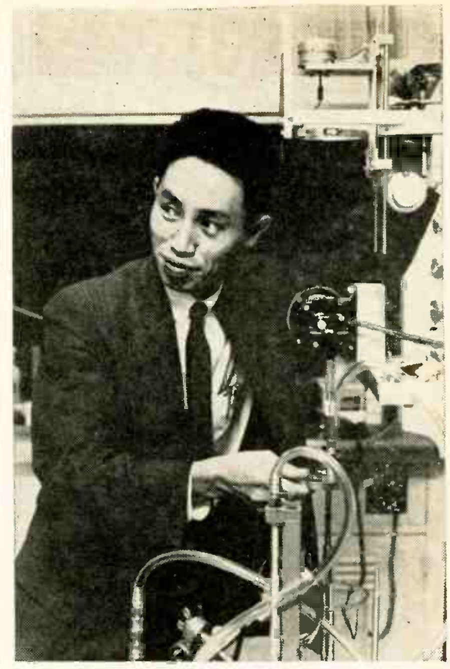

Dr. Esaki of IBM's Thomas J. Watson Research Center, with some of the equipment he used in discovering the bismuth kink.

of high-speed amplifiers and switches may result. The phenomenon is observed with magnetic fields between about 10,000 and 20,000 oersteds and electric fields varying from about 0.8 to 1.6 volts. As the correct combination of magnetic field and voltage is approached, most of the resistance of the material abruptly disappears and the current–voltage curve suddenly kinks upward.

Computer Aids Doctors In Cancer Treatment

The Memorial Hospital for Cancer and Allied Diseases, New York City, announced the first computer installation in a center for the diagnosis and treatment of cancer. The computer, a Bendix G-15, will be used in applying data-processing techniques to the study of radiation in diagnosing and treating cancer patients.

Dr. John S. Laughlin, head of the hospital's Physics Department, said that the computer will be used initially to determine quickly and accurately such information as the amount of radiation from external sources delivered to cancer tissues and surrounding normal tissues, and the distribution of radiation by needles and seed implants.

Additional data on radiation doses delivered through the body by metabolic means and measured by blood, urine and other external counting of radiation activity will also be fed to the G-15. The computer will also be used in solving other problems, and will be a prototype for additional uses of computers in treatment of cancer.

Dr. Richard D. Vanderwarker, vice president and general manager of Memorial Hospital, believes this

(*Continued on page* 12)

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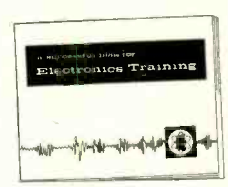

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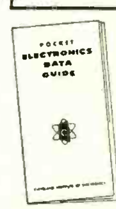

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RE-63B

(*Continued from page* 8)
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Early Gernsback Editor Dies

Austin Lescarboura, one of Gernsback's first editors, died Jan. 8 in Tarrytown, N. Y., at the age of 70. He joined Gernsback in 1910 and later became managing editor of *Modern Electrics.* After leaving

Gernsback, he was managing editor of *Scientific American* from 1915 until 1924. Later, he formed his own publicity and advertising agency, handling electronic and related accounts.

He was author of several books including *Radio for Everybody, Beyond the Motion Picture Screen, This Thing Called Broadcasting* (with Dr. Alfred N. Goldsmith) and *The Cinema Handbook.*

In 1951, Mr. Lescarboura was awarded the Legion of Honor for technical advice in industrial rehabilitation of the French nation after World War II.

The Lescarboura advertising agency continues under the direction of his son, Stanley Lescarboura.

Earth Wears Helium Girdle

Satellite ventures have confirmed the fact that a 900-mile-thick belt of helium surrounds the earth and have altered scientists' concept of the earth's atmosphere. Dr. Robert Jastrow, director of the theoretical division of NASA's Goddard Space Flight Center in Greenbelt, Md., summarizes recent findings, which present this picture:

Nitrogen and oxygen comprise about the first 72 miles, followed by about 600 miles of oxygen. Next is the newly discovered 900-mile helium belt, topped by the layer of hydrogen which had been presumed to lie above the oxygen–nitrogen belt.

The temperature of the upper atmosphere, says Dr. Jastrow, averages 2,025°F with a 600° fluctuation between morning and afternoon.

The outer Van Allen radiation belt, it has been learned, is composed of electrons plus protons, and not primarily of electrons, as had been thought. There is also evidence of many "soft" particles in the Van
(*Continued on page* 16)

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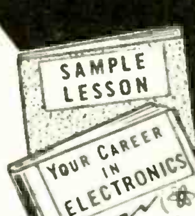

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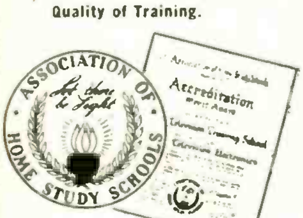

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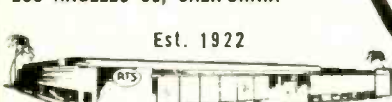

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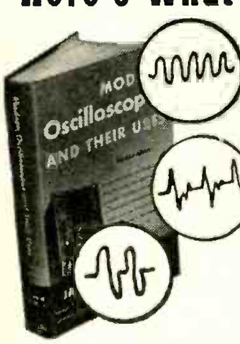

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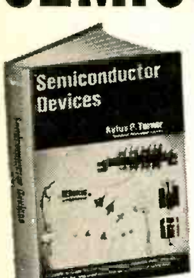

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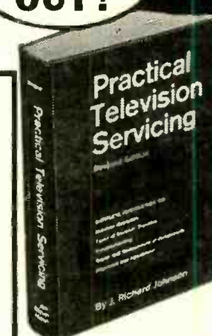

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(*Continued from p.* 12)

Allen belts, which may have triggered aurora whenever ejected into the upper atmosphere, and perhaps produced currents observed in the earth's magnetic field.

Huge Glass Resistors Are Dummy Antennas

Four-foot resistors of glass are being used as dummy antenna loads for testing and calibrating transmitters in Project Mercury tracking

stations. They also act as power-dissipating terminations for rhombic and other transmitting antennas.

Produced by Corning Electronic Components, the resistors consist of a tin oxide film, fused into Pyrex brand glass cylinders 5 inches in diameter. The resistive elements were spiraled to obtain specific ohmic values, uniform heat dissipation and minimum series inductance and shunt capacitance. Resistances are between 140 and 300 ohms. These produce dummy antennas of 700 and 600 ohms impedance. The impedance is very little affected by changing frequencies, which run between 2 and 28 mc. in the Mercury network.

Calendar of Events

IRE, AIEE, NBS Scintillation and Semi-conductor Counter Symposium, Mar. 1–3, Shoreham Hotel, Washington, D. C.

EIA Committee and Section Meetings, Mar. 14–16, Statler Hilton Hotel, Washington, D. C.

EIA 38th Annual Convention, Mar. 23–25, Pick-Congress Hotel, Chicago, Ill.

IHFM High Fidelity Show, Mar. 20–25, Ambassador Hotel. Los Angeles, Calif.

IRE International Convention, Mar. 26–29, Coliseum, New York, N. Y.

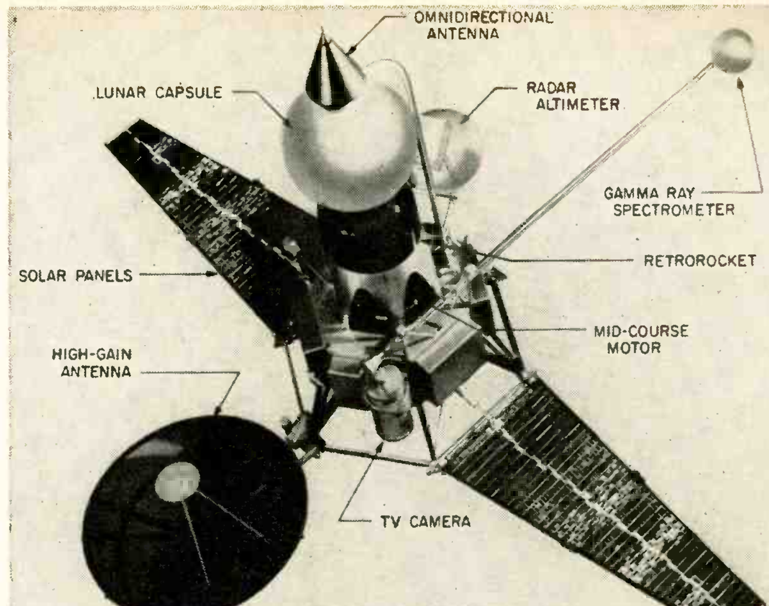
Southwest IRE Conference and Electronics Show, April 11–13, Rice Hotel, Houston, Tex.

IRE-AIEE Symposium on Mathematical Theory of Automata, April 24–26, United Engineering Center, New York, N. Y.

SMPTE 91st Convention, April 29–May 4, Ambassador Hotel, Los Angeles, Calif.

Rangers for Moon Trip

Ranger 3, the first of a series of 3 such satellites to be launched this year, missed the moon by some 30,000 miles. A subsequent shot, if successful, should take more than 100 TV pictures of the moon's



RANGER 3 SPACECRAFT

surface as it approaches. Each photo will show an area 800 feet square (about three city blocks) and definition will be great enough to distinguish objects only 12 feet in diameter.

The Ranger is basically a 727-pound instrument capsule. Two panels carrying a total of 8,680 solar cells are fastened to the base of the spacecraft. They develop 155 to 250 watts of electrical power. A 1,000-watt-hour silver-zinc backup battery supplies power when the solar cells are not operating.

Besides its main mission of moon photography, the Ranger vehicle is expected to deposit a 96.5-pound instrument package on the surface of the moon. This device, a miniature seismometer and radio transmitter, is expected to detect and report on moonquakes and meteorite impacts for a 30-day period. The main Ranger vehicle will crash at 6,000 mph and be destroyed.

Two other scientific experiments will be conducted by the Ranger spacecraft. Both are intended to help scientists determine the composition of the surface of the moon.

First, a measurement of the gamma-ray spectrum found in lunar surface rocks and dust will show the composition of this material. Second, a radar reflectivity experiment will provide data on the nature of the lunar surface. This test is coupled to a radar altimeter that also determines when the instrument package must be released to land safely on the moon.

Information on Space

The Voice of America is now transmitting a special series of space news broadcasts. They contain the latest information (including orbit data and radio frequencies) on new satellite launchings as well as statistics on satellites already in orbit, revised up to the minute. The broadcasts are heard from 0330–0335/-GMT, six days a week (Tuesday through Sunday). This is equivalent to 2230–2235 pm EST, or 1930–1935 pm PST, Monday through Saturday. The schedule up to March 3, 1962, calls for broadcasts on four frequencies: 9765, 11790, 11830 and 15290 kc. Station calls are, respectively, WLWO, WDSI, WBOU, WLWO. Frequencies may be changed after March 3. More information may be obtained from Voice of America, Washington 25, D. C.

Brief Briefs

Rhenium, alloyed with tungsten in receiving tube filaments, can increase the reliability of receiving tubes more than four and one-half times, report General Electric receiving-tube engineers. Refined rhenium costs about $600 a pound.

New small closed-circuit TV camera introduced by Marsan Industries of Newark, N. J., is priced

under $500—well below the price of any comparable unit, Marsan's spokesmen point out. It puts out either video or rf on channels 2 to 6.

Half a million watts ERP is being put out by FM station WJEF-FM, Grand Rapids, Mich., which claims to be the most powerful FM station in the world. The power is produced with an RCA 50-kw transmitter and a 12-bay high-gain antenna, mounted 800 feet above local terrain. END

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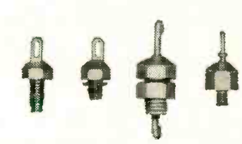

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Correspondence

FM STEREO ADAPTER HINT

Dear Editor:

The multiplex adapter by Donald L. Stoner that appeared in the December 1961 issue certainly meets the need for a relatively simple quality circuit, but the required minimum input of 0.4 volt imposes a severe and unnecessary limitation.

Many FM tuners place the de-emphasis network ahead of one or two stages of amplification, consequently the multiplex output must be taken at a point where only a level of about .05 or 0.1 volt can be relied upon. For such outputs I would suggest a silicon diode for rectification, and instead of the suggested substitution of a 6C4 for V2, the two halves of the 12AU7 should be connected as conventional amplifier stages.

As an added refinement, I would also insert a locking type volume-control pot to avoid excessive input volume, and to allow recalibration when the adapter is used with a different tuner.

HEINZ P. POLLAK
San Francisco, Calif.

A CASE OF FRAUD?

Dear Editor:

Upon rereading the June 1961 issue I again came across the item in Technicians' News concerning the fraud charges and their dismissal in the Ellis Haddad case in Jackson, Miss. The thought came to me that in these cases of rigged sets the real point is apparently missed completely. If a man deliberately and intentionally took small amounts of lead to see how long it would take a doctor to find what was making him sick, no one would expect to prove anything by showing up a doctor's skill in such a manner. Nor would any court in the land hear fraud charges against the doctor because of the expensive procedures necessary to find the man's trouble when all that would be needed to correct the trouble was not to introduce the poison in the first place.

Suppose a rigged-set artist drained the brake fluid from the brake system on his car, leaving it dripping from the wheels and brake cylinders on the car. Any reasonably good mechanic told to make necessary repairs would take off the wheels and inspect the internal parts of the brake system before adding more fluid to system if he is expected to effect a reasonably permanent repair. How could he avoid the labor it takes to run down the fact that someone had punched a hole in the hydraulic line somewhere else to fool him? If, upon inspection of the internal

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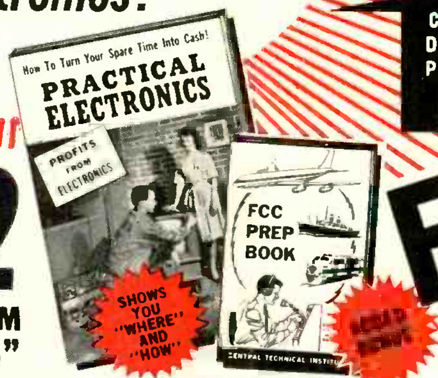

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Superintendent of Communications for the K. C. Southern Railway Company is Central graduate Lawrence D. Fry, with 15 years of railroad communications experience. "Central is a fine school," says Mr. Fry. "I've always recommended it, and have sent several students to Central."

Field Service Representatives for the Bendix Computer Division, L. A., California, are Central graduates E. John Kempf, left, and Robert Young. Mr. Kempf was employed as a maintenance man before he became interested in radio and TV. His first project was building test equipment at home. After enrolling with Central, he began to make extra money repairing radios, auto radios, etc. "The field of Computers is expanding, and there's a real need for trained technicians," he says. "I have found the work to be both profitable and interesting!"

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parts of this brake system, worn parts are found, the logical course would be to replace them. The fact that the rig artist knew of the intentionally damaged parts but did NOT know of the worn or damaged parts associated with the brake system does not prove or even suggest fraud or dishonesty on the part of the mechanic trying to make a practical and legitimate repair. Also, the smart "rig artist" might put water in the brake system. It would certainly take more than new brake fluid to complete that repair.

These people should spend their efforts in finding a way whereby honest service technicians could have an income at least on the level of truck drivers and collect their past-due accounts.

M. C. McCombs

McCombs' Radio Shop
Easley, S. C.

THE REASON WHY

Dear Editor:

Mr. Elmer C. Carlson's letter in the December 1961 issue requires an answer from someone familiar with conditions affecting TV service rendered to hotels and motels, and in Florida particularly. As service manager for a TV distributor in Miami, I cover 13 counties of south Florida.

First, let's put the blame for poor service right where it belongs: on those hotel and motel owners or managers who will not pay the price of good service. Many of the better ones have service contract arrangements with distributors, manufacturers or established service companies, and get excellent servicing. The rest want the cheapest service possible, and many are do-it-yourself types who cannot understand why a technician will not contract to service for $1 a set a month sets 3 to 4 years old.

The practice of limiting discounts to licensed service companies is not meant to control the competency of their men, but rather to discourage this do-it-yourself tendency and eliminate the "moonlighters" and others who use TV service as a sideline, and channel this service business to established, reliable service companies. The incompetents and tyros mentioned by Mr. Carlson exist only because there are people who put price before quality. Quality of service can be a competitive quantity only when price does not come first, and, Mister, in the motel business, and particularly in south Florida, price is the first consideration.

James A. Hart

Hollywood, Fla.

A DISSENTING VOICE

Dear Editor:

You published in the January 1962 issue on page 10 an article concerned with the proposed merger of IRE and AIEE. It stated that the sentiment for the consolidation was overwhelming, even unanimous. I would like to point out that the condition is very much the opposite. The unification must be voted upon and many are hopeful it will be rejected by a very comfortable margin. Meanwhile there

are pressure groups in both Institutes cajoling and threatening for merger. You by publishing such one-sided items are cavorting with these narrow-minded persons. The purpose of RADIO-ELECTRONICS is to print the monthly electronic developments—not to take sides in controversies. We do not want the Institute members who are undecided to be swayed by something approaching "black journalism."

World history has shown the leaders of entire nations and leaders of entire civilizations can be wrong or despotic. It is human to err.

JOHN H. HARDING

Downey, Ill.

CREDIT WHERE DUE

Dear Editor:

May I draw your attention to the article by Eric Leslie on Banana picture tubes in the December 1961 issue. I think you ought to know that the diagrams seem to have been taken without acknowledgement from *Wireless World*, July, 1961. These illustrations were made in our drawing office and we think they are an improvement on the original presentation of the material.

F. L. DEVEREAUX
Editor

Iliffe Electrical Publications Ltd.
London, England

[Unfortunately, the magazine itself was directly responsible for the artwork. We were much impressed by the illustrations in *Wireless World* and turned the magazine over to our art department, along with material from Mullard. It was not until we received the above letter that we realized how closely the *Wireless World* diagrams had been followed. RADIO-ELECTRONICS apologizes for the failure to credit *Wireless World*, the very excellence of whose presentation was responsible for the imitation.—*Editor*]

OFFBEAT IS MY MEAT

Dear Editor:

I'm for electronic ignition, engine analyzing oscillographs, light dimmers, electronic regulators, electronic door openers, electronic lawn-watering controls, small electric motor repair, remote control lighting, computers and all the rest of the odd-ball items which are of interest to so many, but which spark the argument that they do not belong in an electronics magazine.

While I take many of the auto, mechanical, ham and electronic publications, most of them deal with the electronic articles rather superficially and leave one hanging in the air, so to speak.

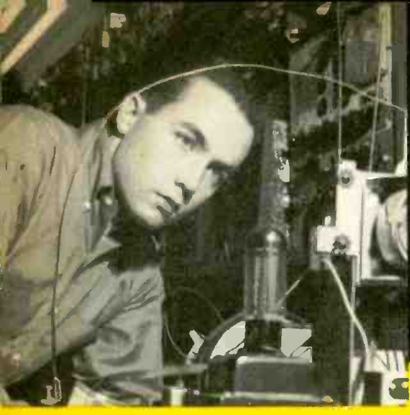
Electronic magazines delving into automotive ignition, for example, will usually get well into the subject and especially so in a build-it-yourself project.

Variety is the spice of life—even in electronics—so, let's keep it that way.

GEORGE PARTIS

Santa Rosa, Calif.

[Guess you liked "Build a Simple Reverberator and an Electronic Micrometer" in the January issue too. Well, so do we.—*Editor*] END



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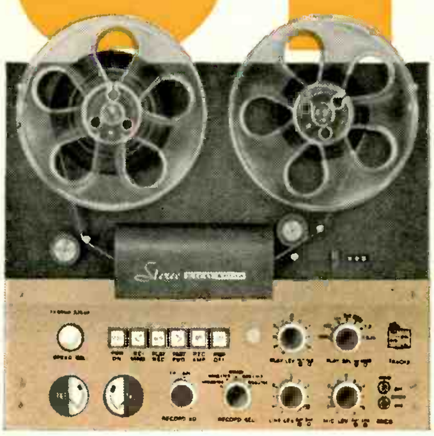

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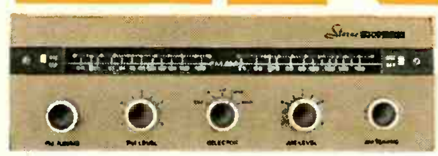

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FM TUNER: Switched AFC (Automatic Frequency Control). Sensitivity: 1.5uv for 20db quieting. Frequency Response: 20-15,000 cps ±1db. Multiplex-ready: Regular and MX outputs built in.

AM TUNER: Switched "wide" and "narrow" bandpass. High Q filter eliminates 10 kc whistle. Sensitivity: 3uv for 1.0V output at 20db S/N ratio. Frequency Response: 20-9,000 cps ("wide"), 20-4,500 cps ("narrow").

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UNEXPLORED ELECTRONIC GAP

. . . *Far-Reaching Discoveries Are Due in an Unknown Region* . . .

POSSIBLY the most important unexplored region in the electromagnetic spectrum lies in the band between the radio and the visible wavelengths. As we contemplate the ultraviolet, then the visible, and next the infrared region, we come upon the largely unknown "gap" of the *extreme* infrared or submillimeter waves which merge into the radio millimeter waves.

The "gap" actually extends from 1/10-mm (one-tenth of a millimeter) to 1-millimeter wavelengths. Microscopic as the gap is, it holds enormous possibilities for the future. Scientists all over the world are working feverishly toward a breakthrough in this unexplored region, which may well open up vast new domains in communication, meteorological, astrophysical, thermoneuclear research and space exploration—to say nothing of its vital military importance.

While radio waves have been explored down into the millimeter regions,* no radio or similar "contact" has ever been achieved across the submillimeter gap into the extreme infrared territory.

The infrared band lies between the far end of the visible (circa 0.75 micron) and the shortest microwaves (circa 1,000 microns). Since practically all bodies (except those at absolute zero) radiate over this range, infrared detecting gear is of great importance to the military. Nearly every target can be "seen" in the dark because of the infrared energy it radiates; hence it need not be illuminated by ordinary light, but can be detected with a "snooperscope" or similar device.

Infrared radiation is not "heat" in itself, and should not be confused with "heat radiation."

There has been a great deal of speculation as to what we can expect when the breakthrough of the gap between the infrared and radio regions is realized.

Prof. Gwyn O. Jones, of Queen Mary College of the University of London, has given some informative views on the subject in the Dec. 14, 1961, issue of the *New Scientist* (London):

"There are many signs of progress. So far, these have not been due to radical advances in technique; no ultra-powerful source nor ultra-sensitive detector has yet appeared. (At any moment both may appear, especially if the *maser* principle is successfully applied at these wavelengths. It has already been used on both sides!) Advance has come, rather, through the all-round improvement in electronic techniques which has occurred since World War II.

"What is to be found at our *extreme infrared* or *submillimetre* wavelengths and what uses will there be for techniques of handling such radiation? To answer the strictly scientific question, one has only to observe how much of physical interest is found on both sides [of the gap] and to realize the extent of the wavelength gap to be filled in. There is enormous scope for studying the properties of matter with radiation of these wavelengths. The properties studied will be, generally, those concerned with large assemblies, such as those of atoms in crystals —just as the classic and heroic early experiments of Czerny and Barnes in the far infrared dealt with the main large-scale lattice vibrations of ionic crystals.

"A little unexpectedly, there is much of astrophysical and meteorological interest at our wavelengths. Radiation from the Sun and Moon at about one millimetre wavelength reaches the Earth in spite of the water vapour and carbon dioxide in the atmosphere, which absorb heavily at shorter wavelengths. Such radiation from the Sun comes from the outer part of the chromosphere, about which there is a great deal of speculation. Observations on radiation from the Moon tells us about fluctuations in the temperature of its surface and thence about its nature. There are suggestive differences between the behavior of the infrared and centimetre-wave radiation arriving from the Moon which point to the need for further observations in our region. There is the possibility that atomic or molecular transitions occurring in outer space may give rise to detectable radiation in our region. Much nearer home, it may be possible to turn to advantage the heavy absorption by water vapour, and to study the formation of clouds and rain by direct observations at appropriate wavelengths.

"There is no doubt that important technological applications would immediately follow the development of powerful sources of extreme infrared, or submillimetre radiation, particularly if the radiation had the coherent character of radio waves (as does the radiation obtained from generators of the *maser* class) rather than the incoherent character of the thermal radiation from hot sources. Radiation at these wavelengths has at least three potential advantages for communication in radio and radar. Because of the high frequency it would be possible to transmit a very large number of independent signals without interference; narrow beams could be transmitted with small aerials, and there is the possibility of transmission through "windows" in the atmosphere (wavelength bands where absorption due to atmospheric constituents is small). A Russian report of a window at about 0.35 millimetre wavelength suggests that intensive work is proceeding in that country on the possibilities of these wavelengths for communication.

"Finally, there is some possibility that coherent beams of submillimetre waves might be used in the control of the very hot ionized gases or *plasmas*, in which thermonuclear reactions might one day be sustained. As certain types of oscillations of charged particles generate electromagnetic waves, so such waves will interact with the particles themselves. It is a large step from the milliwatts or microwatts of power now available at our wavelengths to the megawatts of power released in thermonuclear reactions. Perhaps the really important applications of submillimetre waves will turn out to be even more unexpected."

To the above we might add our own speculation.

Since much of the electromagnetic spectrum can be transformed into other forms of energy, for example light into electrical energy, there can be other transformations between infrared and radio waves.

Let us mention only one. Imagine a parabolic reflector at whose focus we place a submillimeter radio transmitter which can be adjusted to function also as an infrared emitter or transmitter. We could then at will send out radio or infrared energy—or both—and with a few additions, even coherent light. Using the same transmitter as a receiver, we could then transform incoming light, or infrared radiation into radiant radio or electric energy. —*H.G.*

*See also editorial "Millimeter Waves," in the June 1959 issue RADIO ELECTRONICS.

Television is also on the Navy ET's job list.

ELECTRONIC CAREERS in the NAVY

The Navy offers electronic training-- the price is time in service

By G. VERN BLASDELL

If you want to get into the radio-electronics field, you may do well to consider the possibility of permitting the US government to provide your training and experience. You will have to pay, of course, but many who have preceded you have not found the price excessive. The cost is primarily in time, not money.

Each of the armed services offers remarkable opportunities for anyone who is strongly motivated, somewhat above the average in intelligence, and has the touch as far as electronics is concerned.

The Navy is unique in this respect. It is starving for people in the field and offers liberal inducements in the form of schooling, rapid advancement and proficiency pay. The greatest need is for electronic technicians.

However, since electronics is widely used throughout the Navy, there are many other jobs besides that of electronics technician (ET) in which electronics plays an important part. Today, with the multitude of communication, radar, sonar, loran, countermeasure and fire-control gear on every ship, naval base and naval air station, almost every Navy man comes into contact with some kind of electronics. Fire-control technicians, for example, swear they know more about electronics than the ET's. Perhaps they do, but you won't find many ET's agreeing with them.

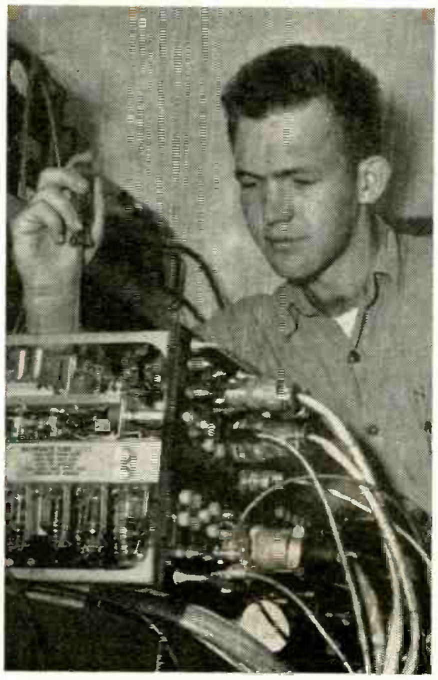
To give a picture of the range of training and experience offered, here is a fairly detailed rundown of just what your rating as a Navy electronics technician means:

You maintain and repair all electronic equipment on ships and stations, including radio, radar and sonar gear used for communications, detection, ranging, recognition and countermeasures. You use standard tools and testing devices to calibrate, tune and adjust equipment.

Jobs you could handle

Here is a list of the jobs you would be capable of performing:

- Draw and interpret schematic diagrams of simple electronic circuits and interpret complicated electronic wiring and circuit diagrams.
- Operate and make necessary adjustments including shifting frequencies on radio transmitters and receivers, direction finders, radioteletype, sonar, radar, infrared and countermeasures equipment.
- Make major repairs on all standard naval types of radio, radar, sonar and other electronic equipment.
- Analyze electronics equipment; test, isolate and replace defective parts.
- Maintain and repair motor generators used in electronics equipment power supply systems.
- Make sensitivity, selectivity and ac-



Fire control station undergoing repairs.

All photos U.S. Navy

curacy measurements for electronic equipment.

Here is what you would learn:

▶ Electronic theory including vacuum-tube and transistor characteristics, power supplies, audio- and radio-frequency amplifiers, oscillators, timing, detection and modulation circuits.

▶ Theory and application of electronic circuits in and technical maintenance procedures for radio, radar and sonar systems and equipment.

▶ Direct and alternating current theory, effects of circuit components including resistors, inductors and capacitors on flow of alternating and direct current.

▶ Theory and operation of electronic test equipment.

▶ Characteristics of ultra-high- and super-high-frequency circuits used in radio and radar equipment and very-low-frequency circuits used in radio and sonar equipment.

▶ Radio-wave propagation including effects of magnetic storms, sudden ionosphere disturbances and seasonal and geographic factors.

Search radar is repaired aboard Navy plane while it is airborne.

▶ Function, theory, adjustment and repair of remote-control systems such as selsyn and amplidyne.

▶ Principles of sound; effects of temperature, density and depth on propagation of underwater sound.

▶ Procedures for operating, maintaining and repairing emergency and portable power supply equipment.

▶ Transmission-line theory, methods of installation and procedures for maintenance of transmission lines.

▶ Theory and operation of motors, generators, rectifiers and control circuits in electronics equipment.

No one man, of course, becomes professionally familiar with all these areas. In this age of specialization you, too, specialize. Roughly speaking, the Navy has three areas of specialization for ET's:

1. *Radar:* primarily concerned with air and surface search radar, radar repeaters, loran and identification equipment.

2. *Communications:* in which you concentrate on transmitters, receivers, and teletype terminal equipment.

3. *Sonar:* which deals with searchlight and scanning sonar, fathometer, servo and synchro mechanisms.

When you have completed your service obligation to the Navy (more about that later), you can consider yourself well qualified as an electronic technician, radar repairman, radiomechanic, radio repairman or electrical repairman. If you are bright and aggressive, the Navy may pay your way through 4 years of college in one of the science programs and you will end up in one of the engineering fields.

What you will do

Although the gear with which they work may vary somewhat from that of an electronic technician, the actual job of a fire-control technician (FT) does not differ too widely.

Briefly, here you will maintain and repair fire-control components and systems, including fire-control radars and target designation equipment. You will make detailed mechanical, electrical and electronic casualty analyses; make transmission, computing and rate tests; align missile, gun and underwater fire-control systems.

Allied rates—or occupations—in the Navy which include a varying amount of electronics work might include:

Sonarman—Maintains and operates electronic underwater sound equipment used to detect the presence, direction and range of underwater and surface craft as well as submerged objects. If you are interested in submarine duty (including the new nuclear subs), you might consider this interesting avenue of approach.

Radarman—Does basic preventive maintenance, and operates electronic radar equipment used in searching for and following movements of other ships and aircraft, in navigation and maneuvering, in recognition and identification, and in jamming the operation of enemy radars.

Radioman—The oldest rating in the field of electronics. He also does basic preventive maintenance and operates radios, radio direction finders, teletypewriters and similar gear. It is his job to keep this equipment in good working order when technicians are not available—and they usually aren't.

Guided Missileman—Uses electronics to a great extent in checking, testing, aligning, adjusting and repairing the Navy's guided missiles. He prepares the missile for firing or launching and also is concerned with the technical maintenance of the missile and its equipment.

Aviation Guided Missileman—Similar to that of the Guided Missileman, except he concentrates on the Navy's air-launched missiles.

Aviation Fire-Control Technician—Acts in a capacity similar to his earthbound counterpart in his care and maintenance of aircraft electronic fire control systems and components.

Aviation Electronics Technician — Concerned with air-borne radio, radar, loran and radio altimeter equipment.

Navy schools

The gear with which you will work represents an investment of thousands of dollars, and the Navy isn't about to let you poke blindly about with a screwdriver until you know what you are doing. Navy technical schools have the reputation of being the finest of their kind in the country.

As a rule, in addition to boot camp, the Navy maintains technical schools at four distinct training levels.

Class-P schools are, so to speak, prep schools. The one in which you are interested is located at Great Lakes, Ill., and offers a 16-week course covering basic electricity and electronics. All students enrolled in this school have their orders to the next higher level schools in these subjects: IC Electricians, Electrians Mates, Electronics Technicians, Fire-Control Technicians, Radarmen.

Computer-board circuit check aboard the USS Compass Island.

Two class A schools are available for ET's. One at Great Lakes, Ill.; the other at Treasure Island, San Francisco. Each offers three classes—a 26-week ET radar class; and one each of 24 weeks on ET communications and ET sonar. To qualify, you must possess a GCT + ARI (General Classification Test plus arithmetic) of 115 and MECH or MK ELECT (mechanical or mechanical and electrical aptitude) of 40. Normal color perception is required.

Here, you will learn as much math as you need for the course and, depending upon which course you select or are assigned, you will receive instruction in the maintenance and repair of search radar equipment, maintenance and repair of communications equipment or maintenance and repair of sonar equipment. The training time spent in the class P school mentioned above is included in the course length referred to.

The class B electronics technicians school is also located at San Francisco.

Courses last for 28 weeks and cover advanced electronic theory and maintenance problems. Courses are open to ET2's and above or ET3's with 1 year's experience in rate in an operational billet. You must be in your second enlistment to qualify.

Class C schools are located at Great Lakes and San Francisco. The length of the courses range from 1 to 6 weeks. Each course covers instruction in the technical maintenance and repair of a specific piece of ET equipment and is open to ET petty officers.

In addition, there are innumerable Fleet Training schools to which you may be assigned during your naval career, and you will receive on-the-job training until you've reached a point where you're ready to drop.

One point to bear in mind—once you've signed on the dotted line and taken your oath, you are obligated to stick to your bargain. You have promised to serve in the Navy for 4 (or 6) years and you will be required to serve the full time, as agreed, whether you like it or not.

to prepare for the higher petty-officer rates, require 18 months' obligated service for a 20-week or less course, 2 years for courses running from 21 to 40 weeks.

Class P schools have the same obligated service requirements as the class-A schools.

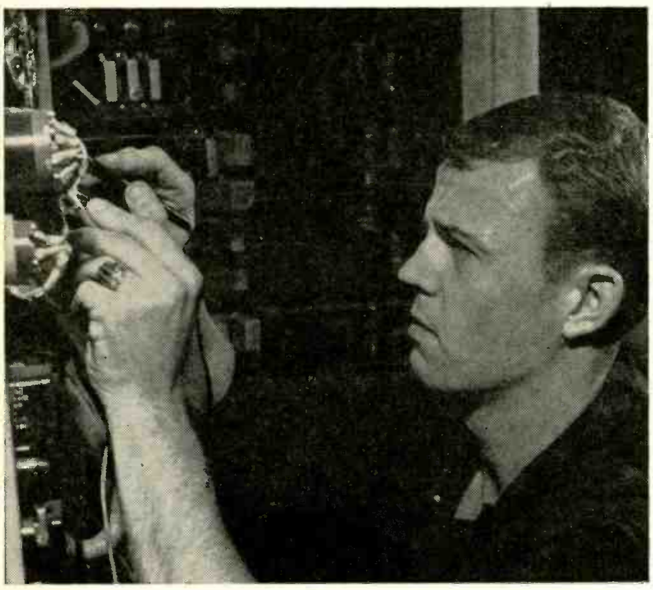
There are two ways of looking at the financial situation. No matter how simple his job may be—grocery clerk, gas station attendant or clerk typist in an office—if any of your friends is working for a living, he will tell you that the beginning take-home pay offered by the Navy is ridiculously low. In this day and age of fairly good wages, no man in his right mind would consider a starting salary of $78 a month.

On the other hand, no college, university or technical training school that we know of will offer you room, board and clothing, plus spending money as inducements to study with them. None will guarantee you a job after you've completed your studies. The Navy will, and does.

per month.

However, on the assumption that you're bright enough to earn a promotion as soon as you have spent the minimum time in grade, you will be ready for the big jump from seaman (pay grade E-3) to petty officer third class (pay grade E-4) after you have spent 6 months as E-3 or a total of 14 months in the service. As an E-3, you will have been preparing yourself for your specialty, whatever it may happen to be, and undoubtedly will be going to school.

As an E-4, you will have definitely committed yourself in your occupation and it will become increasingly difficult to change your rate. An E-4 receives $122.30 for the first 2 years, $150 for over 2 years, $160 for over 3 years. Further, as soon as you reach E-4 status, you are eligible for proficiency pay, which amounts to an additional $30 per month. However, you will undoubtedly progress to E-5 or petty officer second class after you have served the minimum of 12 months as an E-4. This pays $145.24 per month.



Checking out equipment in the navigation center.

Sonar maintenance class studying receiver repairs.

Price of training

You should also know that, although the Navy is quite willing to give you the finest education in electronics possible, it expects something in return. For each school that you attend, you will be obligated to serve a definite period of time after you graduate from that school. If you don't have sufficient time remaining in your enlistment, you will not be permitted to attend the more advanced schools.

Generally speaking, you must have 2 years' obligated service before you will be permitted to attend a class A school if the course is 20 weeks or less. (A class A school provides the basic technical knowledge required to prepare for the lower petty-officer rates.) If the A school runs from 21 to 40 weeks, you will be required to serve 3 years.

Class B schools, which offer the advanced technical knowledge required

Either viewpoint is correct, within limitations. Very briefly, here's the way it works in the Navy. Basic pay when you enter the service is $78 per month, plus allowances which include uniforms, food and quarters, dental and medical care. If you're married, you also receive rent for your family.

At this time, you are in pay grade E-1 and, if you stay there for more than 4 months, your pay will be raised to $83.20. However, at the completion of your recruit training, which is normally 11 weeks, you are eligible for promotion to the grade of E-2, which pays $85.80 per month.

After 6 months as an E-2, or seaman apprentice, or 8 months total service, you are eligible for advancement to E-3, which pays $99.37 per month. If, perish the thought, you should remain in pay grade E-2 for 2 years or more, you will receive $108 per month and, if at the end of 2 years you have the grade of E-3, your pay will be $124

(And don't forget to add to the figures your living and the sundry other expenses paid for you by the Navy! It will boost the total.)

Two years of service as an E-5 is required for promotion to E-6, which pays $175.81 per month. We won't worry about further advancement, as you are very unlikely to go any higher than E-6 during your first 4-year enlistment.

So there you are. Any one of the points discussed above could be developed indefinitely, but this is enough to give you some idea of what the Navy has to offer any young man who is interested in a career in radio or electronics.

If you want to know more about it, see the man in the recruiting office nearest your home. Watch yourself, however. As soon as he hears that you are interested in and have some kind of background in electronics, he'll really turn on the sales pitch. END

Shoot that Soldering Gun

Rebuild that defective gun, don't just throw it away.

By JOHN A. COMSTOCK

When your soldering gun refuses to "shoot", what then? Should you toss it in the trash barrel or troubleshoot it yourself? Those who like to save money and service their own equipment will find the following pointers very helpful.

Is the transformer burnt out?—Possibly the gun manufacturer will supply you with a replacement at nominal cost. Or maybe you can rewind it yourself or have it rewound.

Is the switch defective?—Most are permanently sealed, making repair almost impossible. Buy a replacement or substitute a push-button switch.

Is the power cord or plug defective?—This should be a simple job; much simpler than that last set you repaired!

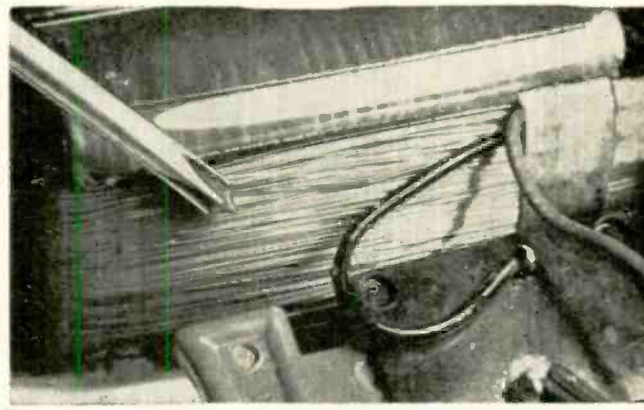


Photo 2

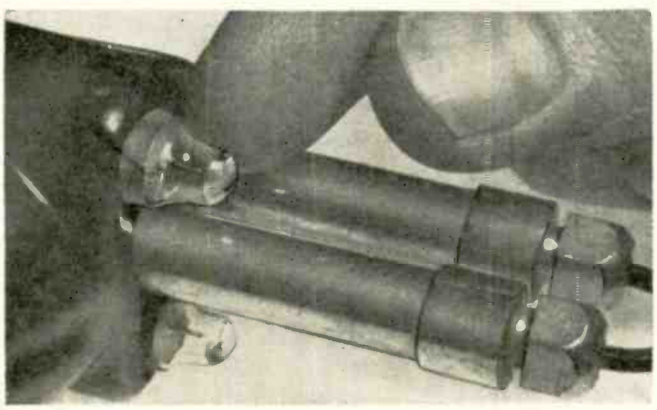


Photo 1


Photo 3

Tip doesn't heat, bulbs don't light. **Three possible troubles: 1. Blown or loose bulb (Photo 1), 2. Open transformer winding (Photo 2), 3. Worn out power cord or plug.**

Check bulbs and transformer with an ohmmeter. What about the trigger switch (Photo 3)? Check it with an ohmmeter too. Inspect all soldered connections closely. Check power cord and plug with ohmmeter.

Bulbs light, tip doesn't heat hot enough. **Is the tip clean and well tinned (Photo 4)? What about the tip-holding nuts or screws (Photo 5)—are they tight? If not, tighten them. It wouldn't hurt to remove the tip and tin the two prongs (Photo 6) which make contact with the nuts or screws.**

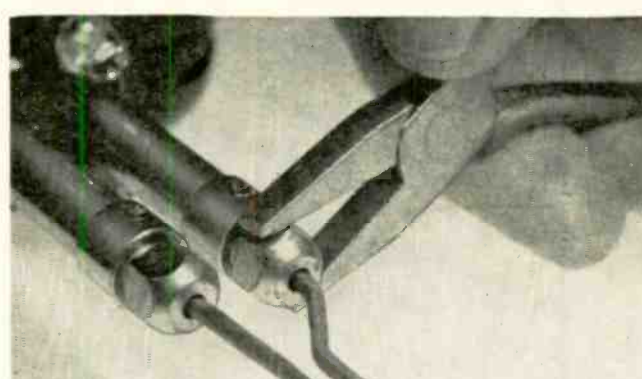


Photo 5

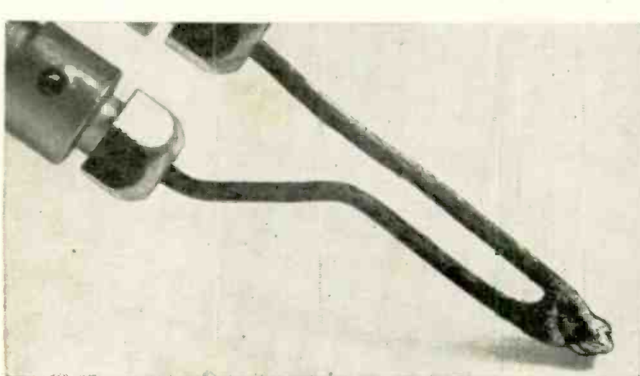
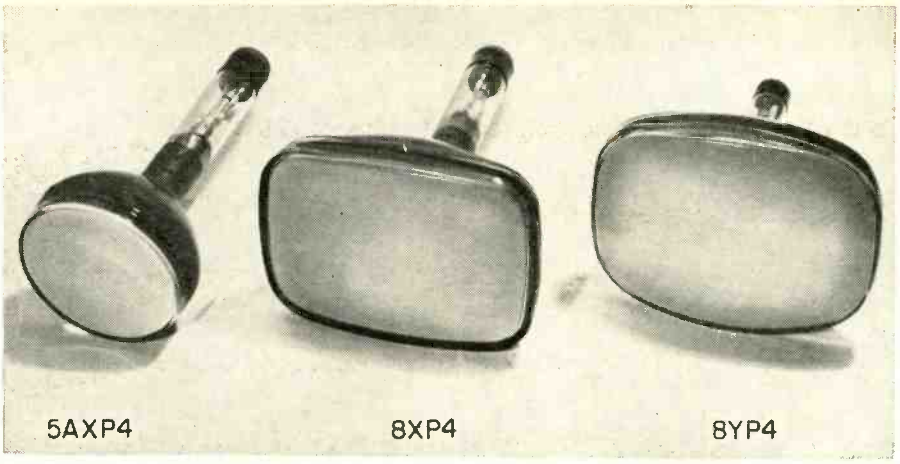


Photo 4


Photo 6



CRT SUBSTITUTION WORKS!

Leave the CRT in the cabinet when you pull a chassis. In the shop, hook up a universal check tube.

By WILLIAM KELVIN

SUBSTITUTE SPEAKERS HAVE BEEN around for decades. Now we have substitute picture tubes too. These "check tubes" are rapidly becoming popular. I was talking recently with an old-timer in the service business. He is a typical holdout, but he's weakening.

"Check tubes?" he asked. "Oh, sure! But we don't bother—there's always a good CRT around that we can use." He sensed the objections I was about to raise, and he quickly added, "We'll probably get one pretty soon, though. They're pretty handy."

Actually, CRT substitution always made sense, and now there is a small group of excellent check tubes available, covering most every type of picture tube found in TV sets. Handy accessories include universal yokes, carrying cases and ruled screens for checking linearity, pin-cushioning, etc. There is another good reason for making a habit of using a check tube. It serves as a professional standard for your shop.

The first of the check-tube family was the 5AXP4. When it was new, all receivers had a 70° deflection angle or less, and this one model worked with just about any TV set. Many are still in use. Some manufacturers put them in a handy caddy, set up for universal service. An advantage in keeping this early one around is that it is the smallest. In some sets, parts on the chassis are still inaccessible and an even smaller check tube would be handy.

The 8XP4 answers the need for a

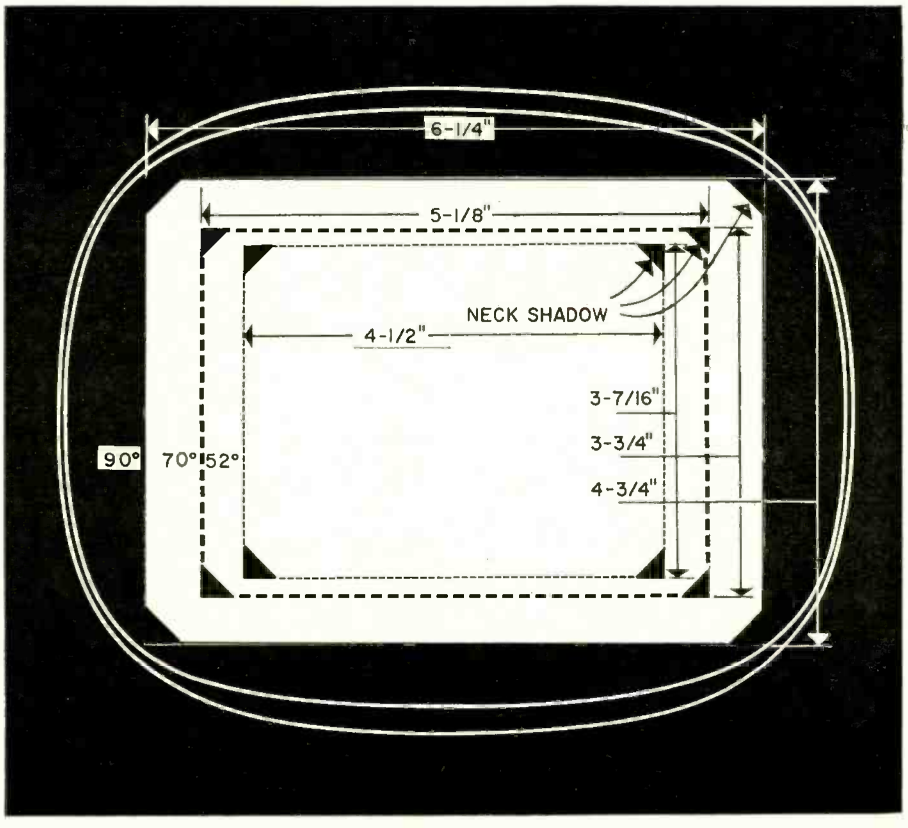


Fig. 1 — With paint or marking pencil, outline the raster produced by properly operating receivers. You'll need it for 52°, 70° and 90° deflection sets. A 110° set will fill the screen.

Sylvania Illustrations

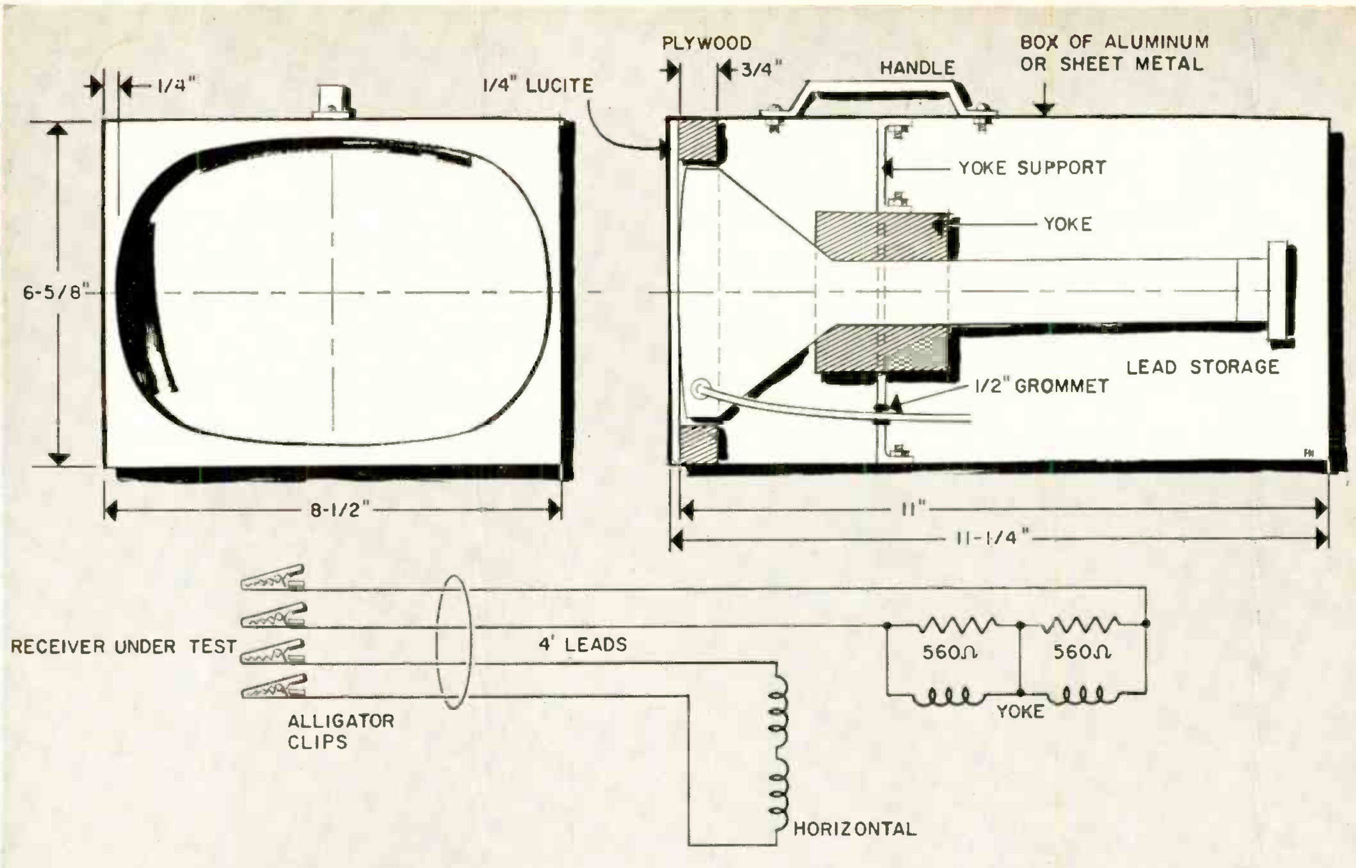


Fig. 2—Cabinet construction and yoke connections for a typical check tube.

90° check tube. It has the standard 1½-inch neck and duo-decal base. The 8YP4 was introduced early in 1958. It has a 110° scan and the narrow 1⅛-inch neck. The 8JP4 is a similar tube. These 110° types are truly universal; their heaters will match both 600- and 450-ma circuits at 6.3 volts, and 8.4-volt circuits at 450 ma. They even come with base adapters, so they can be used with sets that have older conventional bases.

Fig. 1 shows how to solve width problems encountered when a 110° check tube is used with different angle yokes. Simply get a properly operating TV chassis for each of the three common narrower scanning widths, and outline the raster that appears with a marking crayon. Marks can also be painted on, or a plastic mask can be cut to the desired size and pasted onto the tube. Some check-tube setups come with a plastic screen that can be marked with a handy crosshatching for width and linearity testing.

To make a monitoring unit more versatile, make up two or more basic yoke types which can be quickly mounted in the cabinet. One should be a standard 90° type with a horizontal inductance, 12 mh; horizontal resistance, 15 ohms; vertical inductance, 48 mh, and vertical resistance, 52 ohms. The Stancor DY-13A and Merit MDF 91 are two yokes that closely approximate these values.

The second yoke we keep on hand is a low-vertical-impedance type (found in many early RCA sets). Its horizontal inductance is 30 mh; horizontal resistance, 45 ohms; vertical inductance, 3.5 mh, and vertical resistance, 3.5 ohms. The Stancor DY-14A is of this type.

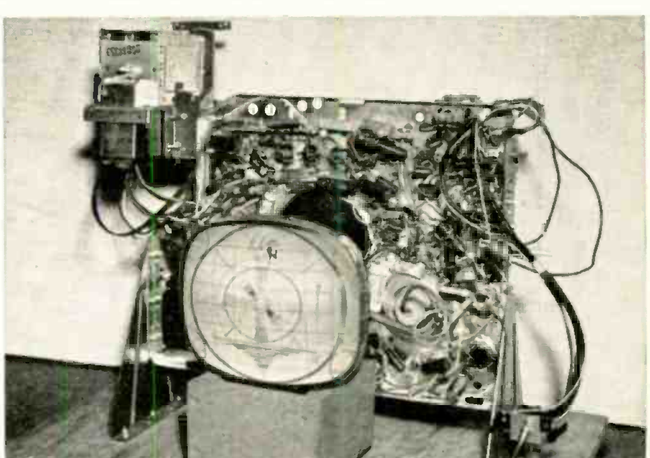
It is easy to set up a 110° (narrow-neck) yoke too, for interchange with either of the above types. Yoke hookup and cabinet construction details are shown in Fig. 2.

Some technicians may ask, "Can I get by with *one* check tube for *all* TV sets?" The answer is yes. You can use an 8YP4 or 8JP4, 110° type. However, when checking older sets, you must make allowance for the resultant picture shrinkage. Furthermore, with 90°, 70° and 53° sets, the proper yokes call for picture tubes with 1½-inch diameter necks. To use the yokes, make a collar of corrugated cardboard, felt, etc.

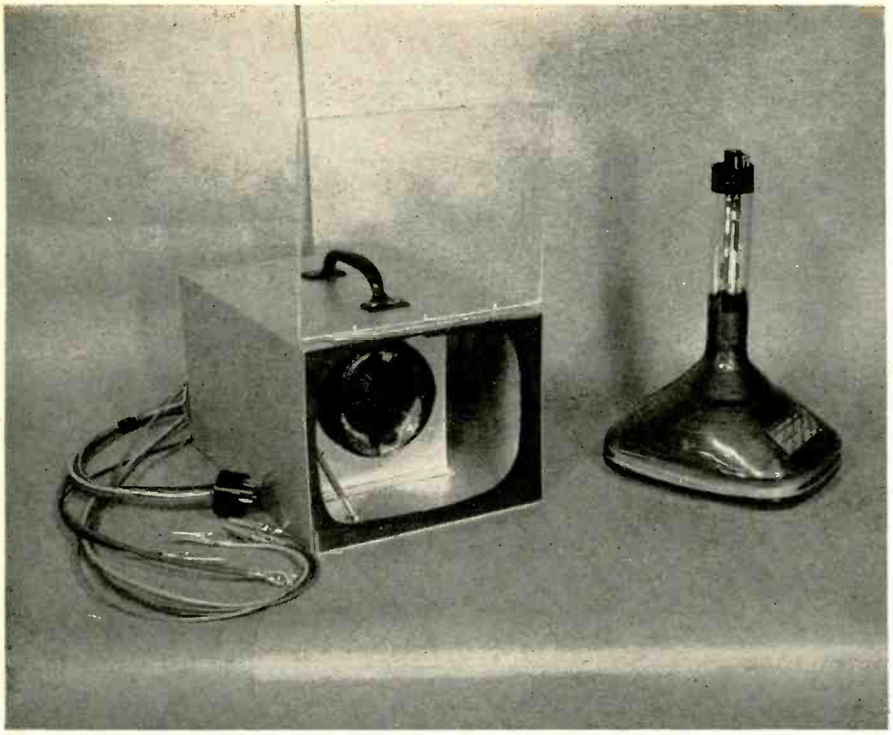
BASIC CHECK TUBE TYPES

TYPE	MAKER	SCREEN	DEFLECTION ANGLE	NECK DIAM. (IN.)	E_f	I_f
5AXP4	Sylvania	round	53	1½	6.3	0.6
8XP4	"	rectangular	90	1½	6.3*	0.6
8YP4	"	"	110	1⅛	6.3*	0.6
8JP4	CBS, DuMont	"	110	1⅛	6.3*	0.6

*Manufacturer's specs. for these types permit operation at any of the following ratings:
6.3 v @ 600 ma.
6.3 v @ 450 ma.
8.4 v @ 450 ma.



Check tube being used while servicing a vertical chassis TV.



The completed check-tube setup shown in Fig. 2.

to wrap around the 1⅛-inch neck so it will be a snug fit in the center of a full-size 1½-inch yoke.

Even a 5AXP4 inserted in a vertical chassis may hide components and be an inconvenience while servicing. A method I use to avoid this simply requires you to twist the yoke around so it faces backward. Now the check tube can be inserted from the back and can be seen with the aid of a mirror while all chassis components are now accessible. (The yokes in most portable and conventional type vertical chassis dangle on their own leads. These yokes can easily be reversed so that they face backward in most cases.) For such a setup you may need extensions for the base cap and anode lead.

You may wonder if you can use a 600-ma check tube in a 450-ma string. Well, you'll be surprised to know that you can. You can even substitute a 6.3-volt 600-ma check tube for a 2.35-volt 600-ma tube (such as Philco's rather rare SF types) with fairly good results. The reason for this is that the voltage buildup across the check-tube heater will rise considerably higher than 2.35 volts if 600 ma normally flows in the circuit. What you are doing is replacing a 4-ohm resistance (the resistance of the 2.35-volt heater) with a 10-ohm resistance (the approximate resistance of the check tube). Since this represents only a small percentage change in the total resistance of the string, the string current will fall only a little below 600 ma. The manufacturer states that check tubes will work equally well at 450- or 600-ma heater current, so fairly good results can be expected when using a regular check tube as a substitute for an SF type. Incidentally, the converse is *not* true. An SF tube *cannot* be used as a substitute for a 6.3-volt 600-ma CRT, because the higher voltage will burn out the SF tube's heater.

As a guide to the gradually swelling number of CRT types and bases I recommend a CRT chart such as the wall-size versions published by Sylvania, RCA and others. END

CALIBRATOR FOR SIG GEN

Adding a crystal oscillator, diode detector and an auxiliary dial pointer will improve the accuracy and increase the versatility of your signal generator and give it some of the advantages of a heterodyne type frequency meter. The modifications made to the circuit of the Heathkit SG-8 rf generator are shown in solid lines in Fig. 1. Original parts are dashed.

The Pierce crystal oscillator was added first. It operates with fundamental type crystals from the if range up to 10 mc or so. Rfc is a 2.5-mh rf choke or one coil from a 455-kc if transformer. The trimmer across the crystal is set for maximum grid voltage consistent with reliable oscillation.

When the calibrator is turned on, two rf signals appear in the output. By tuning a receiver to the crystal frequency and setting the signal generator to zero beat, you can check accuracy of dial calibration. I've followed harmonics of a 7-mc crystal up to 84 mc.

My next step was to add a crystal diode as a heterodyne (zero-beat) detector so I wouldn't have to use a receiver. With phones plugged in, you can zero-beat the signal generator fundamental and harmonics against the crystal to check dial calibration.

The addition of the detector makes it easy to check the frequency of receiver and transmitter oscillators whose approximate frequencies are known. Place the generator's output cable close to the other oscillator and tune the signal generator to zero beat. Read the frequency from the sig gen dial. This does not pull the oscillator frequency as many grid-dip meters do.

Don't be surprised to hear distorted audio in the phones when checking the oscillator in a radio. When the generator is turned off, the crystal diode acts as the detector in an rf signal tracer.

The final addition is a small clear plastic pointer bolted to the main pointer as in Fig. 2. It should be snug but loose enough so you can set it to the correct frequency when the generator is zero-beat with the calibrator.

In the Heathkit SG-8, the af choke was turned and moved closer to the front, leaving room in the rear left corner for the calibrator. The oscillator tube is mounted upside down to allow mounting everything close without extra work. A five-prong socket was used for the crystal and to provide tie points. The phone jack was mounted above the pilot lamp.—*Fred Voss*

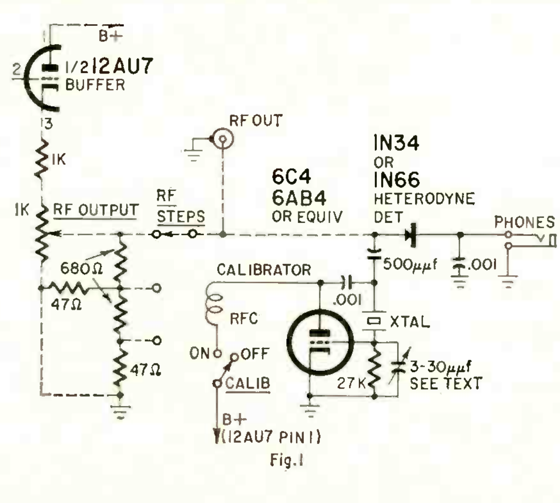


Fig.1

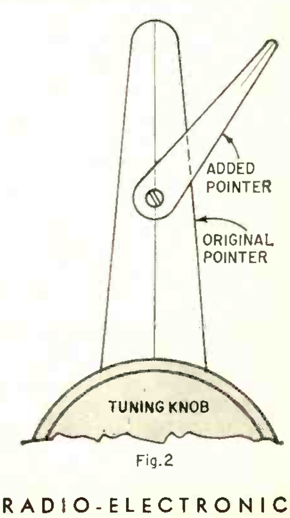


Fig.2

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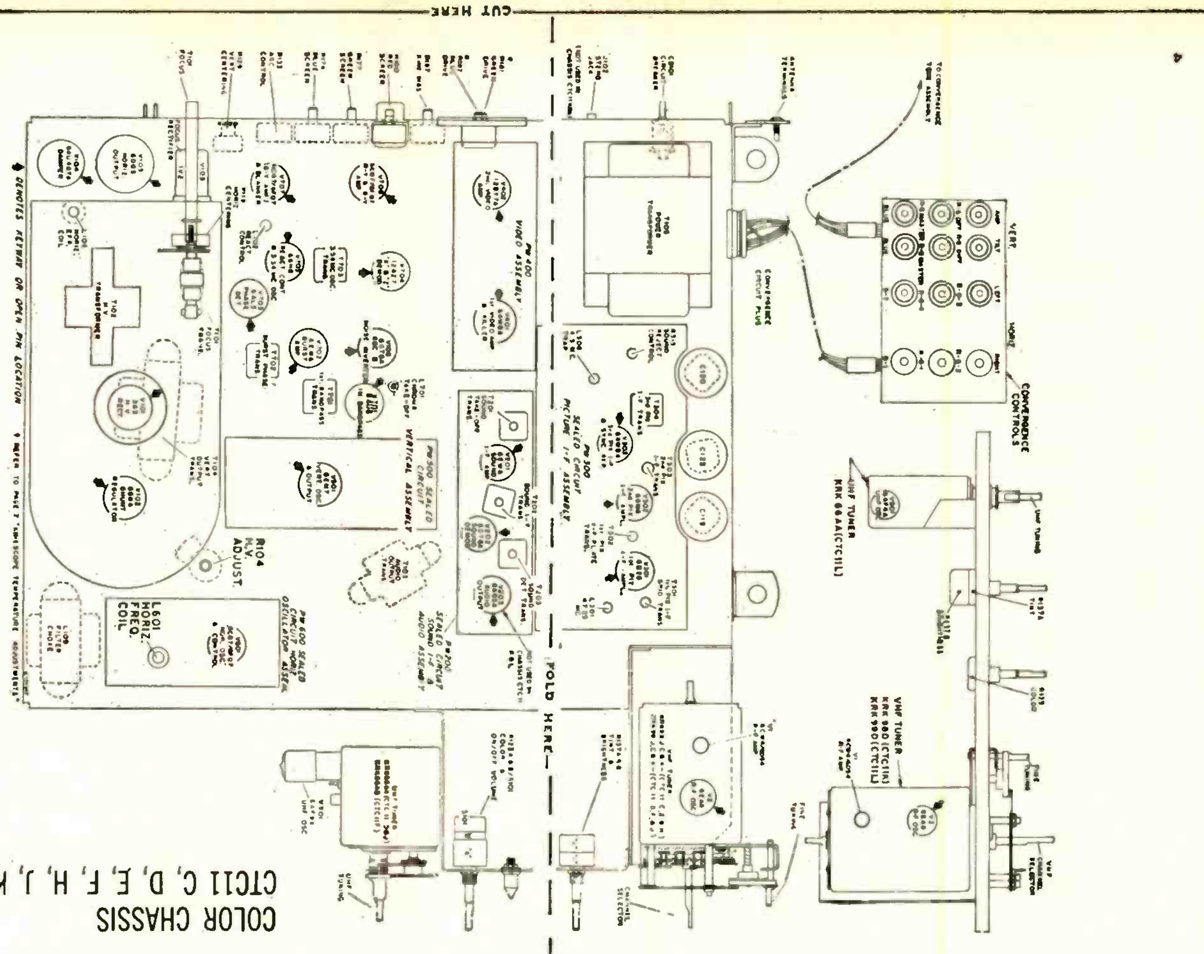
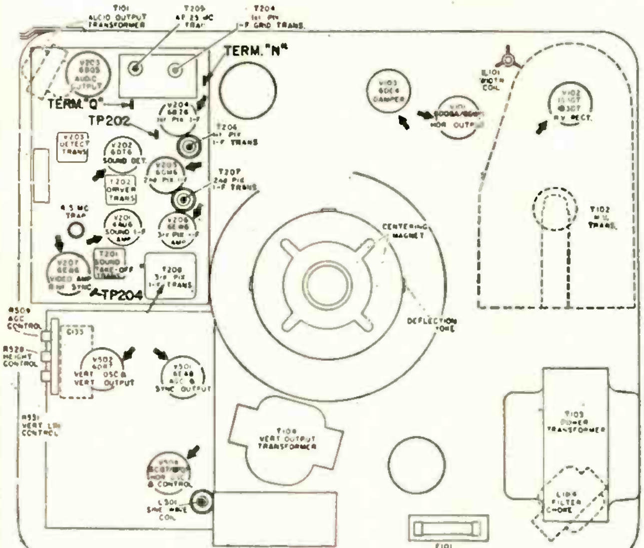


COLOR CHASSIS
CTC11 C, D, E, F, H, J, K, L

TRIM HERE AFTER FOLDING

KCS130YAB and YAC CHASSIS



HOW TO FOLD

Fold the top down and back, keeping the cover facing you. Then fold from left to right on the line marked **fold here**, keeping the cover facing you. Staple the booklet along the left-hand edge. Now run a sharp knife or razor blade along the closed top and you're finished. You now have another useful piece of service data, exclusive with RADIO-ELECTRONICS.

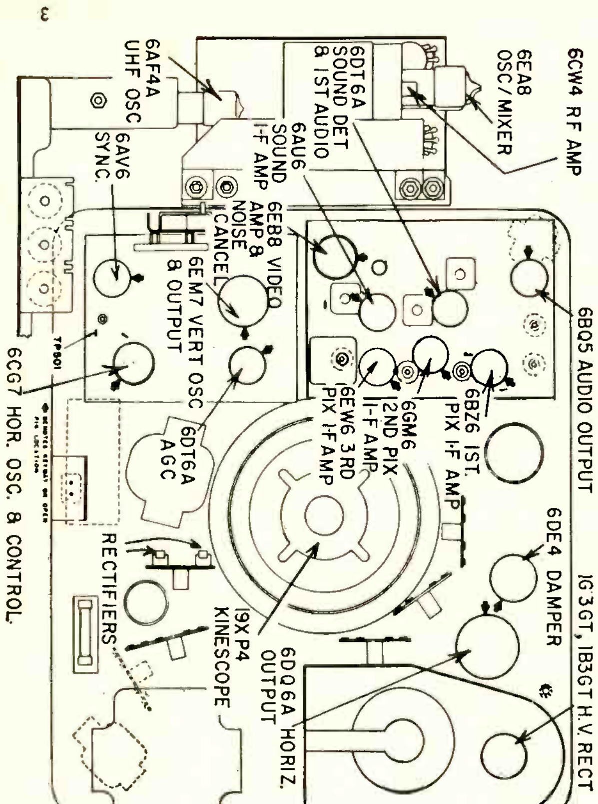
CUT HERE

Radio-Electronics

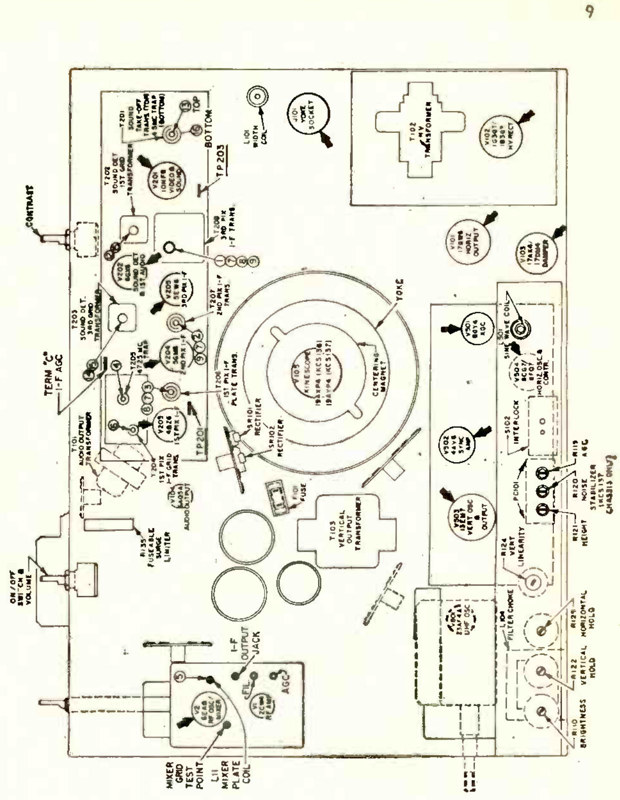
TUBE LAYOUTS
IN TV SETS

Compiled by Larry Steckler, Associate Editor

RCA
1962

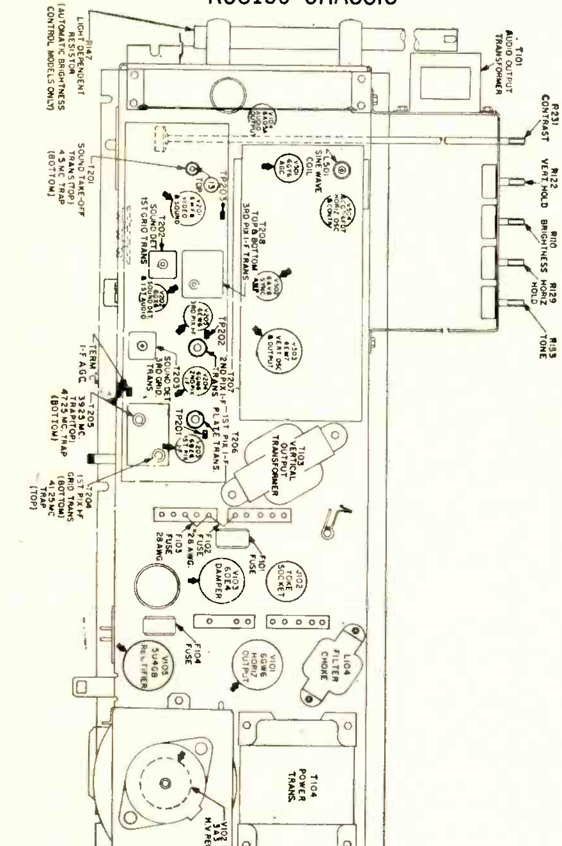


KCS133F and H CHASSIS

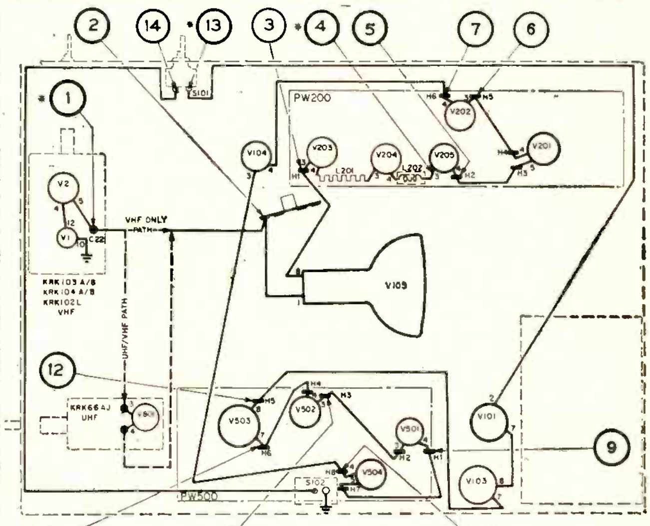


KCS137 and 138 CHASSIS

KCS136 CHASSIS



FILAMENT CONTINUITY CHECK KCS137 and 138 CHASSIS



BALLOONS 1 & 2 ETC., INDICATE CONTINUITY CHECK POINTS ACCESSIBLE FROM TUBE SIDE OF CHASSIS.

BALLOONS MARKED WITH AN ASTERISK* INDICATE CHECK POINTS WHICH INCLUDE 2 TUBES FROM PRECEDING CHECK POINT.

TO LOCATE OPEN FILAMENT:

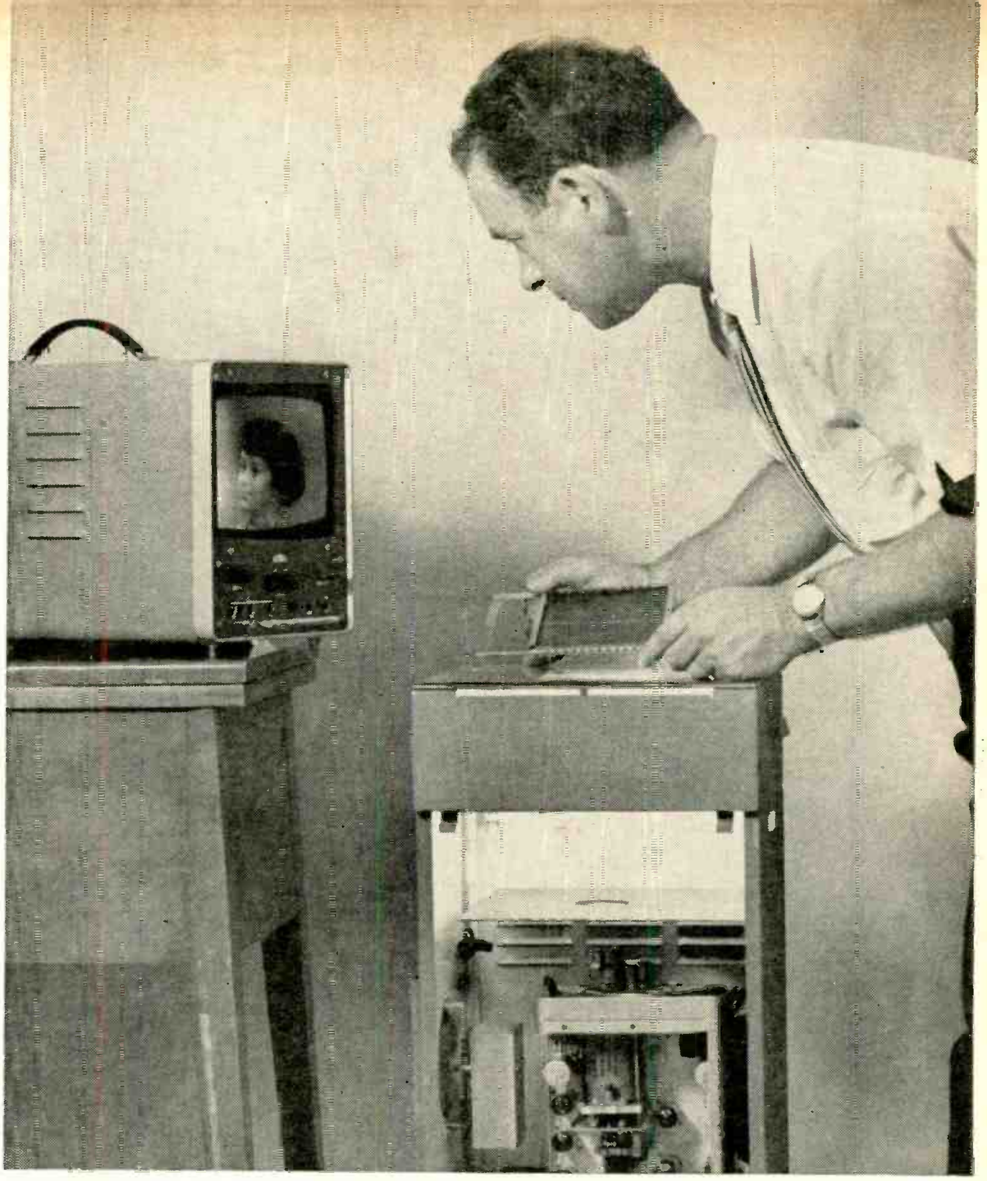
A. SET "VTVM" TO 150 V. AC RANGE.

B. CLIP "GROUND" LEAD TO CHASSIS. APPLY AC PROBE TO CHECK POINTS INDICATED, BEGINNING AT 1 ON TUNER.

C. ALL CHECK POINTS AHEAD OF OPEN FILAMENT WILL READ ZERO VOLTS — ALL CHECK POINTS PAST OPEN FILAMENT WILL READ FULL 120 V. LINE VOLTAGE.

COVER STORY

NEW Uses for Closed-Circuit TV



The TV camera (bottom) turns negatives placed in the light box into positives for viewing by the customer in the studio or reception room.

Low-cost installations are put to good use by small businesses

By JOHN L. RUSSELL, JR.

MOST OF US IN ELECTRONICS RECALL HOW closed-circuit TV was first introduced right after World War II with a flurry of publicity after the initial demonstrations.

Most serious-minded businessmen viewed its future dimly and dubbed it simply a novelty, a gimmick or a useless toy. As recently as 1950, yearly sales amounted to only a few thousand dollars. By 1952 there were three manufacturers, but with the sustained efforts of industrial engineers, safety experts, merchandising people, traffic and materials handling engineers, along with closed-circuit sales engineers themselves, the number of manufacturers soon jumped to more than a dozen.

Today, of course, we find thousands of applications for closed-circuit TV and new ones are cropping up all the time. For example, here in Miami, photographer David Ugent of 135 S.E. 3rd Ave., is using closed-circuit TV in his portrait studio very effectively and profitably. Not only do customers pose in front of the TV camera with their likeness on the TV screen in front of them, but Ugent has a way of flashing the developed negatives, changing the polarity of the TV, to give nice 8 x 10 positive "proofs" on the spot on the screen of the closed-circuit TV. Mr. Ugent says:

"In all the years that I have been a professional portrait photographer, one of the problems which has disturbed me the most has been what I call 'The Battle of the Mirror.' Everyone stands before a mirror every morning to brush his teeth, groom his hair, and adjust his clothing. During this process all people learn through the years to retouch mentally the image in the mirror to suit their own emotional tranquility.

"But whenever I have to make portraits, I have to contend with this mental image people have built up about how they look. Unfortunately, the 'Battle of the Mirror' is most often a losing one for the photographer.

"I often thought how wonderful it would be if only I could find a mirror that would tell the truth to the person looking into it. Instead, most people gaze into the mirror reflecting the thought in the age-old fairytale: 'Mirror, mirror on the wall—who is the fairest of them all?'

"Several years ago in the quiet darkness of my laboratory I discovered what I thought might be the answer to my prayers. Closed-circuit television appeared to be a possible answer to the dilemma. The screen image looked much more like a photograph than that in the mirror. Several questions had to be answered: What would the psychological impact be? How much could really be accomplished with this electronic device? And would it be acceptable to my customers?

"The proof of the pudding would be in the eating. I contacted the local representative of a closed-circuit television company. The very next day two men arrived carrying a light and simple-looking device which resembled a medium-sized professional motion-picture camera. A few minutes later, one of them rolled in a portable television receiver. He plugged a length of coaxial cable into the camera, plugged in the television monitor and I was in business.

"I sat down on my posing bench, the lights were turned on, I looked into the monitor and saw stark naked realty. My receding hairline, the wrinkles of age and even the pounds the scale told me about but which I myself had never been able to see in the mirror (mirror, mirror, on the wall). Involuntarily I said to myself, 'Good gosh! is that really me?' As I moved my body and changed my expression I realized that here truly was reality in a form I was able to accept. The immediate question of course was: Is my reaction normal? Will other people come to the same tranquil logical acceptance of this realistic mirror? I didn't have to wait very long to have them answered.

"As business continued, the succeeding portrait sittings confirmed what I had already learned in my first exposure to closed-circuit television. People do accept the truthfulness of a televised picture, even though it flusters their feathers at first contact. When they can see what the camera is really photographing, they are much more ready to accept the result.

I found that I had the best coupling angle for the portrait and TV cameras when I mounted them side by side. This method in no way cluttered the working area. It all went so simply and quickly that I never would have guessed that all this could have been done so easily in such a short time.

Positive proofs

"I had heard that many television newsreels are shot on 16-mm negative film projected at the television station in the negative form and that they make it into a positive electronically. It appeared to me that, if the television station can reverse negative motion-picture film into the positive, perhaps I could show my portrait negatives as positive proofs electronically and save a great deal of time, effort and money by cuttting out the proof printing processing. I asked the representative of the closed-circuit TV company about this unique faculty of the television camera. He told me that it was known as reverse polarity and could be incorporated into the camera quite simply.

"While the engineer installed a single-pole double-throw switch in my TV camera, he explained in simple terms what he was doing. The normal procedure is for the camera to pick up the image on the vidicon tube. Here photons are converted into electrical energy which is amplified in a number of different stages. It is then carried to the receiver where it is reprojected upon the picture tube. Polarity is reversed by using a phase-splitter tube with one load resistor in the plate circuit and one in the cathode. If the switch is thrown to take the signal from the plate circuit, a picture of the same polarity as the input image is shown on the picture screen. When the switch is thrown to the cathode circuit, the image on the screen becomes the opposite or negative of the original.

"In other words, when I throw the switch in front of the TV camera up, there is a positive picture. When I throw the switch down, I get a negative picture. So if I scan a photographic negative when the switch is in the negative or down position, the camera scans the transparent negative and electrically converts the televised image into a positive.

"With this system, then, I not only give my customers the opportunity of seeing what I call a 'pre-proof-prevue' while the picture is being made but, immediately after the sitting, the photographic films are developed and fixed in a period of 5 minutes. Then the negatives scanned by the television camera and the electrical proofs are transmitted to the front office where the customer selects the desired portrait immediately, instead of waiting for proofs to be printed. They are delighted with the results more often than they are disappointed, after seeing themselves so long while posing on the closed-circuit TV screen.

"The television camera has two outlets for transmissionn to the monitor —one is straight video signal which requires the standard video monitor much like those used in a television station. It also has an outlet for rf which can be fed directly to the antenna lead on the back of any standard TV set. It would be worth mentioning that there is a marked difference in the visual characteristics between straight video and rf input. The video is considerably sharper and more stabilized whereas rf fed directly into a standard receiver is somewhat more diffused. But I find the rf method considerably more reasonable in expense and the diffused image cuts the sharp edge of reality shown the viewer. It's no use to hit them with too much reality all at one time.

"The televised image seen by an individual also differs from the mirror image in that it is just the opposite of what one sees in the mirror. If a sitter tries to adjust her hair she becomes somewhat flustered. When her right hand is raised, it appears on the screen on the left side. It would take a great deal of practice to be able to comb one's hair this way. I have, therefore, installed an additional switch on the side of the camera where I have cut into the horizontal sweep leads to the horizontal deflection coil. With a flip of this switch, I can give the sitter an image more like that anticipated with a mirror.

"My gross investment came to approximately $1,500 for the camera, lenses, monitor and coaxial cable installations.

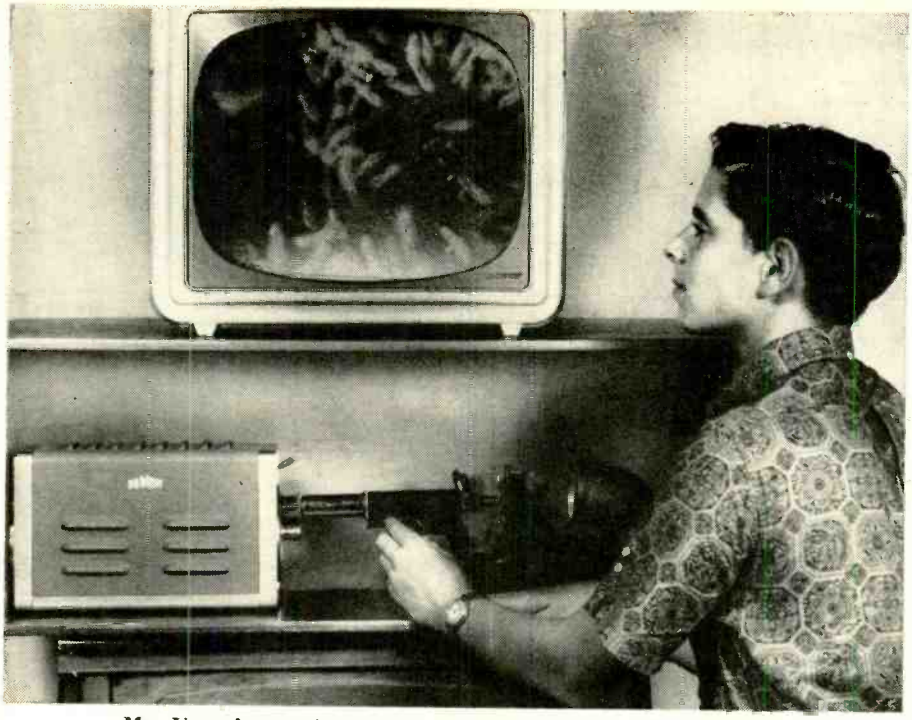
"The expense of operating the system in my studio hardly runs more than that of a few 100-watt light bulbs. Maintenance after 2 years of continuous daily operation Monday through Saturday has been the replacement cost of three small TV tubes—an average $3 each. The television sets I use for monitors have performed equally well.

Other applications

"The system that I employ so effectively in my studio has been of further use to me outside of my business. I devote many evenings in my observatory at home viewing the celestial sphere. Several times a month groups of boys and girls, with their science teachers who come to see the moon, planets and stars at close hand. Recently I found that I could hook the TV camera up to the eye end of the telescope and feed the image directly into several monitors so everyone could view the heavenly scene together. I can thus traverse far more of the celestial area in one evening than if each child were to take a turn at looking at objects individually, though I do generally give them each a straight optical view through the telescope before they leave.

"A while ago my 13-year old son, Avery, who is enthusiastically inclined toward microbiology, adapted for his school science fair a project theme involving one-celled animals in a water substance known as deuterium or heavy water. He rigged up his microscope to

Customers can view proofs in the reception room as soon as negatives are developed.



Mr. Ugent's son Avery uses the TV camera to display minute live organisms in a drop of water under a slide. The demonstration was presented at a local science fair.

show the working of his experiments and asked me if it would be possible to show his tiny organisms on the closed-circuit TV.

"I had my doubts about it working out, but I permitted him to try it. I will never forget that evening when I returned from the movies with my wife to be met by my beaming son: 'Look, look! I did it! I did it!' Indeed he did. To my amazement I looked into the monitor and saw detail in the organisms far more vividly than I had ever seen by peering into the microscope. The child had reversed the polarity on the camera and thereby created the picture of the organisms in a negative state. This gave the viewer the effect of an optical microscope using a dark-field system. I don't know if he was the first to use negative polarity for closed-circuit dark-field TV microscopy or not, but one can easily see how it can be applied in many ways with distinct benefits. Closed-circuit TV is not just a gimmick, fad, novelty or toy: it is one of the most useful tools for practical purposes for science, industry, business, education, and medicine."

In drugstores, too

In a Miami drugstore (Douglas Pharmacy) a closed-circuit TV is installed with the camera viewing the pharmacist at work in the back. The receiver is located on the counter near the cash register. Thus customers (forbidden by law to go back into the room where prescriptions are being prepared) can now, by closed-circuit TV, see their medicines being made up.

Mr. Surface, co-owner of the store, states that the first reaction from his customers when he started to use closed-circuit TV was remarkable. It brought new business, repeat business and a good deal of enthusiasm.

A bowling alley in Miami has installed—on an experimental basis—a TV camera behind the pin balls, with the receiver off to one side of the bowler. Thus he can watch the progress of his ball on the first part of its trip down the alley by unaided eye. Then he can see the ball approaching the pins on the TV screen as if he himself were back where the pin boys used to work before the automatic machines came into use.

Not by TV alone . . .

Interestingly enough, Ugent also has a two-way intercom system that connects his darkroom with the reception room. This equipment saves him the inconvenience of having the receptionist open his darkroom door when he is busy developing and printing. He can talk to the receptionist and she can talk to him. By leaving the switch open, he can hear conversation in the reception room and detect whether any customers are getting impatient. If any customers wish to talk with him while he is in the darkroom, they can do so over the intercom.

The intercom and the closed-circuit TV, both electronic aids, have streamlined his efficiency immensely and he is now able to handle any reasonable volume of work without getting too far behind.

We have seen how closed-circuit TV today is used extensively in hospitals, schools, department stores; in the armed services; in industry, and in so many thousands of ways, but indications are that closed-circuit TV will become even more popular as it moves into small businesses too and finds novel and distinctive uses like the few we have just mentioned. END

COMING NEXT MONTH

New 50-watt stereo amplifier is all transistor

Audio men—here's thought-priming reading —whether you intend to build an amplifier soon or not. This cover story gives a complete description of the new 50-watt KX-60 Knight Kit which has a number of interesting new circuits.

You can set up color TV!

The old complex method greatly simplified! The service technician's technician, Wayne Lemons gives you the lowdown. He uses the new Zenith color set as his example. Even if you have set up color TV before, there's much to learn from this stimulating article.

Electroluminescent flashlight

Here's a fresh idea on how to build a useful pocket lamp around one of those luminescent nightlights. A transistor supplies efficient, high-frequency power.

FM stereo multiplex directory

A valuable supplement to the list that appeared in the October issue of Radio-Electronics. Lists and describes features of adapters, tuners and receivers introduced since the original list was published. Keeps you up to date in this exciting new phase of hi-fi.

Versatile transistor tester

You can't test all transistors the same way. Yet too many of the simpler testers try to—with only one voltage and one fixed collector current for each type. Obviously this gives you an inadequate picture. But now you can build this hard-working job that tests at currents from 250 μa to 100 ma. Makes useful leakage tests too.

PLUS—Many more exciting features and all the regular departments
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semiconductor LIGHT DIMMERS for the home

Three little light dimmers improve tremendously on the old on–off switch

By **ROBERT F. SCOTT**

TECHNICAL EDITOR

COMBINATION LIGHT SWITCHES AND CONtrols have long been used to vary light intensity in homes, churches, restaurants and other areas where an adjustable light level is desirable. These light dimmers or controls use variable-voltage transformers similar to the Variac or Powerstat. Relatively bulky—they mount in 4-inch square or larger boxes—they are not readily substituted for the conventional spst wall switch.

Within recent months, several semiconductor type light controls have been developed for home use. These new units mount in standard single-gang wall boxes and are directly interchangeable with conventional wall switches.

The simplest of such units is the General Electric High-Low control. It is a three-position switch that turns the lights on bright in the upper position, off when centered, and dims them to half brilliance when flipped down. The circuit of the High-Low control is in Fig. 1. In the HI position, the lamp operates on both half-cycles of the line voltage and glows with full brilliance. When the switch is thrown to LO, a silicon rectifier is inserted in series with the lamp so current flows through it only on alternate half-cycles. The High-Low switch handles incandescent lamp loads up to 300 watts.

Slater Hi-Lux

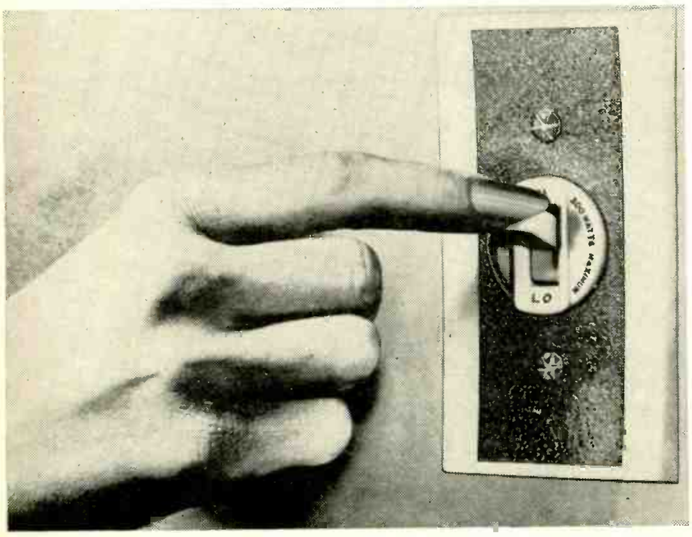
This control, a product of Slater Electric Manufacturing Co., Glen Cove, N. Y., is available in two basic models. The RD-600 provides continuous control from off to half power. The RDC-600 is continuously variable from off to full power. Both are rated at up to 500 watts for incandescent lamps.

The design of the Hi-Lux is based on a silicon-controlled rectifier (SCR). This is a thyratronlike semiconductor similar to a conventional thyratron in that it is blocked in the forward direction until a signal is applied to a third element (gate). When a signal is applied to the gate, the rectifier conducts in the forward direction and continues to pass current—even after the gate signal has been removed—until the circuit is broken or the voltage between anode and cathode reverses polarity. As in any conventional half-wave rectifier, the SCR conducts only when its anode is positive with respect to the cathode. When operated on ac, the SCR can be switched on at any point on the half-cycle when its anode is positive and it cuts off automatically when the anode swings negative. Thus, the voltage and current to the load can be controlled by delaying the point in the positive half-cycle at which SCR switches from the blocked to conducting state.

When used alone, the SCR can vary light intensity from off to half brilliance. When shunted by a conventional rectifier wired with reverse polarity, the control adjusts light intensity from half to full brilliance.

Fig. 2 is the circuit of the Slater Hi-Lux. The SCR's (D2) gate voltage—and thus its firing angle—is controlled by a unijunction transistor (V) connected as a multivibrator. Capacitor C charges through R1, R2 and R3 until its voltage reaches the emitter peak voltage (V_p). At this time, the unijunction turns on and C discharges through R4. When the emitter voltage drops to a fairly low value (for example, 2 volts in some unijunction transistors) the unit turns off and the cycle repeats. The oscillator frequency is fairly independent of supply voltage and is determined by the values of R1, R2, C and the setting of R3.

When C discharges, it produces a voltage pulse across R4 that fires D2. Thus, D2's firing angle is controlled by R3. Minimum output occurs with R3 set for maximum resistance (fully counterclockwise). Under this condition, the voltage across C cannot reach V_p (the unijunction's emitter peak voltage) and



G-E's Hi-Lo control is off when the switch toggle is in the center.

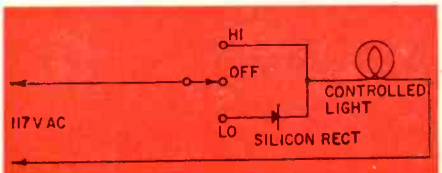


Fig. 1—G-E's Hi-Lo control incorporates a silicon rectifier.

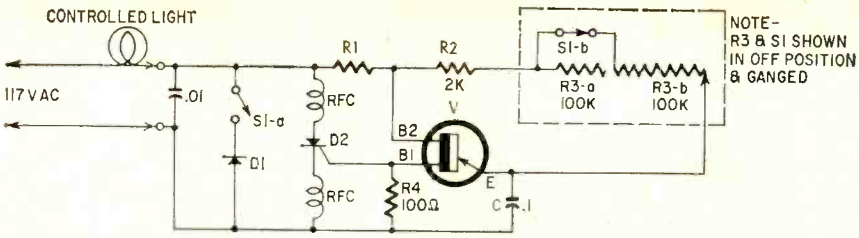


Fig. 2—The Slater Hi-Lux contains three semiconductor elements—a unijunction transistor, a silicon-controlled rectifier and a silicon rectifier.

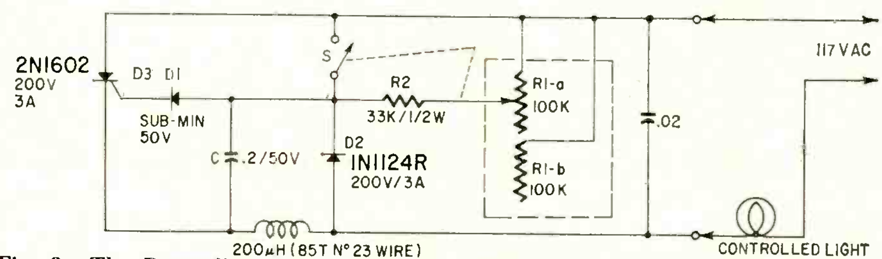


Fig. 3—The Dreamliter control uses this circuit. Note the controlled rectifier is used here too.

fire the unijunction and SCR before the line polarity reverses.

The variable control consists of a split resistance element R3-a and R3-b with the rotor or arm ganged to S1-a and S1-b. In the off position, S1-a is open, S1-b is closed and the control's arm is at the high-resistance end of R3-b. As the control is turned clockwise, the portion of R3-b in the circuit decreases and reduces the SCR's firing angle. This increases the time that the SCR conducts while its anode is positive with respect to the cathode. As we reach the low-resistance end of R3-b, the SCR is conducting fully on positive half-cycles and the lamp glows with half brilliance.

Advancing the control beyond this point brings the control's arm to the high-resistance end of R3-a, opens S1-b and closes S1-a to connect silicon rectifier D1 across the SCR. Again, the SCR is cut off but the lamp still burns with half brilliance because the silicon rectifier is conducting fully on the half-cycles when the SCR's anode is negative.

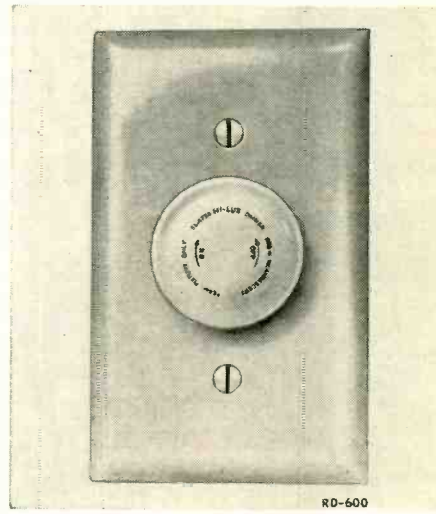
As we continue to advance the control, the SCR's firing angle decreases further and it conducts for increasingly greater portions of the positive half-cycle. In the maximum clockwise position of the control, R3's resistance is completely out of the circuit and the SCR carries its full share of the load so the lamp burns with full brilliance.

Dreamliter 600

This semiconductor light dimmer and control is made by Electro-Solid Controls, Inc. (8001 Bloomington Freeway, Minneapolis, Minn.). The Dreamliter's circuit is shown in Fig. 3. It, too, is based on controlling the firing angle of a silicon controlled rectifier. Control R1 is a 720° rotation type which we suspect is similar to that in the Hi-Lux. In the OFF position—fully counterclockwise—R1's full resistance is in the circuit and switch S is open. R1, R2 and C are in series across the ac supply with the SCR's (D3) gate connected to the junction of R2 and C1 through D1. With full resistance in the circuit (the control's arm at the high-resistance end of R1-b) the voltage across C does not rise high enough to fire the SCR before line polarity reverses.

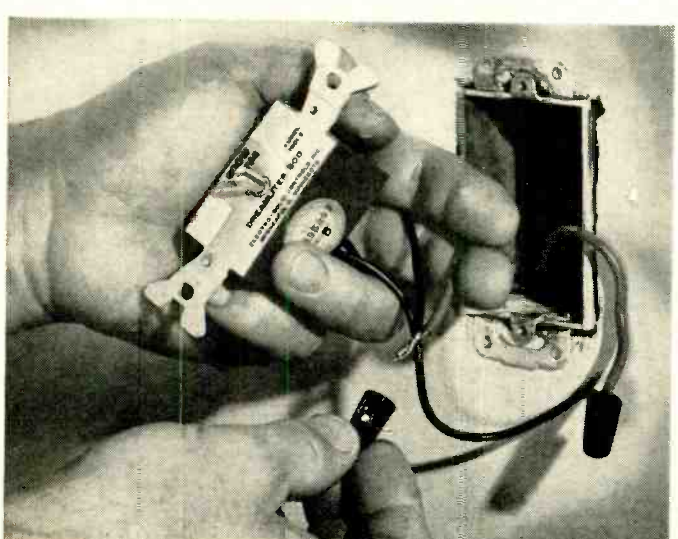
As the resistance is decreased, the gate voltage developed across C rises faster and the SCR conducts for increasingly longer periods of the half-cycle when its anode is positive with respect to the cathode.

With 360° control rotation, the SCR is conducting fully on alternate half-cycles and the lamp burns with half brilliance. Advancing the control further brings the arm of the control to



The Slater Hi-Lux dimmer has a rotary control.

the high-resistance end of R1-a and closes switch S to connect rectifier D2 into the circuit. (This is a conventional silicon rectifier with the same voltage and current ratings as the SCR.) Now, the SCR is cut off and the lamp operates at half brilliance by drawing current through D2 on alternate half-cycles. As we continue to advance the control, the SCR conducts over a greater portion of the half-cycle that makes its anode positive and brightness increases until the SCR and D2 are conducting fully—each on alternate half-cycles. D1 prevents an inverse voltage from being applied between the cathode and gate during the period when the anode is negative.



The Dreamliter being installed in a standard switch box.

Precautions

The light controls described here are directly interchangeable with ordinary light switches and can be installed by the average do-it-yourselfer or handyman. However, use them only on permanent lighting-fixture installations. Do not use them as replacements for switches controlling wall outlets that may be used for other appliances. Appliances other than incandescent lamps may overload and damage the semiconductor control. Furthermore, heaters, motors and other electrical devices are generally designed to operate at full voltage and will not operate efficiently—if at all—at reduced voltage. Also, make sure that the incandescent-lamp load does not exceed the maximum rating of the control—300 watts for the High-Low, 500 watts for the Hi-Lux and 600 watts for the Dreamliter. END

ECHO-JET SIGNAL INJECTOR

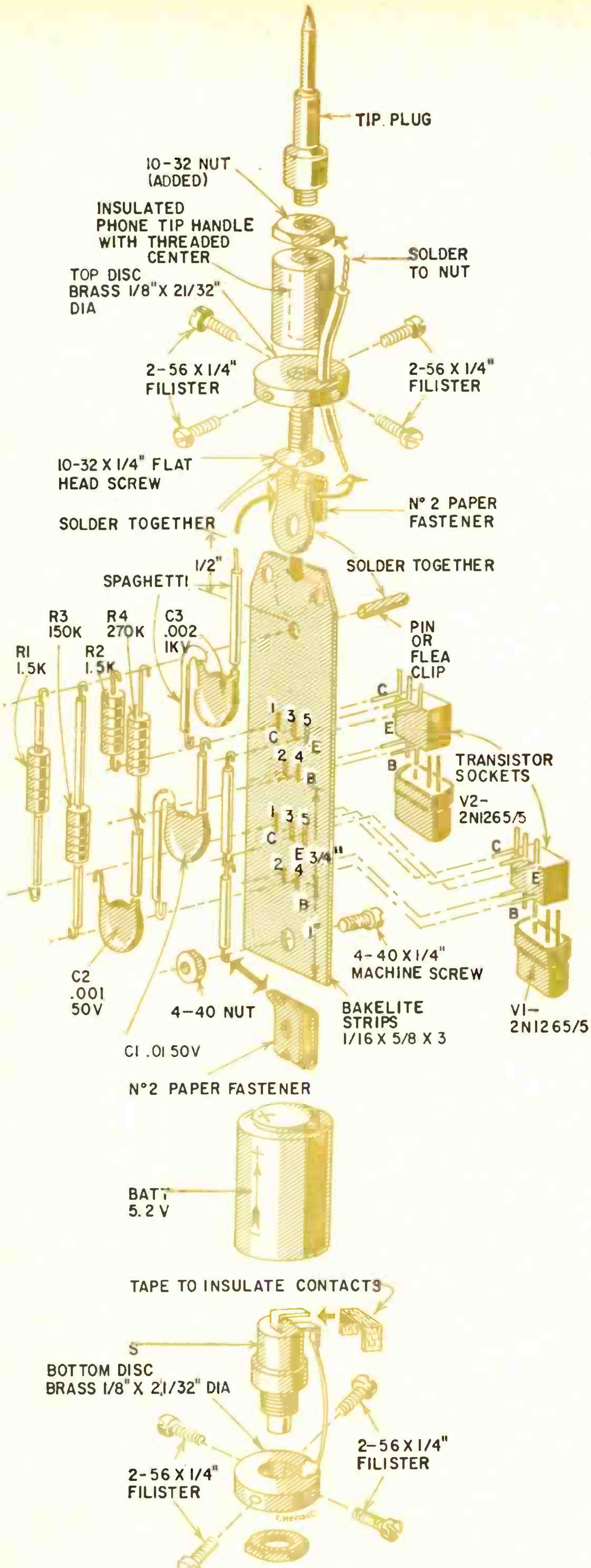


Fig. 1—Construction details of the Echo-Jet.

Build this noise injector to speed transistor radio servicing

By JACK LIPINER

For rapid servicing of modern transistor radios, manufacturers recommend signal tracing through noise injection. The Echo-Jet is a two-transistor noise generator housed in a probe type case. It is completely self-contained, portable and easy to use. The finished unit draws about 3 ma from the battery and produces a 2,000-cycle output rich enough in harmonics to cover the broadcast band and if. Output level is approximately 300 mv.

An issue of *Motorola Service News*, under the heading of "Servicing Transistorized Radios," gives a detailed analysis of emitter-voltage determinations to discover current variations. Numerous types of breakdown are indicated by only fractional variations in emitter voltages of the various stages. The voltage-analysis method therefore becomes detailed, cumbersome and time-consuming.

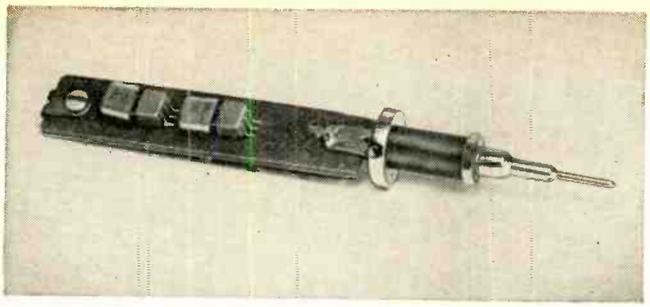
The publication continues, "At times, however, it will be more expedient to signal-trace the set. There is nothing as unresponsive as a dead transistor set. Some sort of noise generator is invaluable in tracing dead sets, and has good possibilities for quickly checking comparative stage gains. A noise generator can easily be constructed, and once the operator acquires a little experience, it will prove to be of immense value for all forms of radio servicing."

RADIO-ELECTRONICS, June 1955, published the "Midget Transistorized Signal Injector," by Elliott A. McCready. If you tried to build that unit today, you would have trouble obtaining several of the components. The Echo-Jet is a modified version of the original, and is constructed of standard, easy-to-get parts.

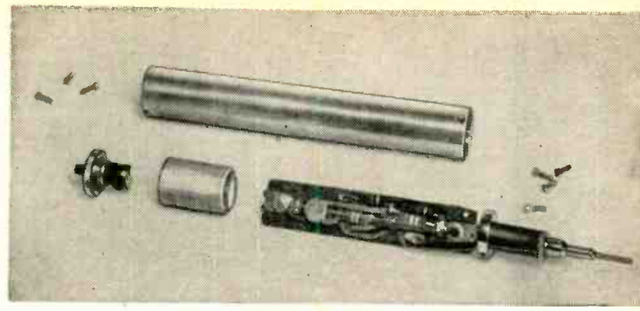
Construction

A bakelite strip is used for the chassis. (Fig. 1 is an exploded view of the unit showing details of construction. Fig. 2 is the circuit.) The transistor sockets are side-mounted in the center above the bottom edge of the strip in Fig. 1. Drill five small holes to correspond with the lugs of the socket. Insert these lugs through the holes and *gently* bend to hold the socket in place. Lugs 2 and 3 are unused in the circuit, and are bent close to the strip. Lugs 1, 4 and 5 are used for collector, base and emitter connections, respectively.

Install a brass paper fastener on the bottom-center edge with a 4-40 screw, solder lug and nut. It becomes the positive battery contact for emitter connections. Insert a flea clip or pin into a small center hole ½-inch from the upper edge of the strip. To this clip solder the second paper fastener. The flea clip



Transistor side of the Echo-Jet chassis.



Parts layout on the signal-injector chassis.

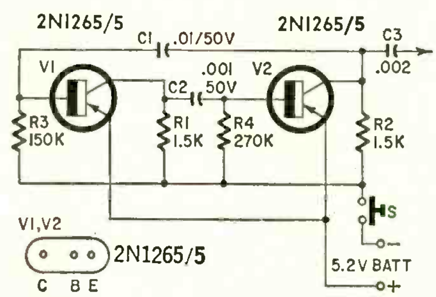
serves as the B-minus terminal and contacts the negative case through the paper fastener.

Cut two ⅛-inch-thick brass discs from a 21/32-inch rod. They serve as top and bottom covers for the case. Drill a ¼-inch hole in the center of the bottom disc to hold the switch. The other disc is center-drilled with a No. 21 drill, tapped with a 10-32 tap, and countersunk to take a flat-head 10-32 x ½-inch brass screw. It contacts the negative paper fastener and places the Echo-Jet case in the negative path. Drill an additional small hole in the upper disc, 3/32 inch from the edge, for the output wire from C3 to the output nut on the tip prod.

Drill four evenly spaced 3/32-inch holes 1/16-inch from one edge of the case. Drill one No. 51 hole in the center of the edge of the top disc, thread it with a 2-56 tap. Then insert the disc in the case and fasten with a 2-56 screw. The remaining three holes in the disc are similarly drilled and tapped for the remaining screws. The bottom retaining screws are inserted in the lower disc after similar drilling and tapping. One keyway indicator slot is filed in one case hole to correspond with its disc hole in each disc.

The switch leads

For easy battery replacement, no switch wires connect to the bakelite chassis. Simply insert the switch into the bottom disc, and slowly bend one lug to the side of the switch body. **Caution: To avoid breaking, the lug bending must be gentle!** Now solder a short, solid wire from the bent lug to the under side of the bottom disc. This connects the case into the negative path of the circuit. Next, insulate the bent lug from the other lug by covering it with a small strip of electrical tape. Cut the other lug to a ⅛-inch length. Then solder a short length of flexible flat spring (obtained at most hardware stores) to it.



R1, R2—1,500 ohms, ½ watt, 10%
R3—150,000 ohms, ½ watt, 10%
R4—270,000 ohms, ½ watt, 10%
C1—.01 μf, 50 volts, ceramic disc
C2—.001 μf, 50 volts, ceramic disc
C3—.002 μf, 1 kv, ceramic disc
BATT—5.2 volts (Mallory TR-114R or equivalent)
S—spst pushbutton (Lafayette SW-70 or equivalent)
V1, V2—2N1265/5 (Sylvania)
Transistor sockets (2) (Lafayette MS-149 or equivalent)
Length brass tube, 5 x ¾ OD x .040 inches
Length brass rod, 21/32-inch diameter (The above two items are available from Manhattan Brass and Copper Co., 150 Lafayette St., New York, N. Y.
Insulated tip plug (H. H. Smith No. 229 or equivalent)
Bakelite strip, ⅝ x 3 x 1/16 inches
Length thin, flexible, flat spring, 7/16 x 3/16 inch
Paper fasteners (2) (Petite No. 2 or equivalent)
Flat head brass machine screw, 10-32 x ½ inch
Filister head brass machine screws (8) 2-56 x ¼ inch
Brass machine screw, 4-40 x ¼ inch
Hexagon nut, ⅜ x ¼ inch, 32 thread
Flea clip or pin (Lafayette MS-263 or equivalent)
Solder lug

Fig. 2—Circuit of 2-transistor Echo-Jet.

To insure soldering and battery contact, scrape the spring clean at the respective areas. After soldering, bend the lug gently to an angle of about 60° to contact the negative batery terminal.

Wiring

Finish all wiring before inserting the transistors in their sockets. The wiring, as shown in Fig. 1, should be done so the bulk is concentrated toward the center where the area of the case is greatest.

Tap the bakelite prod-tip holder with a 10-32 tap at the open end to engage the brass screw from the top disc. Insert the output nut between the tip and the holder. Then pass the output lead from the .002-μf capacitor through its hole in the top disc and solder it to an edge of the nut.

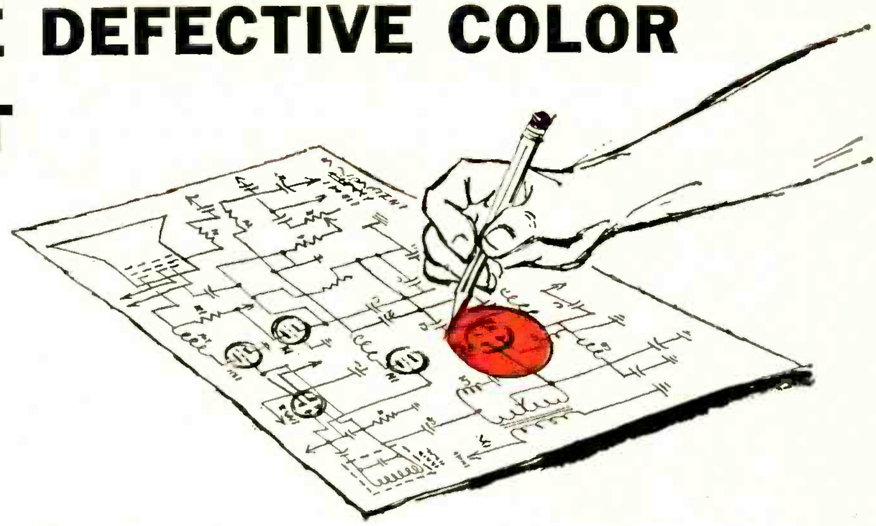
Final assembly and tests

Insert the battery into the case so its negative pole will touch the spring terminal of the switch in the bottom disc.

To test the assembled generator, depress the switch and touch the probe tip to the antenna lead of a broadcast receiver tuned between stations. At a moderate volume setting, a loud signal should be heard. For louder response, turn up the volume control to maximum.

When used in accordance with accepted signal-tracing methods, the Echo-Jet becomes invaluable for signal tracing all types of receivers. It also has many possibilities in amplifier examinations. END

PINPOINT THE DEFECTIVE COLOR SECTION FAST



Quick checks make quick work of this problem

By DAVID R. ANDERSON

Color TV troubleshooting can be greatly simplified by dividing the set's circuits into two major groups—circuits needed for both color and black-and-white pictures, and circuits needed only for color pictures. A defect in the first group is handled just as though it were in a standard monochrome receiver. A defect in the "color only" circuits calls for new techniques. Localizing the bad stage is the usual procedure. And this article details some quick checks to help the technician do just this.

The color portion of the receiver breaks down into several sections (Fig. 1), but finding the defective one is easier said than done.

When the complaint is no color, any of the sections except the color detectors and amplifiers can be at fault. A defect in this section would cause a loss of one or two colors rather than a complete color loss. Fortunately, a few simple checks can quickly determine which section is defective.

The first check tells us whether the chroma bandpass amplifier is working. The schematic of such an amplifier as used in an RCA CTC7 color receiver is in Fig. 2.

Notice that the grids of the bandpass amplifiers connect to the color-killer circuit. When a color receiver is tuned to a monochrome station, the color-killer circuits supply enough negative bias to the bandpass amplifier grids to make them inactive. This prevents the amplifier from interfering with the monochrome picture.

When a color signal is being received, the color killer is turned off, removing the negative bias from the bandpass amplifiers.

Since a defect in the color killer, or an associated circuit, might permit this bias to remain even when a color signal is being received, pull the color-killer tube to check the bandpass amplifier.

If the bandpass amplifiers are work-

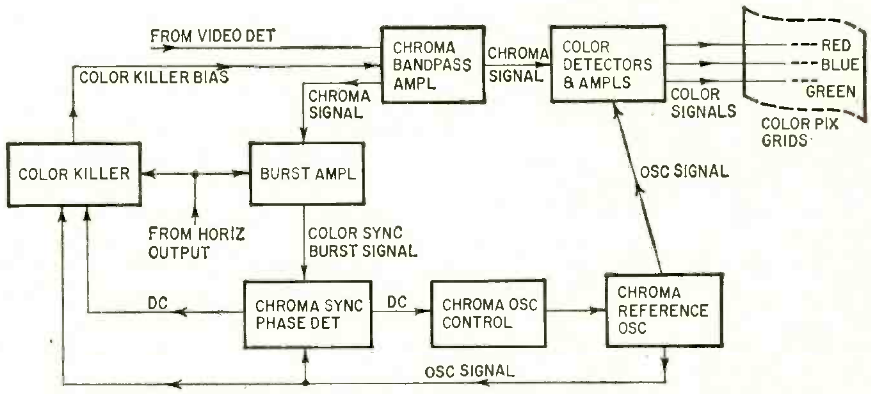


Fig. 1—Block diagram shows division of receiver's color section and signal paths for color signals.

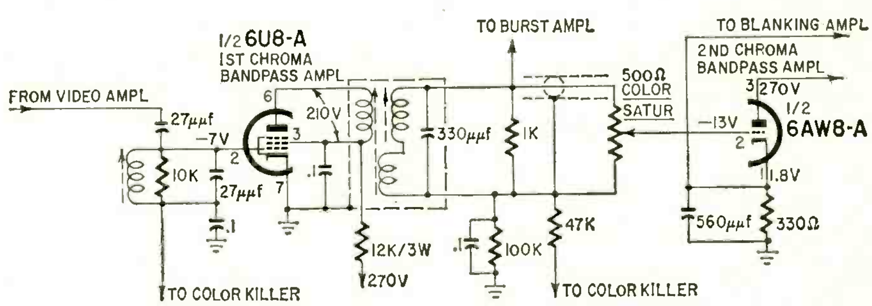


Fig. 2—Chroma bandpass amplifier. It amplifies only color information.

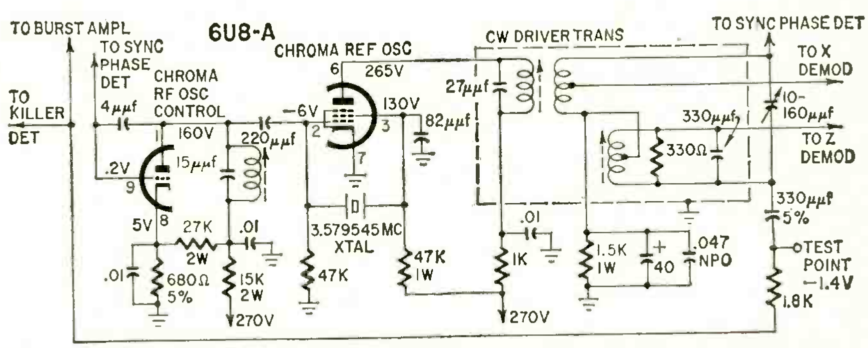


Fig. 3—Chroma reference oscillator and its control tube. The circuit provides the necessary reference frequency for the detection of the color signals.

ing, color will appear on the screen. It may be badly out of sync, but will be there if the amplifiers are working.

If no color appears when the color-killer tube is pulled, the defect is in the bandpass amplifier section and a scope can be used to locate the defective amplifier. Resistance and voltage measurements will pinpoint the defective component.

If pulling the color killer restores color to the receiver, the defect is in the chroma reference oscillator and its control circuit, the chroma sync phase detector, the burst amplifier or the color killer.

The chroma reference oscillator and its control tube are shown in Fig. 3. Check the oscillator by measuring the bias at its grid. If the oscillator is working, you should find about −4.5 volts. If you read low or zero voltage, the oscillator is not working.

The first step in checking the oscillator is to substitute a new crystal. If this fails to restore operation, voltage and resistance measurements will lead you to the defective component.

If the reference oscillator is working properly, check the burst amplifier next. A diagram of a burst amplifier is in Fig. 4. It consists of a single tube and can be checked quickly with resistance and voltage measurements. If this section checks out, the only ones left are the color killer and the chroma sync phase detector.

An example of these circuits is shown in Fig. 5. Here again, as with the burst amplifier, the circuits may be checked with resistance and voltage measurements.

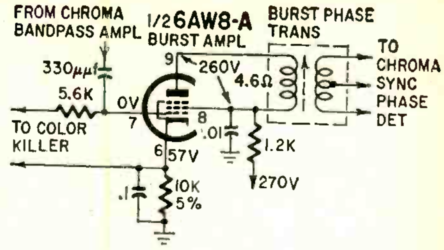


Fig. 4—The burst amplifier amplifies the color burst signal.

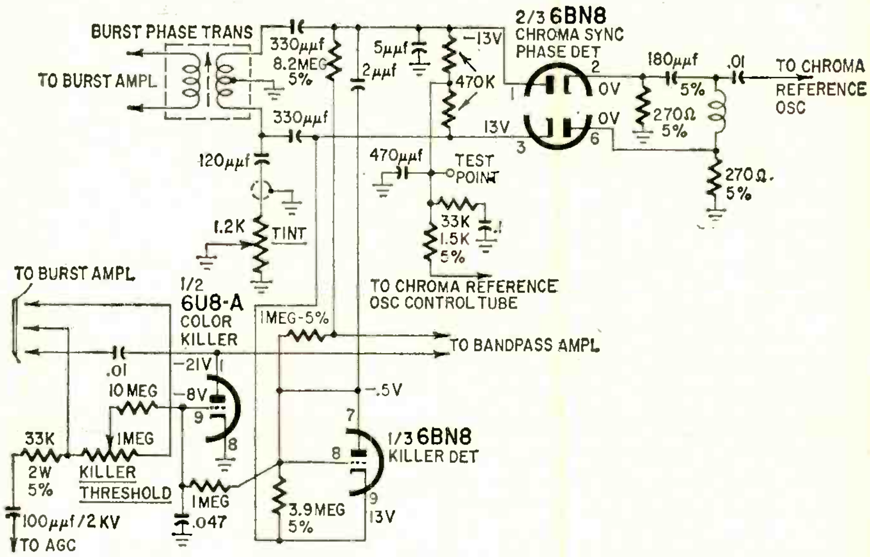


Fig. 5—Color killer and phase-detector circuits. Killer circuit makes the bandpass amplifier inoperative when a monochrome signal is being received.

Missing color

When the complaint is improper color, and adjusting hue and saturation controls does not remedy the situation, one of the primary colors that drive the picture-tube color grids is probably missing.

In this case, the trouble lies in the color detectors and amplifiers. Fig. 6 is the circuit of this section.

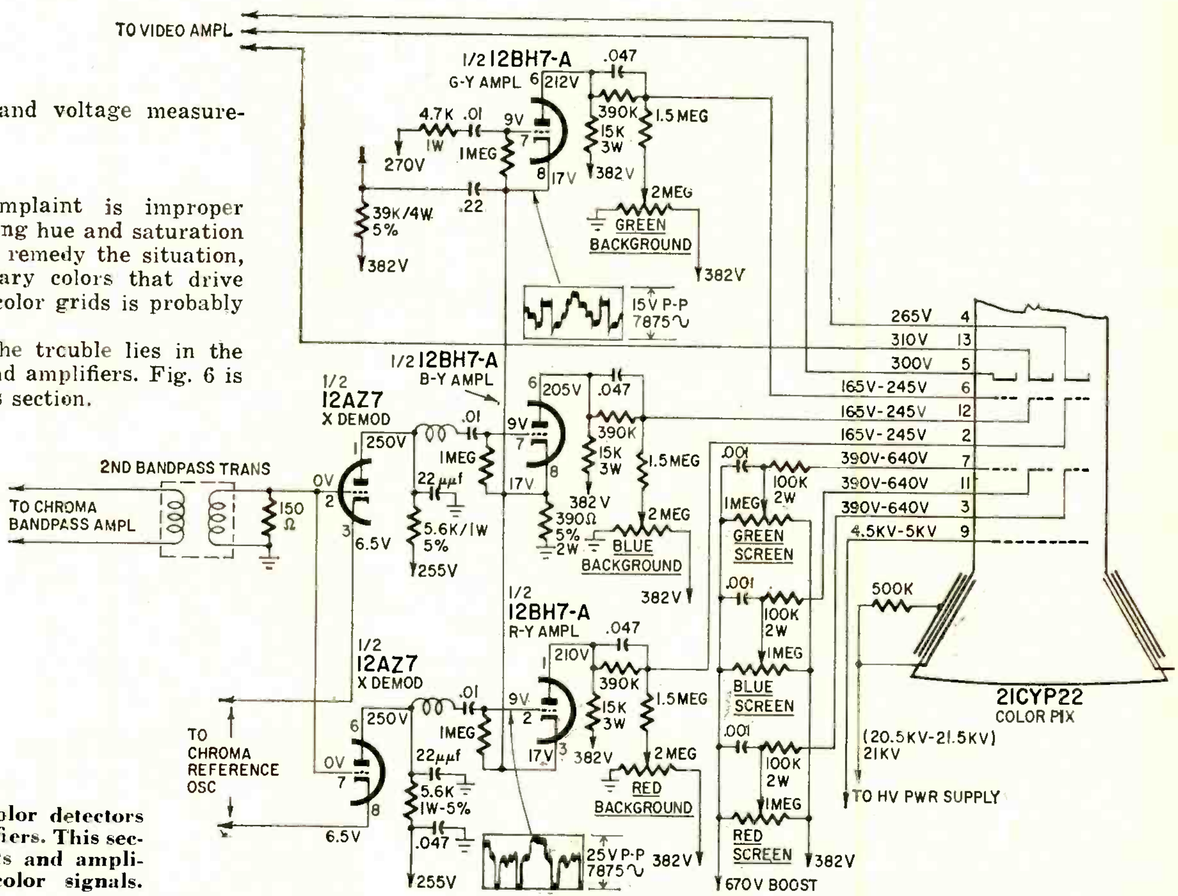


Fig. 6—Color detectors and amplifiers. This section detects and amplifies the color signals.

While similar symptoms can be caused by improperly setting background and screen controls, there is a quick way to find out whether all colors are present.

Pull the G − Y amplifier and the B − Y amplifier. If the R − Y amplifier and its associated detector are working, an all-red image will appear on the screen of the picture tube.

Next, replace the B − Y amplifier and pull the R − Y amplifier. If the B − Y amplifier and detector are working, an all-blue image will appear. Use the same method to check the G – Y amplifier.

If one of the colors is missing, no image will be produced when its respective amplifier is plugged in.

No color sync

The complaint of no color sync can be caused by the chroma sync phase detector, the reference-oscillator control tube or the reference oscillator. To determine if the defect is in the phase detector or the oscillator and its control tube, ground the grid of the control tube. This removes any voltage fed to this grid by the phase detector.

If, with the grid grounded, the colors roll slowly through the picture, the phase detector is the defective section. It may then be checked out with resistance and voltage measurements.

If the color remains badly out of sync with the grid of the control tube shorted, the defect is in either the control tube or oscillator section. These sections can be checked with voltage and resistance measurements. END

STEREO RADIO

AN INTERESTING WAY OF SUPPLYING stereo to the listener who already has a monaural FM radio is the FM Multiplexer made by Zenith. In effect, it is simply an FM multiplex receiver with a switch that makes it possible to supply the 6 x 4 speaker with a signal on either the right or left channel. The Multiplexer is placed 6 feet or more away, either to the right or left of the old FM radio, and either the right or left channel switched on, as indicated by its position.

Let us say that the Multiplexer is to the right of the FM receiver and switched to the right channel. Now the FM set is supplying right plus left, and the Multiplexer right only. The right signal is reproduced by both units, and the left signal by only the old unit. The right sound source now appears at a point midway between the FM radio and the Multiplexer, the left signal from the monophonic receiver. Thus we have a stereo field, not between the two units but between the monophonic unit and a point halfway between it and the Multiplexer. Since right-channel information is coming from both speakers, the volume on the right channel will be up 3 db, and the volume level of the Multiplexer may be adjusted to compensate for this, at the same time increasing the apparent separation. A switch on the back of the Multiplexer permits putting the speaker in phase with that of the monophonic receiver. This is done with the Multiplexer switch set in the monaural position, which makes it easier to tell whether the two speakers are phased.

Zenith suggests that it is possible to buy two stereo FM Multiplexers to receive stereo FM. One unit would be set to reproduce the right channel, the other the left channel. It is not quite clear that an additional jack cannot be added to the FM Multiplexer, so that simply adding a small audio unit would bring in the second channel.

DX SHORT-WAVE FORECAST

Feb. 15–March 15

By STANLEY LEINWOLL†

The range of useful frequencies for DX has been lower this winter than at any time since 1955.

This has happened because sunspot activity has been dropping at a much faster rate than anticipated. As a result, radio conditions that are typical of the low part of the sunspot cycle have already begun. These had not been expected before the latter part of 1962 or early 1963.

During evening and night hours 4, 6, and 7 mc have been most effective, while the 15- and 17-mc bands have been best during daylight hours. In late March, with seasonal increases in absorption and noise levels, conditions on the bands below 6-mc are expected to deteriorate during the evening and night hours and remain poor until the fall.

Major schedule changes will be made by most of the world's broadcasters on March 4, and these will reflect the continuing trend toward lower frequencies brought about by decreasing solar activity.

The tables show the optimum broadcast band, in megacycles, for propagation of programs between the locations shown during the time periods indicated.

To use the tables, the listener selects the one most suitable for his location, reads down the left side to the region he wishes to hear, then follows the line to the right until he is under the appropriate time. (Time is given at the top of each table in 2-hour intervals from midnight to 10 pm, *in your local standard time.*) The figure thus obtained is the short-wave band (in megacycles) nearest to the optimum working frequency.

For example, a listener in Chicago would use the Central USA table. He would be most likely to hear broadcasts from West Europe in the 6 megacycle band at 8 pm, Central Standard Time.

EASTERN US to:

	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	6	6	11	15	17	15	11	9	6	6	6
East Europe	7	6*	6*	11	15	15	15	11	9	7	7	7
Northern Latin America	9	9	9	9*	15	17	15	15	15	15	6	6
Southern Latin America	9	9	9	11	15	15	15	15	15	11	9	9
Near East	7	7	7	9	15	17	15	11	11	7	7	7
North Africa	6	6	6	11	15	15	15	15	15	9	7	7
South & Central Africa	7	7	7	11	17	17	15	15	11	11	11	7
Far East	7	7	6	9	9	7	7*	6*	7	11	11	9
Australia & New Zealand	9	9	9	9	9	9	9*	15	15	17	15	11

CENTRAL US to:

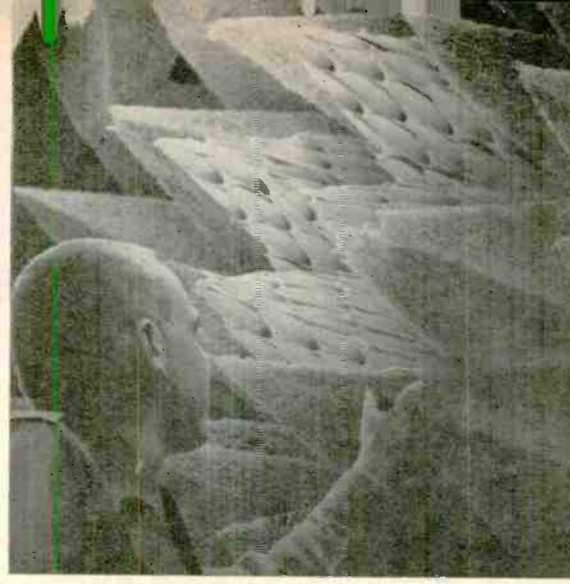
	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6*	6*	6*	11	15	17	17	11	9	6	6	6
East Europe	7	6	6*	11	15	15	15	9	7	7	7	7
Northern Latin America	9	9	9	11	17	15	15	15	11	9	6	6
Southern Latin America	9	9	9	11*	15	15	15	15	11	9	9	9
Near East	7	6	6*	15	17	17	11	9	9	7	7	7
North Africa	6	6	6*	15	15	15	15	11	9	9	7	7
South & Central Africa	7	6	6*	11	17	17	17	11	11	11	11	9
Far East	7	6	6	6	7	7*	7*	9*	17	15	11	9
Australia & New Zealand	11	11	9	9	9	9	17	17	17	17	15	11

WESTERN US to:

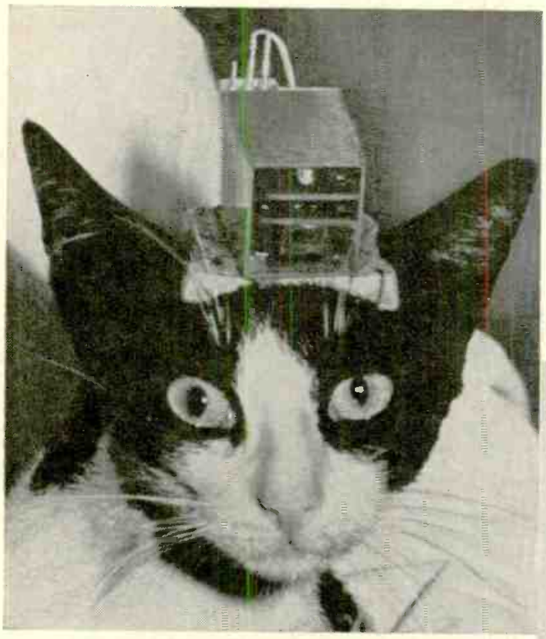
	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	6*	6*	15	15	15	11	9*	7	7	6	6
East Europe	6	6*	6*	15	15	9	9	7	7	7	7	7
Northern Latin America	9	9	9	15	15	15	15	15	11	9	9	9
Southern Latin America	9	9	9	15*	15	15	15	15	11	9	9	9
North Africa	6	6	6*	15	15	15	11	11	9	7	7	6
South & Central Africa	7	7	7*	11*	17	17	17	11	11	9	9	7
Far East	7	7	6	6	7	7	7	15	17	17	15	9
South Asia	6	6	6	6	9	11*	11*	9*	9*	15	11	9
Australia & New Zealand	11	11	7	9	9	15	21	21	21	17	17	15

†Radio-frequency and propagation manager, RADIO FREE EUROPE.
*Reception may be very poor or impossible on this path at this hour.

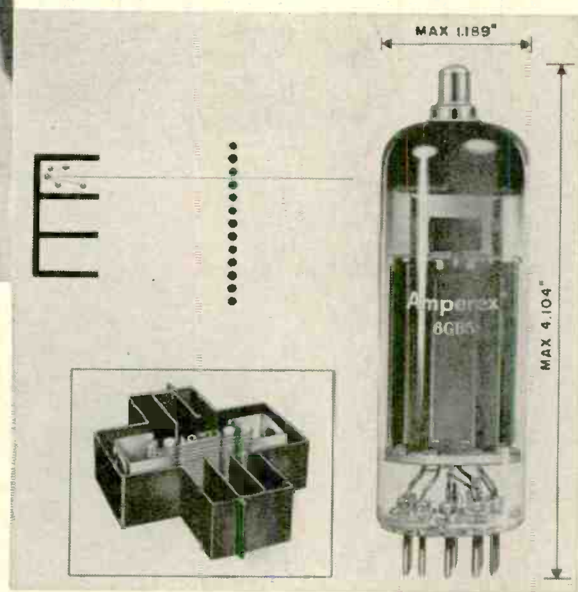
What's New



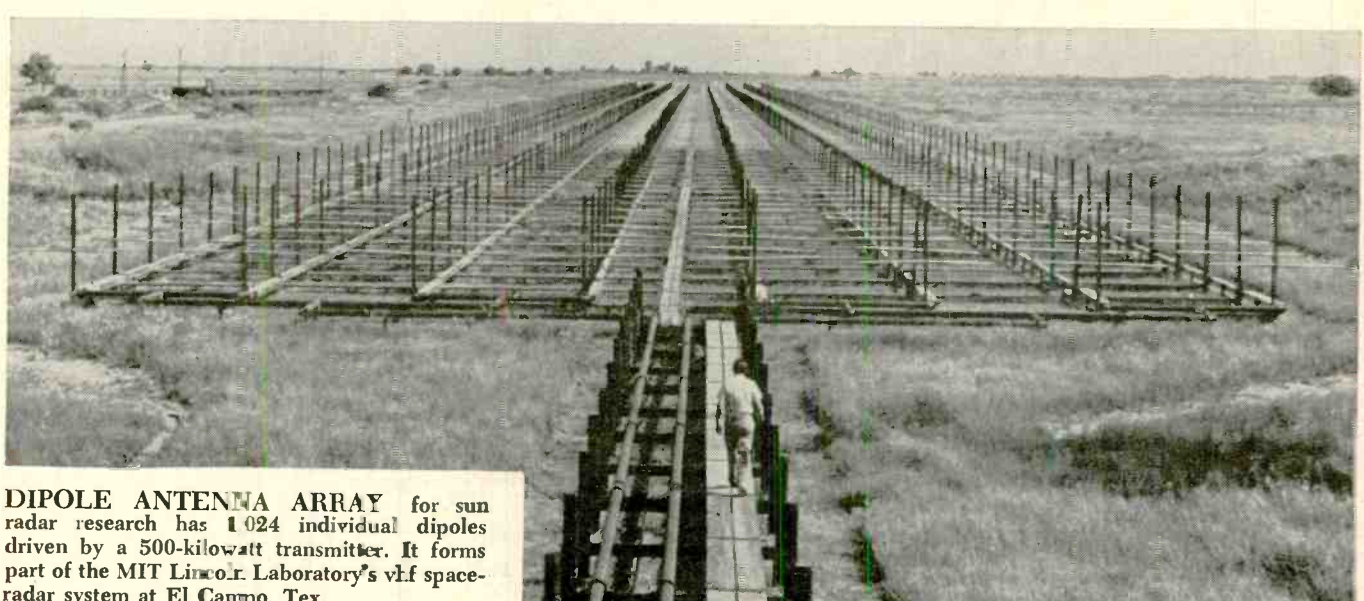
ANECHOIC ROOM FOR MICROWAVES at Air Force Special Weapons Center, Albuquerque, N.M., is made with pyramids of rubberized hog bristles impregnated with carbon. These soak up radio energy as ordinary anechoic room does sound, creating free-space conditions for checking antenna patterns or high-frequency fuze systems. The cardboard tube pyramids are part of the room's ventilation system.



CATEGORICAL information about wearer's brainwaves are sent out by this radio transmitter as cat goes about its normal activities, undisturbed by measurements being made at nearby radio receiver and recorder. The EEG transmitter was developed by H. Fischler and E. H. Frei at the Weizmann Institute of Science, Rehovoth, Israel.



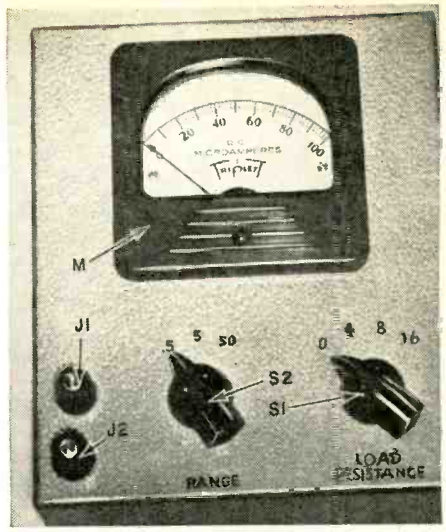
"CAVITRAP" construction of new Amperex 6BG5 (above, right) increases plate vs screen-current ratio. Secondary electrons from plate are mostly absorbed by the partitions. Larger peak currents and thus greater power for wide-deflection-angle picture tubes is the result.



DIPOLE ANTENNA ARRAY for sun radar research has 1 024 individual dipoles driven by a 500-kilowatt transmitter. It forms part of the MIT Lincoln Laboratory's vhf space-radar system at El Campo, Tex.

BUILD

Another handy instrument for the audio workshop



AN AUDIO VOLTMETER-WATTMETER

By JAMES A. FRED

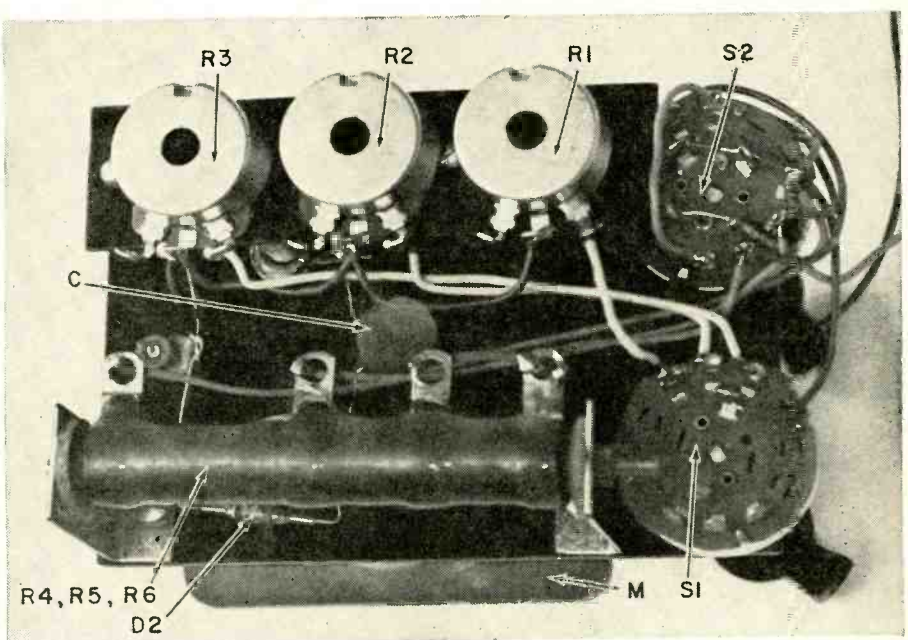
An ac voltmeter is a necessary item in the electronic workshop. Another desirable item is an audio wattmeter. This article will show how to build a combination audio voltmeter-wattmeter using a dc microammeter, two diodes and several resistors.

This meter can measure the power output of radio receivers, audio amplifiers and audio oscillators. By using a modulated if oscillator with the audio wattmeter, you can measure sensitivity, bandwidth and image rejection of any radio receiver. It can also be used to measure any ac voltage up to 50. *It is not intended to be placed in series with the line and a receiver or other device whose power consumption is to be measured.*

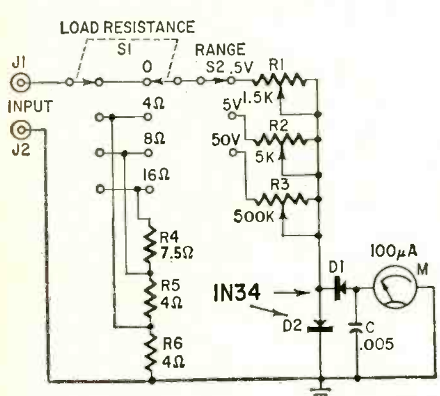
After carefully considering the possible uses of an audio voltmeter-wattmeter, I decided that three ac voltage ranges and one audio watts range would do. The ac voltage ranges are: 0.5, 5 and 50 full scale. The meter reads up to 10 watts with the built-in load resistor and up to 620 watts with an external load resistor.

The instrument has several novel features (Fig. 1). Whenever a voltmeter is designed and built there is the problem of obtaining suitable multiplier resistors. This is aggravated whenever a microammeter and diodes are used because the resistors always come out to some odd value. The problem is solved by using a composition carbon volume control as a multiplier resistor. I used Mallory controls which are said to be quite stable and should not vary more than 2% over a long period of time. In addition, these controls are small, noninductive and inexpensive. The multiplier resistors being variable, the instrument can be recalibrated at any time.

Another interesting feature is the built-in load resistor. The voltmeter-wattmeter is rather small, so a small (in size) load resistor had to be used. I used a home-made 10-watt unit. However, you will find that two 4-ohm and one 7.5-ohm 10-watt resistors are shown in the circuit. If you intend to work with large amplifiers, make up an external load box using 100-watt resistors. I am designing a high-power load box using eight 2-ohm resistors in series with taps at 4, 8 and 16 ohms. The audio voltmeter-wattmeter, as designed, will measure up to 600 watts across a 4-ohm load, with an external load box.



All components are arranged on a phenolic chassis that fastens onto the meter terminals.



R1—pot, 1,500 ohms (Mallory SU-6 or equivalent)
R2—pot, 5,000 ohms (Mallory SU-14 or equivalent)
R3—pot, 500,000 ohms (Mallory SU-50 or equivalent)
R4—7.5 ohms, 10 watts
R5, R6—4 ohms, 10 watts
C—.005 μf, ceramic disc
D1, D2—IN34
J1, J2—5-way terminal posts
M—meter, 0–100 μa (Triplett model 327T or equivalent)
S1—2-pole 6-position nonshorting rotary (Mallory 3226J or equivalent)
S2—1-pole 5-position nonshorting rotary (Mallory 3215J or equivalent)
Case to suit (3 x 5 x 6 inches or larger)
Piece of phenolic board for chassis
Miscellaneous hardware

Fig. 1—Complete circuit of the audio voltmeter-wattmeter.

The third design feature is the way most of the components are mounted on a phenolic board that is mounted on the meter studs. In this unit only the meter and binding posts are fastened to the metal box.

Since this is an audio-frequency device, you do not have to take special precautions when assembling or wiring it. You must be very careful when soldering the diodes. Excessive heat can ruin them. If you follow the design

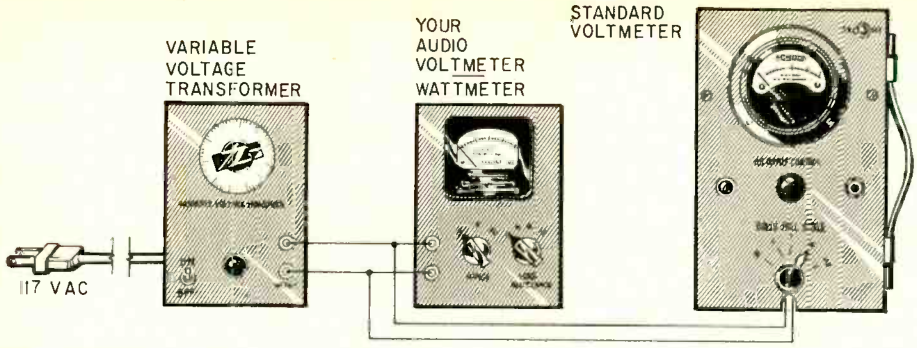


Fig. 2—Block diagram shows hookup for calibration.

shown, adjust and calibrate the multiplier resistors before you mount the parts. It's easier that way.

Calibration technique

You'll need an ac meter to be used as a standard and a variable ac voltage source to calibrate the audio meter. I used a Ballantine audio voltmeter as a standard, but you can use the ac range on your vtvm if nothing else is available. A small variable transformer, such as a Variac or Powerstat, together with a filament transformer, will make a convenient voltage source for the two low-voltage ranges. The variable voltage transformer can be used for the 50-volt range.

To adjust the multiplier:

1. Connect the standard voltmeter, the variable voltage source and the meter you have just built as in Fig. 2.
2. Set the RANGE switch for the 0.5-volt range and the standard voltmeter to cover the same range.
3. Set LOAD RESISTANCE to zero.
4. Adjust the variable transformer until you get a 0.25-volt reading on the standard meter. Adjust R1 until your meter reads exactly half scale.
5. Set the RANGE switch for the 5-volt range and the standard voltmeter to a similar range.
6. Adjust the variable transformer until you get a 5-volt reading on the standard meter. Adjust R2 until your meter reads full scale.
7. Set the RANGE switch for the 50-volt range and the standard voltmeter to a similar range.
8. Adjust the variable transformer until you get a 50-volt reading on the standard voltmeter. Adjust R3 until your meter reads exactly full scale.

This completes the meter multiplier calibration and you are now ready to plot a scale for your meter. Use the arrangement shown in Fig. 2 and remember that the more calibration points you plot the more accurate your meter will be. You'll find the 0.5-volt range is nonlinear. It must have a separate scale. The other two ranges are very linear and one scale can be used for both. You can mark this scale from 0 to 5 and use a mental multiplier of 10 when you use the 50-volt range. You can also add a wattmeter scale if you like, or you can make a conversion chart like the one in Fig. 3. Unless you have installed new meter dial scales before, better use the calibration chart. A microammeter magnet will attract any iron filings within a radius of several inches. I can speak from first-hand experience here since I nearly ruined a 200-μa meter when I opened it up on my work bench. If you can make a new dial scale and install it, you will certainly have a much nicer instrument.

Using the meter

When you have finished the calibration and are ready to measure an unknown ac voltage (less than 50 volts, of course), merely set the RANGE switch to the highest range and the LOAD RESISTANCE to zero. When you get a reading on the meter, readjust the voltage knob to a lower range until the reading falls near the center of the scale. To measure the voltage across a load, set the LOAD RESISTANCE to give you the desired load. If you want to know how much power is being generated across the load resistor, just take the voltage and load resistance and apply them to the watts-vs-voltage chart. Find the voltage reading along the left side of the chart, go horizontally across until you meet the load resistance line, go straight down and there's the wattage. If you add a wattage scale to your meter, you can read the wattage direct.

For those readers who would like to know how this wattmeter works, it might be well to review Ohm's law. The formula for power in watts is voltage squared divided by resistance. Since all audio equipment operates into either a 4-, 8- or 16-ohm load, we know what the resistance will be. The audio voltmeter will give us the voltage. By working the formula, we will find power in watts. By substituting some numbers in the formula, you will soon see that the wattage across 16 ohms for any given voltage is double for an 8-ohm load and four times for a 4-ohm load. Thus we can calibrate the meter for a 4-ohm load and merely multiply the reading by 2 when using an 8-ohm load or by 4 when using a 16-ohm load.

The time spent building this audio voltmeter-wattmeter will be time well spent. When it is finished, you will have an instrument that would cost many times what this one does if purchased ready made. You will find many other uses for this instrument besides the ones mentioned. END

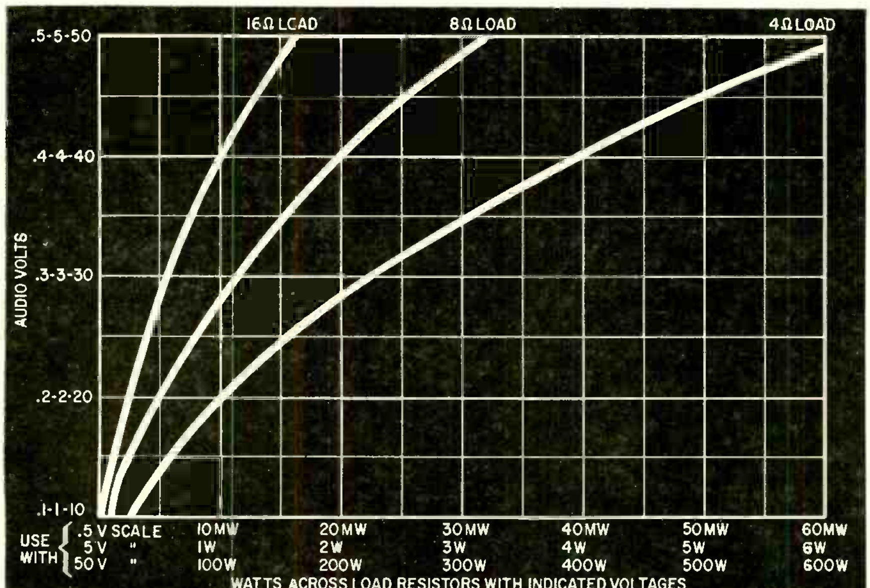


Fig. 3—Conversion chart for wattage. If you add direct-reading wattage scales to your instrument, this chart is not needed.

"It automatically rejects Rock 'N' Roll"

PA SPEAKERS—why so many types?

because they've got a heap of different jobs to fill

By VICTOR BROCINER*

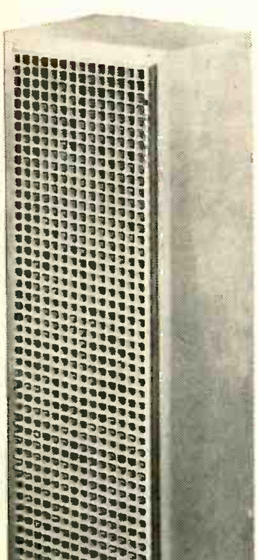
Everyone is acquainted with public-address speakers in one way or another. Whether it be a paging system in an industrial plant or hospital, an announcing speaker cluster at a stadium or a sound-reinforcement system at an open-air concert, the PA speaker is literally all around us. Those of us who have thumbed through a catalog of PA speakers are usually struck by one thought: Why are there so many kinds? Are they used in so many varieties of applications that a large number of types is required? The answer is: "Yes."

PA speakers are usually thought of in connection with voice reproduction, but they are also widely used for background music and sound reinforcement of orchestral music. These uses have different requirements. For voice reproduction, the primary requisite is intelligibility. For sound reinforcement, especially for music, fidelity of reproduction becomes important.

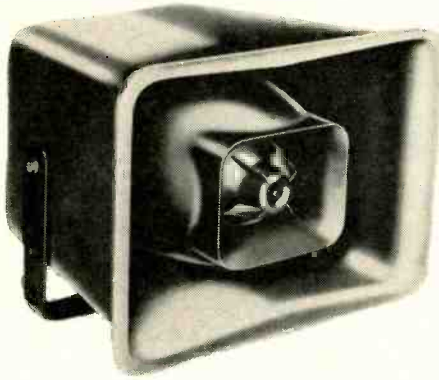
Sound installations vary tremendously in power, depending on the requirements. A paging system in a hospital operates at a very low level, and uses multiple speakers to put the sound where it is needed. Such speakers may be rated at several watts power-handling capacity and are usually operated far below their ratings. At the other extreme, a special super-power speaker used for soundcasting from planes for psychological warfare, warnings and announcements in disaster areas, and similar uses requiring tremendous range—up to several miles—may be used at a power input of 1,200 watts. In between, the horn speakers used at athletic fields, race tracks, stadiums, for announcing purposes, are usually rated at 20 to 60 watts each, and may be used in clusters for more power and greater angular coverage.

Speakers used outdoors must be designed to withstand a wide range of environmental conditions—intense heat and sunlight, rain, snow, sub-freezing temperatures—without deterioration of performance or appearance. Indoor applications do not require a weatherproof design. Then there are special industrial and military requirements:

*Director of Engineering, University Loudspeakers, White Plains, N. Y.

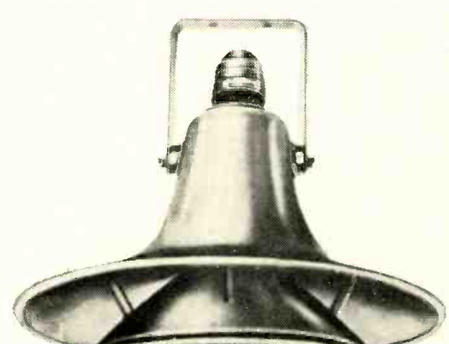


Typical column speaker.



A weatherproof coaxial speaker.

High-power reflex PA speaker.



Radial reflex projector gives 360° coverage.

explosion-proof designs for operation in surroundings containing inflammable gases, vapors and dusts; speakers able to withstand gun blast; speakers that can withstand submersion, and more. Incidentally, there is also a nonindustrial application requiring a speaker that operates under water[1] to provide sound for submerged swimmers.

Another variation in requirements is portability. Although the typical sound installation is fixed, increasing use is developing for portable lecterns and compact, transistorized, battery-operated packaged PA systems for civilian defense, police and fire department use and for communication between power boats.

This, by no means exhaustive review of PA speaker applications, illustrates the many different needs that exist, each with its own requirements that are best met by a speaker specifically designed for that application, rather than a general-purpose unit.

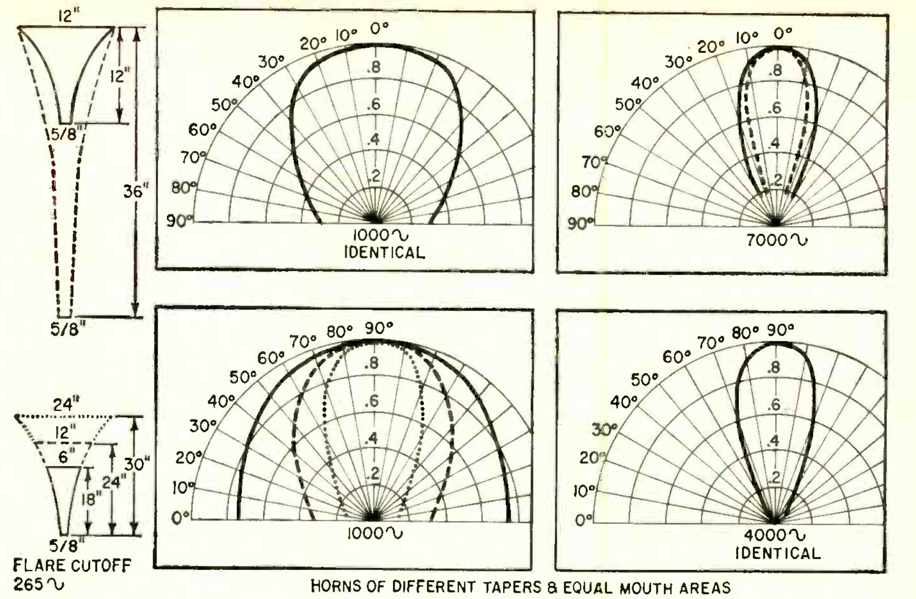


Fig. 1—Typical horn characteristics. The diagrams are for horns of different tapers and equal mouth areas.

PA speaker characteristics

With this background take another look through the PA speaker catalog and note how the many speaker types fit the various applications. One thing becomes obvious at the start: most speakers are horn units. They consist of a horn, usually folded in some way to conserve space, and a driver unit, which may be separate from the horn or built into a complete assembly. Why? Simply because a horn speaker offers these desirable characteristics:

1. High efficiency.
2. Controlled directional response.
3. Operation without additional housing or baffle.

Efficiency: In home reproducing systems, speaker efficiency is virtually ignored. Direct-radiator (cone) speakers have efficiencies around 5% at best. High-compliance types are more likely to be near 1%. But ample amplifier power is available and levels of operation are low—in the order of 0.1 acoustic watt on peaks.

In PA installations, a typical speaker may be called upon to produce a level of 130 db at a distance of 4 feet on axis, which corresponds approximately to an acoustic power output of 10 watts, or 100 times as much as the hi-fi speaker. If the efficiency of the speaker were 5%, a power amplifier rated at 200 watts would be required! Fortunately, horn speakers have efficiencies as high as 30% and more, permitting the use of an amplifier of reasonable rating—35 watts in this case. (Also note that the 200-watt amplifier needed for the direct-radiator speaker would burn out the speaker long before the desired sound output could be attained.)

Even within ranges that are much more reasonable than those of the extreme examples given, efficiency is *economically* important. Approximately, doubling amplifier power from, say, 30 watts to 60 watts costs $40. This gives a 3-db increase of sound-pressure level. The increase is noticeable, but not greatly so. We can get the same increase by selecting a horn speaker with 3 db greater efficiency. This way the cost increase is less than $10, affording more conservative operation of the speaker (because it usually has a higher power rating, too) and less operating and maintenance cost for the amplifier.

Directional response: In an outdoor PA or sound-reinforcement system, it is necessary to direct the sound at the audience and to minimize it in other directions. In this way, all the energy is concentrated where it is wanted, and little is wasted, improving the effective efficiency. Also, high-level sound is prevented from disturbing those in the surrounding area, who may not care to be a captive audience.

Indoors, there is an additional factor that calls for effective direction of the sound—reverberation. Sound impinging on walls, floor and ceiling is reflected many times before finally dying out. As the sound literally bounces many times around the auditorium or hall, successive reflections are delayed appreciably. In a large hall where two walls may be 100 feet apart, the time taken by a sound wave to cover this distance is slightly under 0.1 second—a delay easily detected by the ear. As a result, the listener hears, not only the sound originally received from the source, but also a series of overlapping repetitions of diminishing intensity due to reflections. The effect is a blurring of the original which is not only unpleasant but can also decrease intelligibility greatly. In addition, the feedback of energy to a microphone, if one is used, further increases the effective reverberation, often to the point where a sustained oscillation or howl takes place, making the system unusable.

Sound can be directed as desired through the use of suitably designed horns and *line radiators* or column speakers. A horn concentrates the sound along its central axis, and generally becomes more directional as the frequency increases. The degree of directivity is determined by the size of the horn mouth and by its rate of flare. Fig. 1 shows some typical horn characteristics. A rapidly flaring horn is somewhat less directional than one that tapers gradually for all frequencies except those near the lower limit of its range (called the cutoff frequency). In this lower range, the size of the mouth plays the important part in determining directivity.

By shaping the horn so the taper and mouth dimensions are different in two planes at right angles to each other, it is possible to get entirely different directional patterns in these two planes. This is useful where sound must be spread out widely in the horizontal plane and concentrated in the vertical. The directional patterns of a horn of this type are shown in Fig. 2.

Horns become very bulky if designed to reproduce low frequencies, and few horns for PA applications have to reproduce sound below 100 cycles. (Large low-frequency horns are used in theaters, however.) Even the larger PA horns lose much of their directivity below 500 cycles. This means that the lower frequencies cannot be directed as required. Fortunately, in most installations this is not too important because the higher frequencies cause most of the trouble, such as acoustic feedback to a microphone.

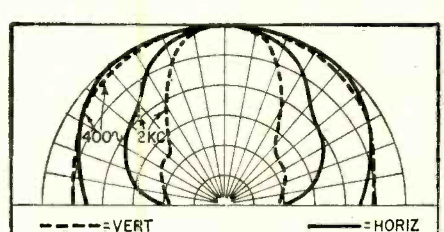


Fig. 2—A rectangular horn's directivity patterns.

[1] "Sub-Marine Sonics," *Audio*, July 1961.

Fig. 3—In-line array of speakers used in line radiator or column speaker.

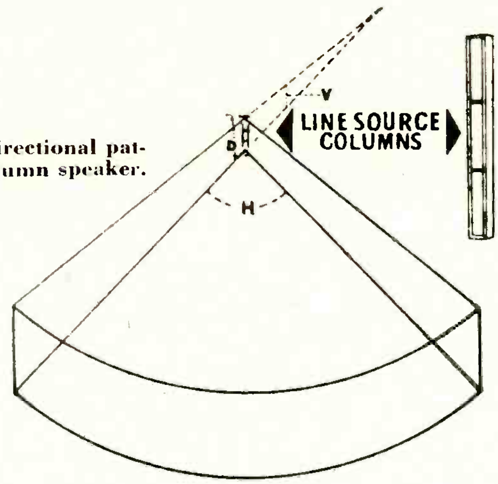


Fig. 4—Directional pattern of column speaker.

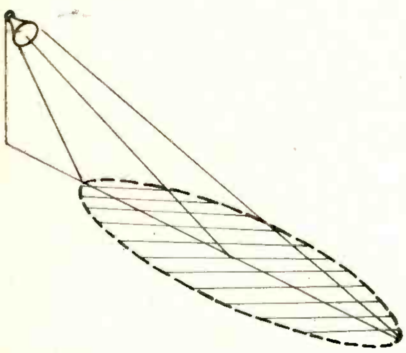


Fig. 5—A horn raised above the audience and tilted downward gives an elliptical distribution pattern.

In surroundings where reverberation is excessive and where, for reasons of fidelity, higher directivity is required in the low-frequency range, the line radiator or column speaker offers a ready solution. It consists essentially of an in-line array of direct-radiator speakers (Fig. 3). One might expect such an arrangement to spread the sound out vertically, but actually the reverse occurs. The directional pattern is wedge-shaped (Fig. 4).

Since a horn speaker consists simply of the horn itself plus a driver unit, the speaker is completely self-contained. The result is a weatherproof, ready-to-operate unit that needs only a suitable mount.

Column speakers do not fall into this category, but they are supplied as complete units that take up relatively little space and are readily mounted in an unobtrusive manner because of their slim cross-section.

Classes of PA speakers

Let's go back to our speaker catalog. The first page is headed "Trumpets and Drivers." Here are driver units with power ratings from 20 to 60 watts. Trumpets, or horns, are of various types. Straight horns are rarely encountered. For all but very few applications they are too space-consuming and clumsy to mount. Most modern horns are reflexed types, in which the horn is folded back on itself to conserve space. Most of the larger horns have round cross-sections. Their distribution angle is relatively small. This type of horn speaker is generally used in an elevated location to cover a specific area. Fig. 5 illustrates such an application. Note that, while the cross-section of the horn and its distribution pattern are circular, the area covered is elongated. The horn acts somewhat like a spotlight in this respect.

In some installations, particularly where the speaker is closer to the audience than in the case just described, it may be necessary or desirable to mount the speaker rather low. To properly cover the audience, the speaker should have a wide angle of coverage horizontally and a narrow angle in the vertical plane to conserve energy and minimize reverberation effects.

Still another requirement for a special directional pattern is for coverage of a large area with a single horn some distance overhead. This is done with a radial trumpet. Because of its symmetrical design, this horn provides 360° coverage.

Within each classification of driver unit and trumpet just reviewed, there is a selection of different models. Drivers vary in terms of frequency response and power-handling capacity. (As already noted, the higher power units also have greater efficiency.) There are also models with built-in matching transformers.

High-frequency performance is better in the more expensive units. It should be kept in mind that a 7,500-cycle range provides excellent intelligibility for voice reproduction, while extending the range to 10,000 cycles and beyond improves naturalness and adds to clarity. The low-frequency performance of the horn-driver combination is usually determined by the horn selected, although some lower-power driver units do have somewhat limited low-frequency capabilities and should not be used with the very largest trumpets.

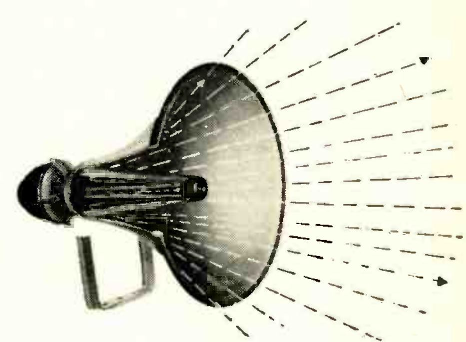
As to horns, each type is available in various sizes. The table in Fig. 6 reveals the variations in performance of the different sizes. The larger horns have extended low-frequency response, and also are more directional. Selection of the directional pattern has already been dealt with; low-frequency response is, of course, desirable for music reproduction and unnecessary or even undesirable for maximum intelligibility of speech.

Public-address horns with rectangular mouths may be folded in different ways. While some of the variations are determined by different manufacturing techniques, the exact method of folding can have considerable bearing on the smoothness of frequency response and on range at the high-frequency end of the spectrum.

Turning to the next page of our imaginary catalog, we see "Paging, Talk-Back, Multi-duty Speakers." These appear to be miniature editions of the types we have just been reviewing. Essentially, they are. Here, as for the larger speakers, there is a choice of shapes, corresponding to different distribution patterns. There are speakers of round cross-section, those with roughly rectangular mouths—sometimes referred to as "cobra" horns—and radial types for 360° distribution. Most of these units have built-in drivers for maximum compactness. One variant is a flanged unit for flush mounting in walls or sheet-metal housings. This one is used extensively in trains.

Because they are smaller than the PA trumpets, the low-frequency range is limited to the 250- to 350-cycle region, and some of the ultra-compact units only go down to 500 cycles. This is entirely adequate low-frequency response for speech and low-level background music. After all, the average table-model radio is not much better than this, not to mention transistor portables.

Typical power ratings are 5–10 watts. However, since there is also need for compact speakers with higher power ratings, some of the units have power-



LOW-FREQUENCY CUTOFF	85 cycles	120 cycles	150 cycles	200 cycles
SOUND DISTRIBUTION	65°	75°	85°	95°
AIR-COLUMN LENGTH	6½ ft	4½ ft	3½ ft	2½ ft
HORN LENGTH	28 in	19 in	15¾ in	12 in
BELL DIAMETER	31 in	25¾ in	20⅜ in	16¼ in

Fig. 6—Horn performance varies according to its length and bell diameter.

handling capacities as high as 25 watts. Special-purpose units are available up to 50 watts, for such applications as electronic sirens. Still other models are for use under conditions of steam, dampness, dust, chemicals and even submergence in water. The last condition applies for speakers used on ship decks, where speakers must withstand periodic immersion, after which they must drain and resume operation. Rugged construction is a necessity here.

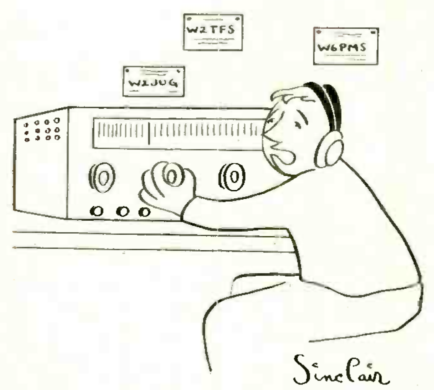
The next category of PA speakers to appear is "weatherproof, *High-Fidelity*." These are actually two-way systems, the low frequencies being reproduced by a horn-loaded woofer 6 to 12 inches in diameter. The low-frequency horns, which may be of metal or molded fiberglas, are re-entrant, folded types which also constitute the outer housing. The low-frequency range depends on the size. The most compact unit, only ¾ cubic foot in volume, goes down to 150 cycles while the largest, almost a yard in diameter, reproduces 50 cycles. The tweeters used in these systems go out to 15,000 cycles, amply justifying the "hi-fi" in the speaker designation. The wide range and low distortion of these units indicate their use for outdoor music reproduction and where naturalness in speech reinforcement is required in addition to intelligibility.

Super-power speakers have large horns and are driven by a multiplicity of driver units, the number ranging from 4 to 24, affording a power range from 240 to 1,200 watts.

Explosion-proof horn units have special, reinforced housings, conduit entrance and blast filters in their throats to prevent or contain explosions that might be triggered by sparks in the voice coil of a speaker operated where flammable liquids, gases and dusts are present.

Underwater speakers are designed for operation submerged, to provide sound for underwater swimmers. They are used in formation swimming, underwater ballets, scuba-diving instruction and in many private swimming pools for entertainment.

Apparently, then, the many models of PA speakers that are available, have ample justification in terms of the requirements of their many applications. END



Must be some kind of a nut. He just keeps tapping, "Hi, hi, hi . . ."

(If you don't get this see page 6, Radio-Electronics, February 1962)

WHAT'S YOUR EQ?

It's stumper time again. Here are three little beauties that will give you a run for the money. They may look simple, but double-check your answers before you say you've solved them. For those that get stuck, or think that it just can't be done, see the answers next month. If you've got an interesting or unusual answer send it to us. We are getting so many letters we can't answer individual ones, but we'll print the more interesting solutions (the ones the original authors never thought of). Also, we're in the market for puzzlers and will pay $10 and up for each one accepted. Write to EQ Editor, Radio-Electronics, 154 West 14th St., New York, N. Y.

For answers to last month's puzzle see page 73.

Half Speed TV

The horizontal oscillator wouldn't lock in, or come anywhere near it. Some previous "technician" (Ha!) had tied pins 5 and 2 of the 6AL5 together! Apparently this brought the oscillator somewhere within range, but she sure didn't hold for long. Under the test conditions shown in Fig. 1 (ringing coil strapped out, sync grounded), the waveform shown in Fig. 2 was found on pins 2 and 4 of the 6SN7 horizontal oscillator. *All dc voltages were exactly as shown on the schematic!*

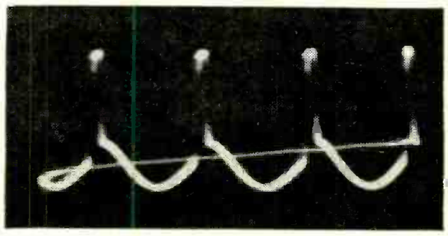


Fig. 2—Waveform found on pin 2 and pin 4 of Du Mont horizontal oscillator. Looks as if there is something wrong here, what? Too many wiggles for the number of spikes!

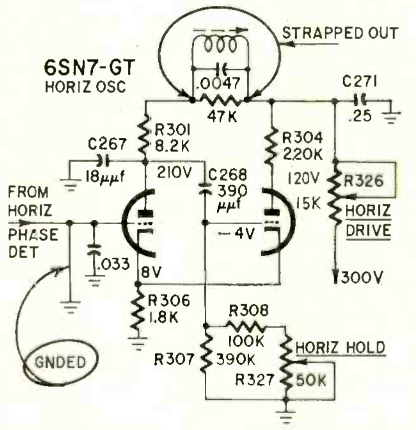
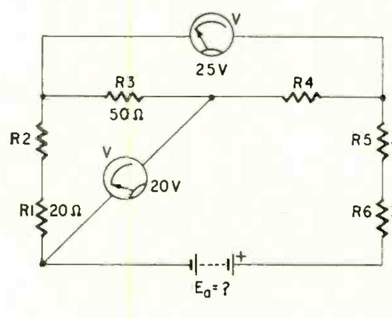


Fig. 1—Schematic of Du Mont RA-166 horizontal oscillator section.

From the fact that the oscillator would make a dual picture on the screen, it was obviously running at exactly half-speed (7875 cycles), but why? Doesn't it seem that a defective part such as a leaky capacitor or drifted resistor anywhere in the waveshaping circuits would affect the dc voltages? —*Jack Darr*

Applied Voltage

Here is a simple series circuit. Two voltmeters were hooked across the circuit and the readings shown were obtained. What is the applied voltage (E_a)?—*John M. Resch*



What's the Component?

An impoverished experimenter owns only a voltohmmeter, no other test equipment. He is about to check continuity on a valuable thermistor when he recalls that if more than 2 volts are applied the thermistor will burn out. He does not know the battery voltages used on the resistance ranges of the meter. Rather than open his meter, he picks up a common electrical component and with it determines whether it is safe to apply the thermistor directly to the meter leads. What is the component? (It is not a resistor.)—*Richard P. Jones*

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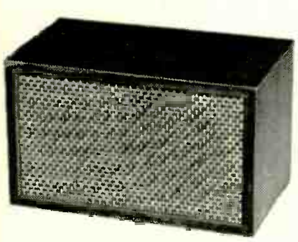

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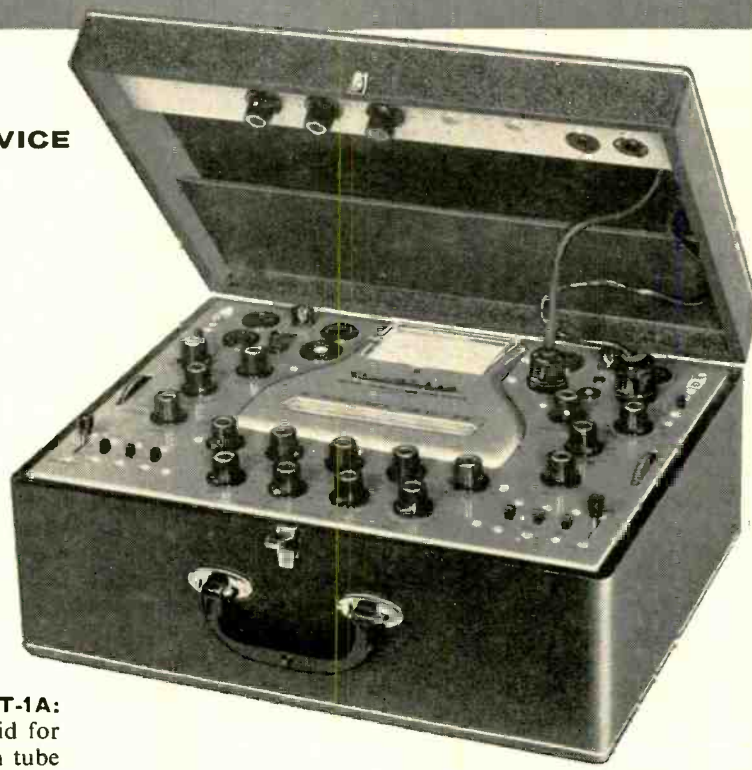

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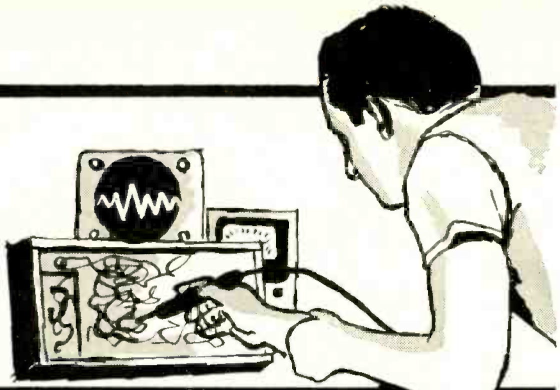


This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.

We've changed our target a little and are no longer restricted to TV. Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here. So if you have a service problem, send it here. We'll do our very best to help you solve it.

HORIZONTAL BENDING CAN BE ONE OF the most annoying problems in TV service. Of course, it can also be one of the simplest. But if you've got a good-sized bend in the picture, it's usually easy to track down.

You can use a scope to hunt for this but, if there is a very definite, permanent bend in the picture, you can find it just about as quickly by using the pattern on the screen. You can do it with a broadcast signal, but it'll be much easier if you use some kind of fixed pattern, especially one with plenty of vertical lines. They point up any weaving or bending in the picture much quicker than the moving pattern you'd have with a program picture.

What causes this? Usually it's ac getting into the horizontal oscillator or the horizontal afc. When you start talking about ac getting into circuits, you've got two kinds: 60 cycles and 120 cycles. We get 60-cycle feed from heater–cathode leakage in tubes or by direct leakage across a low-resistance path somewhere in the circuit—grease smears on a P-C board, carbonized paths due to flash-overs, and that sort of thing. We'll tell you about one real dandy later. So the first thing to check here would be all tubes associated with the horizontal circuit—oscillator, sync or even the output tube—by replacement. If this doesn't help, then start checking for leakage paths.

The typical pattern of this kind of trouble is shown in Fig. 1. This is really a sort of mild case. Notice that there is only one main pull in the picture—at the bottom. This can appear at different locations up or down the raster, though. It can be at the top or middle. As long as there is only one bend in the picture, expect 60-cycle leakage.

Fig. 2 shows a much more severe case. The strip across the upper half of the picture is actually the vertical blanking bar of our pattern generator, so that there is really only a single bend bar in this picture. Here the 60-cycle feedback was so strong that it upset the vertical sync too.

Incidentally, if you do suspect leakage from adjacent parts in a P-C chassis, try lifting or cutting one of the suspected conductors, and replacing it temporarily with a short piece of insulated wire. If this clears up the trouble, cut out the whole P-C conductor and leave the wire in there.

Our other problem, 120-cycle leakage, is caused by insufficient capacitance in the power supply B-plus filter. The quickest way to catch this is to bridge the filter capacitors with a good unit. One of the little substitution boxes made for just this purpose is very handy.

Fig. 3 shows a typical 120-cycle wiggle pattern. Note the double wiggles in the pattern, one at the top and the other at the bottom. This particular one is rather unusual. Its cause was 120-cycle leakage into the horizontal afc. (Possible because the voltage-divider circuit used in this set returned the afc to B-plus and so on.) At any rate, this can be one of the easiest types to fix. When a good capacitor is shunted across the defective one, the picture straightens up with an almost audible snap. If you get a funny one, try tracing around the B-plus network with a low-capacitance probe and your scope. Don't overlook anything that you see in the way of hash, whether it happens to be 60 cycles, 120 cycles or any other frequency. Anything unusual floating around on B-plus lines usually means trouble.

One case like this was very odd. An early-model P-C set wouldn't hold horizontally unless it was left on for at least an hour. In the shop, it worked perfectly. After much testing and head scratching, the trouble was found. Ac leakage from a heater point with about 60–70 volts on it, into the afc diodes, through moisture on the P-C board. The trouble was cured by jumping the ac voltage across the sensitive area, on a piece of wire, and waterproofing the P-C board more thoroughly.

Agc trouble

I've contrast control trouble with a G-E 14T2. I can't get anything but a whiteout or a severe overload condition, with complete loss of sync. If I disconnect the agc and use a variable dc bias, I can get either the overload or a normal picture. I've checked out the agc circuit and it's OK.

Voltage on the agc varies from −3.5 to more than −20. When it's high, I get the whiteout. If I turn the contrast control to lower this negative

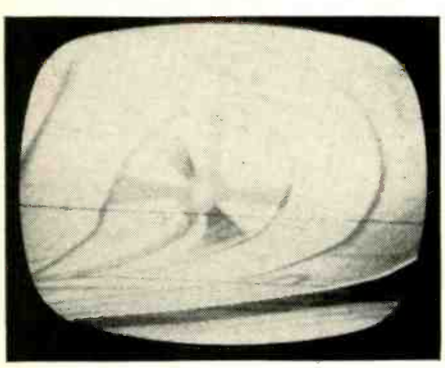


Fig. 1—A mild case of horizontal wiggles. This is caused by a 60-cycle signal as there is only one bend.

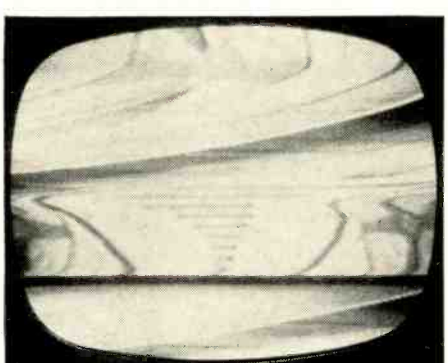


Fig. 2—Severe case of 60-cycle wiggles. There is actually only one bend in this picture. The stripe in the middle is the vertical blanking bar. The 60-cycle signal was so strong that vertical sync was upset too.

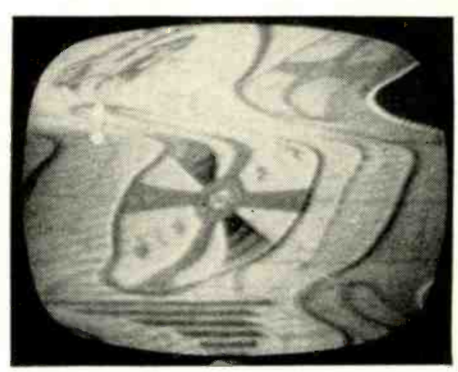


Fig. 3—The two bends in this picture indicate 120-cycle wiggle. It was caused by leakage into the horizontal afc circuit.

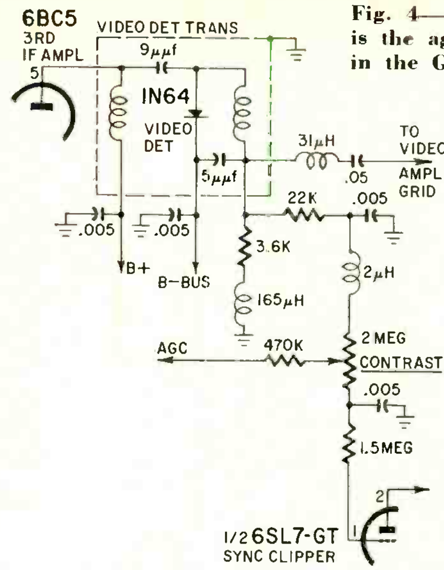
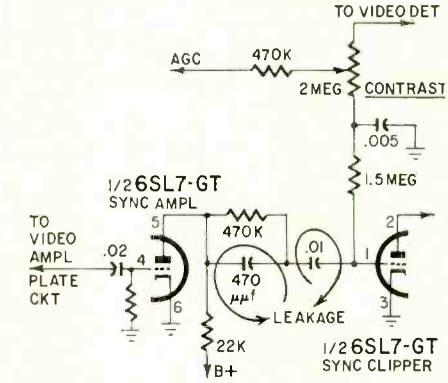


Fig. 4—The video detector is the agc source in the G-E 14T2.

Fig. 5—Agc, contrast and sync-clipper stages of the G-E 14T2.



voltage, the voltage on the grid of the sync clipper drops way down and the overload shows up. I'm not sure how the agc is obtained in this chassis, as this is the first one I've ever seen with the contrast control in the agc line.—B. L., Newark, N. J.

You're in the right place. From the symptoms, this would almost have to be agc trouble. Since you can go from a whiteout to an overload you have enough range on the control. But you ought to have a pretty wide place in the middle of the range where you can get a good picture with good sound. Your basic trouble here is not enough range.

In this circuit, the contrast control is actually a bias control for rf and video if stages. It acts as an agc control at the same time and has confused lots of people, including me. The source of the agc in this circuit is the video detector. The dc voltage is taken off between the detector output and the video grid (Fig. 4).

The major trouble seems to lie around the sync clipper stage or the sync amplifier/sync separator. As you can see, the contrast control returns directly to the grid of the sync clipper stage. Since one of your symptoms is a loss of sync, I'd go into that stage and look around a little (Fig. 5). I'd say that you're going to find a leaky coupling capacitor somewhere in there upsetting the voltage relationship, possibly one of the two circled capacitors in Fig. 5.

It wouldn't hurt to check all the plate resistors in those stages too. A drift in value there would give you trouble. Warm them with a soldering iron and read the voltages. If you get a change, replace the resistor.

Pix-tube conversion

I've an RCA KCS-34B chassis that uses a 12LP4 kinescope. I would like to convert it to a 17-inch kinescope. Is this feasible and, if so, what would it entail?—J. C., Providence, R. I.

This particular chassis should be convertible without too much trouble if you use the right replacement tube. Your original 12LP4 has a 54° deflection angle and magnetic focus. If you choose a new tube with a 70° deflection angle, it will not be too hard to change over. For example, the 17BP4 is a 70° tube, with magnetic focus, and requires only 12,000 volts on the ultor. By tuning up your horizontal output system and getting maximum efficiency out of it, you should be able to sweep the new tube with the original parts; there is not too much difference in the deflection angle.

Be sure to replace the original double-ion-trap magnet with a single-magnet type. One of the adjustable magnets made by Miller and others is a good bet here. Adjust for maximum brightness, refocus, then readjust the beam bender.

Tuner replacement

I've a Stromberg-Carlson model KV 22A that has a combination vhf/uhf tuner. I wish to replace it with a Standard Coil Guided-Grid tuner, GG 4220. I have no need for the uhf facilities. How do I connect the new tuner into the set, and what steps are necessary to align it to the circuit? What B-plus voltage do I need?—F. O. New York, N. Y.

This should be reasonably simple, aside from the purely mechanical difficulties you'll find in mounting *any* kind of replacement tuner. The present if coil in the tuner is aligned at 45.75 mc. The output if coil in the Standard Coil tuner is aligned at 43.5 mc. This is specified in the installation instructions you'll get with the new tuner.

To align the new tuner after installation, tune in a picture and check response of both sound and picture. if a sweep generator and scope are available, run a curve on the if response, feeding the signal into a split (ungrounded) tube shield slipped over the mixer tube. Your present second video if transformer is aligned at 43.5 mc, so I would suggest aligning the tuner if output coil for the frequency specified for the original, 45.75 mc. It will reach this frequency with ease; run the slug *outward*. Set the if response curve to place the 45.75-mc marker approximately 50% down on the high-frequency side of the curve. If the rest of the if's are still in alignment, this should amount to only a touchup job.

As to the voltages, use 125 for the mixer, as before. The dropping resistor for the rf amplifier plate might be increased from 3,300 to about 10,000 ohms at 1 watt. The voltages required for the tuner will also be specified in the installation instructions and service data you'll get with it. It would be a good idea to replace the .004-μf bypass capacitor that follows the dropping resistor, in case it is leaky.

No video or horizontal hold

I've a G-E 17T20, the U-series on the bench with no horizontal hold and no video to speak of. The voltages are all off around the video amplifier. I get only about 40 volts on the plate and 115 on the screen.—W. H., Irving, Tex.

You've an unusual combination of troubles here, I think. But it has happened to me on this same chassis. The 4,000-ohm video amplifier plate resistor is open and the 0.1-μf video coupling capacitor is shorted (Fig. 6). There are other possibilities, of course, such as the 4,000-ohm resistor being away above normal value, but the symptoms indicate this double trouble.

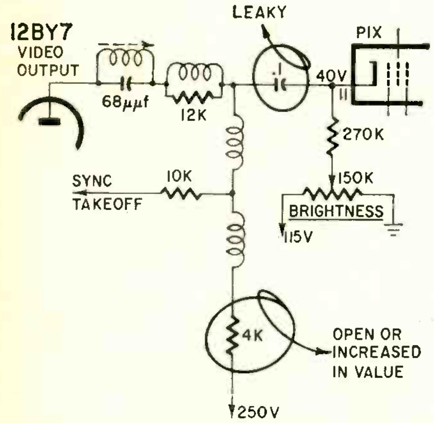


Fig. 6—Double trouble causes loss of video and sync as well as low plate voltage.

Check it and find out which it is. In this case, your "plate voltage" is leaking through from the brightness control. The horizontal hold action is bad because of the loss of sync caused by the very low video level.

Horizontal instability

Because of my big mouth I'm in trouble! I said I'd fix this set! It is very unstable horizontally, with double images on some channels and Christmas trees on others.—H. P., Orchard Lake, Mich.

Your horizontal trouble is caused by a feedback voltage from somewhere—power supply or the vertical oscillator—getting into the horizontal afc. Check all B-plus lines around the horizontal oscillator with a scope, then run a complete readjustment on it.

Also, check electrolytics in the power supply, especially the output and boost filters. END

EQUIPMENT REPORT

flyback & yoke checker

Portable transistorized tester spots bad flybacks and yokes in a hurry

By WAYNE LEMONS

QUITE A LOT OF RATHER UNUSUAL CIRcuitry is incorporated in this DOSS model D150 checker. It has a transistorized power supply, two relaxation oscillators, keyed damped-wave readout, and a unique neon bridge null indicator called a "Neon-O-Meter" that is almost a story in itself.

The power supply delivers about 100 volts negative, measured at the output of silicon diode D1 in Fig. 1. The frequency of the power oscillator circuit is approximately 15,000 cycles. C1 filters the ripple from the output.

A relaxation oscillator—R10, C8, and NE3—is used to pulse the inductance under test. This pulsing causes the inductance to "ring" producing a damped wave as in Fig. 2-a if the inductor is good. A method of reading the damped wave output will give a good indication of the condition of the inductor. But since a partially shorted inductor will often ring for a cycle or two after being excited by a strong pulse, Fig. 2-b, it is essential that the readout circuit does not respond to the initial pulse nor for an instant thereafter.

Arranged in the common end of NE3 is an RC network made up of R8 and C4 (flyback test). So when NE3 fires, a negative voltage is established on its lower side. This back-biases (keys) D2 to prevent a read-out voltage of the initial pulse and the first few cycles of the damped wave. When the back bias decays to a low value, the damped wave is rectified by D2. This charges C5 in a positive direction and

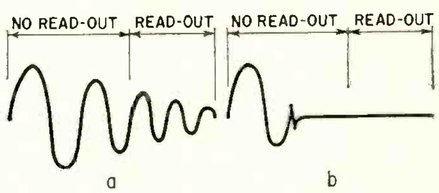


Fig. 2—Wave patterns produced by pulsing good (a) and defective (b) coil. By damping out the beginning of the wave, errors in readout are eliminated.

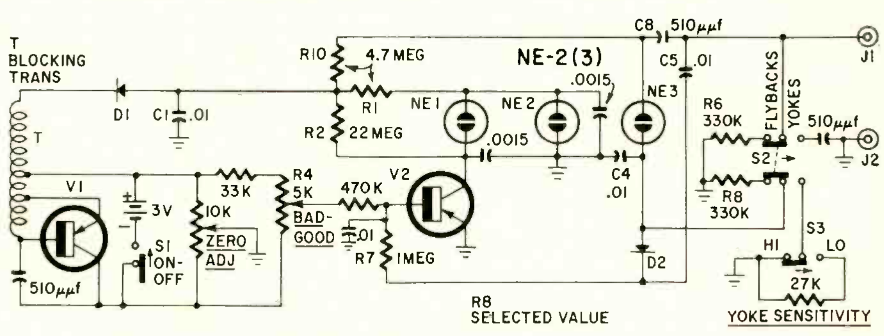
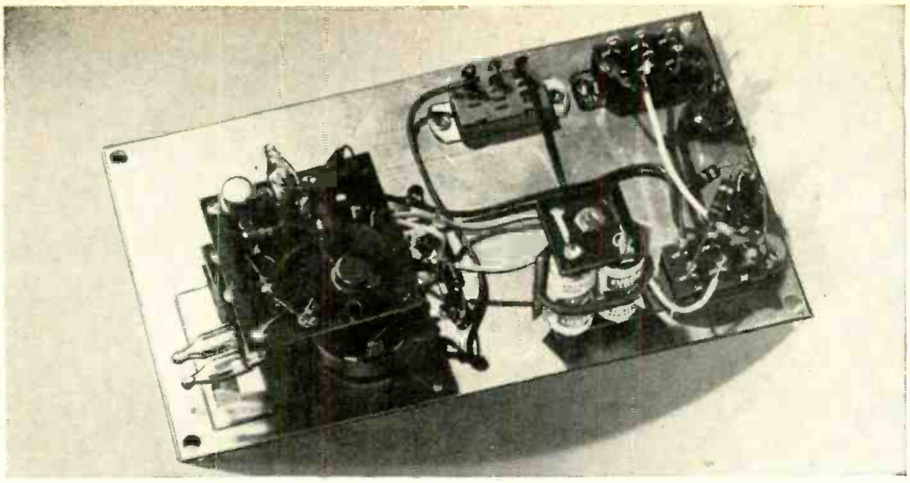


Fig. 1—Complete circuit of the Doss D-150 flyback and yoke checker.



All components are fastened to the front panel.

the resultant voltage is fed to V2's base through R7.

Keying the circuit this way adds to the sensitivity of the instrument since wide ranges of inductance are pretty well equalized and there is not much variation in where the GOOD reading occurs on the dial with either high or low inductances. A 330,000-ohm resistor (R6) is placed across the winding to further equalize the read-out.

If the inductance has a shorted turn, the damped wave is short or nonexistent. Therefore the keyed circuit will have nothing to rectify and no charge will be developed on C5.

The readout circuit

R1, NE1, NE2 and C9 constitute another 60-cycle (approximate) relaxation oscillator, but this oscillator has an entirely different purpose. But first let's look at the overall readout circuitry.

Note that the bottom end of NE1 is tied to the collector of transistor V2 which in turn is tied to −100 volts through a 22-megohm resistor (R2). The bottom end of NE2 is tied to ground. The exact ionization point of NE-2 neons varies as much as 10 to 15 volts. This fact is used here. A lamp with an ionization voltage about 3 volts less than NE2 is used for NE1. With V2 forward biased (negative on base) the collector voltage is almost zero because of the drop through R2 and the neon with the lowest ionization point (NE1) will fire. When it fires, the voltage drop across R1 prevents NE2 from firing.

However, as the main dial of the bridge (R4) is adjusted to provide a zero or slightly positive voltage to V2's base, the transistor is cut off and the collector voltage rises to about 10 to 15 volts negative. This lowers the voltage across NE1 and turns NE1 off and NE2 on. But this is only because of the 60-cycle relaxation oscillation.

Since NE1 (or NE2) is being turned off and on about 60 times a second, the neon with the most voltage across it will ionize and "lock out" the other one because of the voltage drop across R1. If it were not for the relaxation oscillation, however, NE1 would ionize (with zero transistor collector voltage) and would not relinquish its hold on the circuit unless the voltage across it were lowered enough to completely extinguish it. With this circuit, the lamps switch with less than a half volt change in collector voltage at the critical crossover point. Therefore, it can be used as a bridge null indication.

NE1, NE2 and V2 are selected as a group in production.

A positive voltage developed by the charge on C5 will bias V2 to cutoff and R4, the bridge dial will have to be rotated up into the GOOD part of the scale in order to again balance the bridge. If, however, there is no rectified voltage through R7, the bridge will balance in the BAD part of the scale.

Yoke test

The same test circuit is used except that the keying signal is unnecessary because comparative inductance readings are made. (A keying resistor is used but only as a convenient means of adjusting the yoke sensitivity measurement).

Yoke windings are measured separately. If you are measuring a horizontal yoke, you measure one half and then compare with the other half (Fig. 3). The two sides should be identical. This comparative test is a good one since the instrument does not have to be calibrated for different yoke inductances. Also, it is almost impossible for a yoke to develop an identical fault in each half of the winding. END

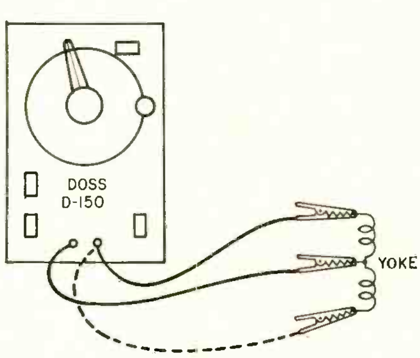


Fig. 3—Compare each half of deflection yoke for identical readings. They will not be the same if either half has a defect.

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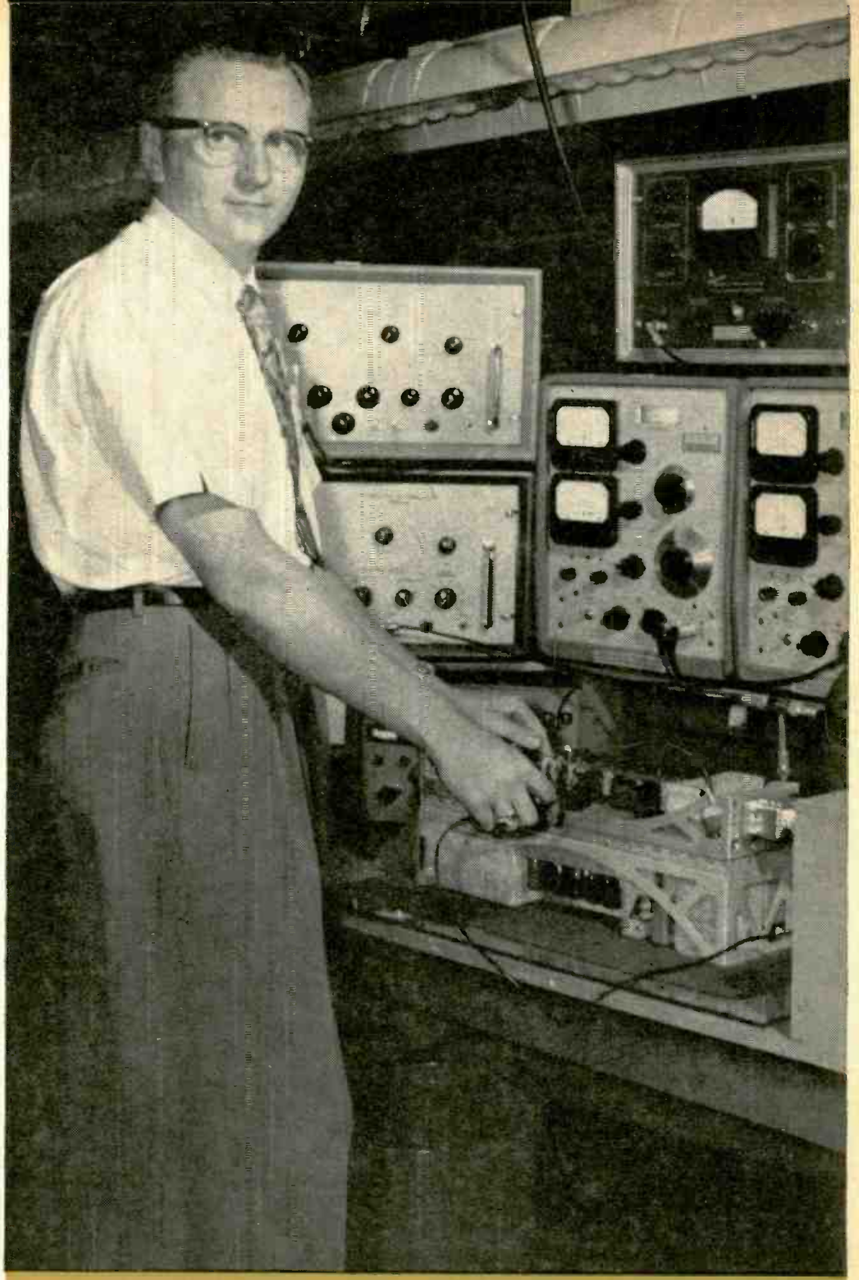

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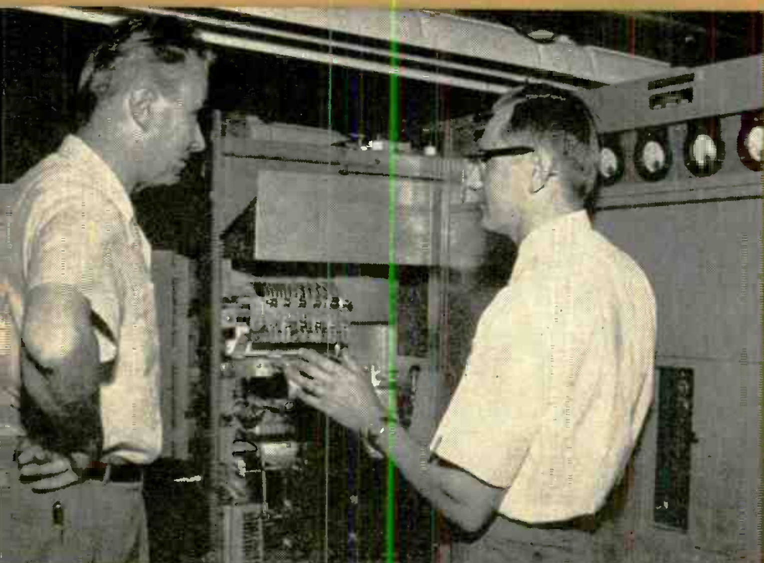

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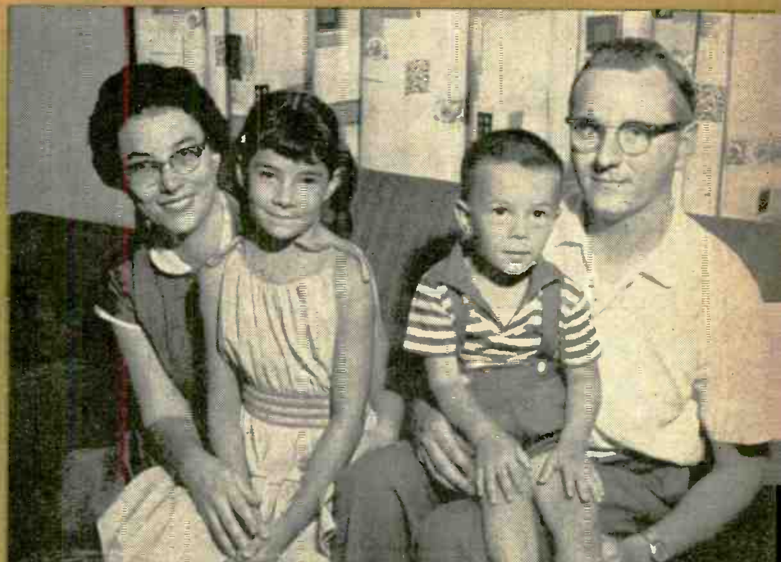

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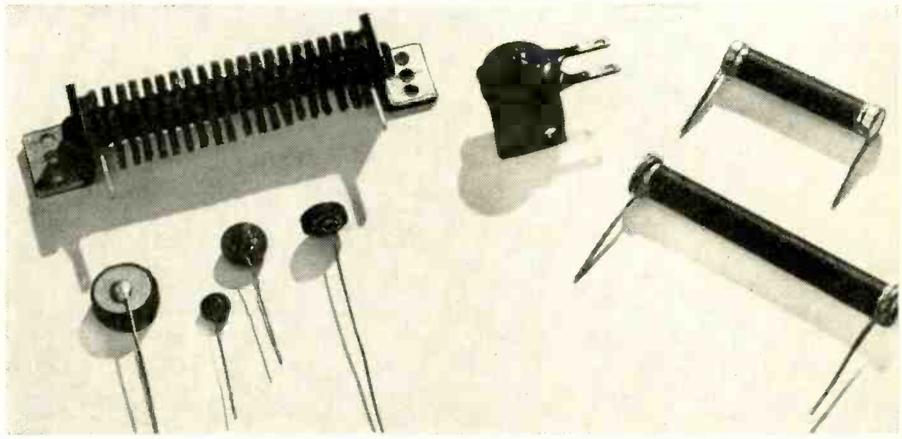
Thermistors in Industry

What is a thermistor?
How does it work?
How is it used?



Thermistors come in a variety of sizes and shapes. *Carborundum Co.*

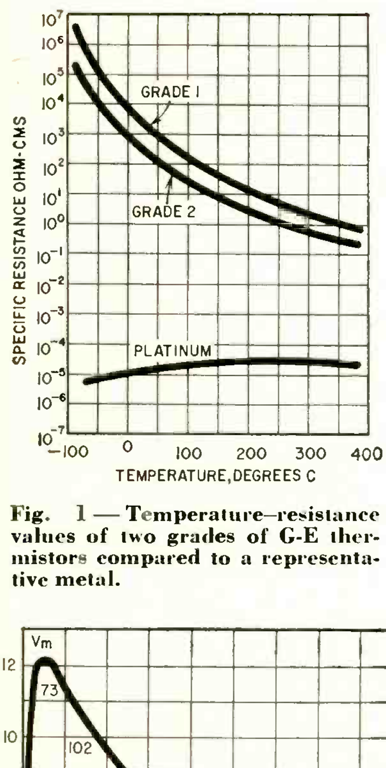
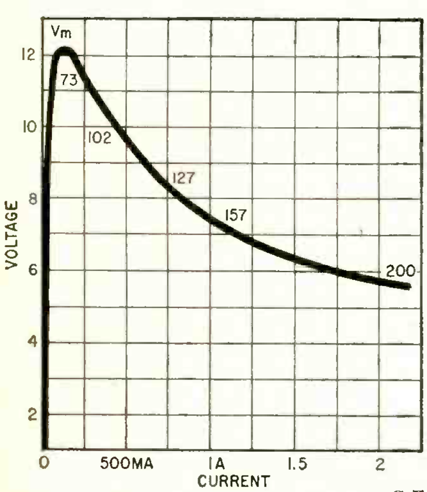


Fig. 1 — Temperature–resistance values of two grades of G-E thermistors compared to a representative metal.



G-E

Fig. 2—Static thermistor characteristics. Numbers along curve represent temperature.

By TOM JASKI

The name thermistor usually brings up an image of small beads used for temperature compensation in transistor circuits, or as sensitive temperature detectors. These are only two of hundreds of applications. Thermistors can compensate for changes in gain, frequency or resistance; can be used to telemeter pressure, temperature and other information. Still other uses will be covered here.

First, what are thermistors? They are special resistors with built-in temperature–resistance characteristics. Sometimes these are positive—when the temperature increases, the resistance increases sharply. More often, they have negative temperature coefficients. When the temperature increases, their resistance decreases. The change of resistance with change in temperature is accurately controlled during the manufacturing process.

Most modern thermistors are made of sintered ceramic material, with leads inserted or silver contacts applied to the surface. Their shape varies from almost microscopically small beads to large thick washer and tubular shapes. The Globar resistor in your series-string TV set is also a thermistor. It prevents application of full line voltage to cold tube heaters. As the current flows through this globar, its temperature increases, lowering its resistance and finally allowing full heater voltage in the tubes.

Thermistors are made by extruding small blobs of a pastelike material into the desired shapes and then sintering at high temperatures. The paste consists of several metallic oxides and a binder. The sintering takes place under rigidly controlled atmospheric conditions. The resulting ceramic material can be classified as a semiconductor.

The composition of the paste determines the temperature characteristics of the thermistors. The thermistor materials most often used are oxides of manganese, nickel and cobalt. Uranium oxide has been used, as have the oxides of tin, copper, titanium, magnesium and iron.

Some thermistors have built-in heater wires, and are used to measure current through the heater by checking the resistance of the ceramic bead. Others have the bead sealed in a glass covering, and some have been mounted in specially constructed quartz bulbs for use in pyrometry (measuring heat at a distance). They can be as large as a half dollar or as small or smaller than the dot over the i on this printed page.

Not only the specially sintered oxide combinations show thermistorlike qualities. Many other known substances also have peculiar temperature–resistance characteristics.

Such common chemicals as sulfuric acid, hydrochloric acid, cuprous chloride and ethyl alcohol show a drastic resistance change with increasing temperature. All these substances have negative temperature coefficients. Stable thermistors were made from them at the National Bureau of Standards by adding gelatin and waterglass.

Thermistor characteristics

Fig. 1 shows typical characteristics of the ceramic type of thermistor material as compared with platinum wire, a metal with a very low temperature coefficient. The characteristic in Fig. 1 is nonlinear.

Just like other nonlinear devices, thermistors are considered in terms of static and dynamic characteristics. Fig. 2 shows a typical static thermistor characteristic—the voltage–current curve. Note that at first current increases with increasing voltage and, apart from the fact that the curve is not exactly linear, the thermistor almost follows Ohm's law. At the top of the curve, the so-called "self-heat" point is reached. This is where the nonlinear traits begin to be useful. The self-heat point is where the thermistor stabilizes with minimum current. After this point is reached, more current will flow even though the voltage across the thermis-

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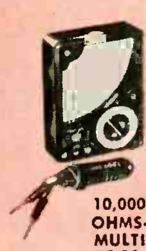

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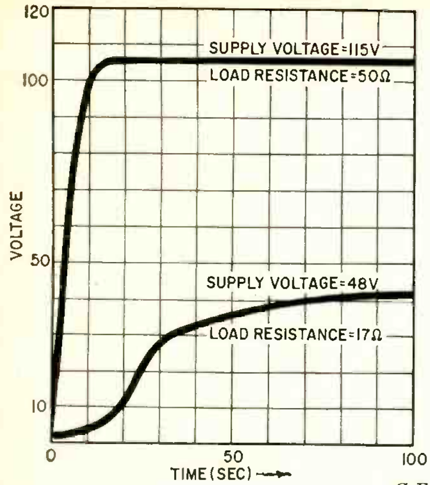
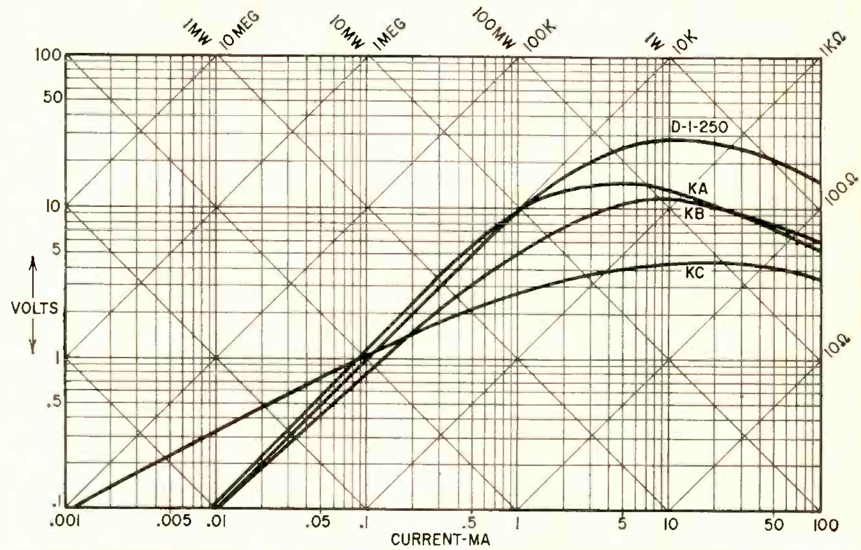


G-E

Fig. 3—Dynamic thermistor characteristics.

Fig. 4—From thermistor curves we can read resistance as well as power dissipation. Area to the left of and above curves is excessive dissipation. Note that a linear resistance would follow the diagonal.



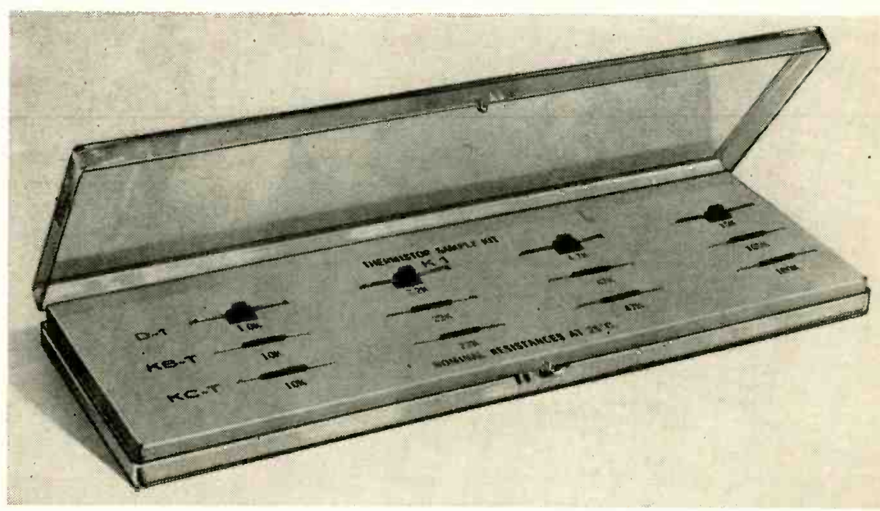
NOTES - ASCENDING PORTION OF EI CURVES MAY BE ADJUSTED FOR COLD RESISTANCE BY DISPLACING CURVE ON A 45° (CONSTANT POWER) LINE. CURVES ARE FOR TYPICAL 10KΩ UNITS, TYPE KC MEASURED AT 1 VOLT.

Kidde

tor decreases—the negative temperature coefficient is now operating.

As the name implies, static characteristics deal with steady-state conditions in which the parameters do not vary. In using thermistors we may have to deal more often with dynamic characteristics. For example, the change of current with applied voltage in terms of time. Fig. 3 shows a typical dynamic thermistor characteristic. The curves are for the same thermistor, but with different applied voltages and loads (in series with the thermistor). From this set of curves we can note one important fact about thermistors—it takes time to heat a thermistor. How much time depends on the material from which it is made, the material surrounding the thermistor bead and, most of all, the size of the bead. On the other hand, we must also consider the dissipation capabilities of the thermistor. The larger the thermistor, generally the more wattage the device can handle.

Since thermistor characteristics deal with current and voltage, factors which can give us a measure of resistance as well as power, the characteristic curves for thermistors look like those in Fig. 4. They show voltage, current, resistance and power. These curves say nothing about time, and for this another curve must be given, similar to those in Fig. 3.



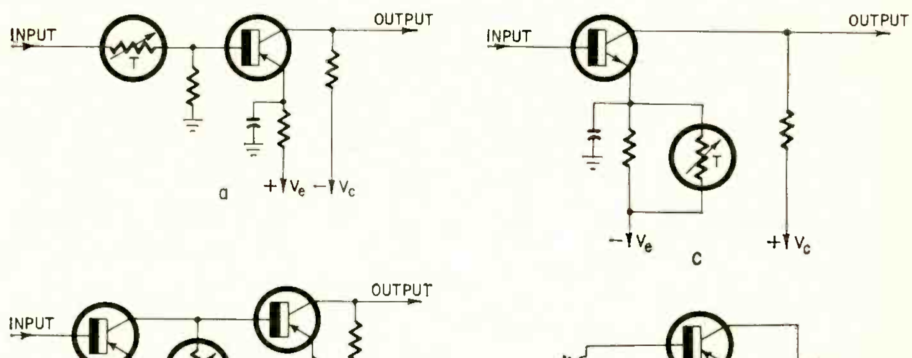
Kidde

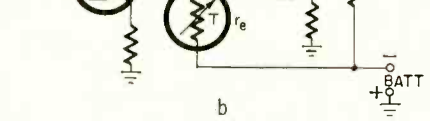
To allow engineers to experiment with new applications for thermistors, many companies sell experimental kits like this one.

Where thermistors are used

Thermistor applications could be a long story, but a few examples will illustrate the versatility of these little gadgets. Fig. 5 shows typical uses in transistor circuits. In Fig. 5-a the thermistor compensates for loss of gain with a rise in temperature. Obviously the thermistor must be placed so its temperature rises with the transistor's, thus lowering its resistance and compensating for the loss in transistor gain. Proper transistor selection can produce very close gain control with temperature.

Fig. 5-b shows a thermistor regulating the output of a dc amplifier, by controlling the output transistor bias. In Fig. 5-c the operating point of the transistor changes with a change in





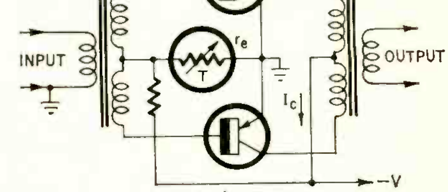


Fig. 5—Typical applications of thermistors in transistor circuits to compensate for temperature-caused changes in transistor characteristics.

temperature, and Fig. 5-d is a fairly familiar circuit for stabilizing a push-pull output circuit. In this circuit the thermistor holds the idling current of the transistors constant with changes in temperature.

Another interesting way to use thermistors for temperature compensation is to select one which has exactly the opposite characteristic of, say, copper wire over a certain operating range. Thus the current through a coil of copper wire can be kept constant. Precision circuits are often set up in this manner, making them relatively insensitive to temperature changes. Or we can use thermistors another way, seemingly creating more circuit differences. Fig. 6 is a circuit diagram of an expanded-scale meter. This is done with voltage-dependent resistors (VDR's). These are resistors which decrease in resistance with an increase in applied voltage.

VDR's have one problem. They have a relatively large negative temperature coefficient. To compensate for this, the meter circuit must also be shunted by something with a negative temperature coefficient. For this reason the circuit has carbon resistors in series with thermistors. The thermistors are selected so that, in combination with the carbon-resistor shunts, they make up exactly for the changes in VDR's caused by variations in ambient temperature. Fig. 7 shows an opposite application, how a thermistor is used in the Simpson thermometer to make the instrument insensitive to ambient temperature changes. A second thermistor is in the meter circuit while the other thermistor does the job in the bridge circuit, thus maintaining meter sensitivity and accuracy.

One very common thermistor application is as the temperature-sensing element for recording temperature. Here the thermistor can be used directly in a bridge circuit, and can be read with great accuracy. Temperature changes involve the exchange of energy. This is a form of electromagnetic radiation. Infrared, heat radiated by a glowing body, is also electromagnetic radiation. It has the same characteristics as radio waves or visible light, but at another part of the frequency spectrum. Thus thermistors can also be used to measure energy at other portions of the electromagnetic spectrum, since they are not at all frequency-sensitive. For example, thermistors are used as power transducers in microwave circuits. For this purpose, a thermistor is mounted inside waveguides and special coaxial mounts. It is then connected to a sensitive power bridge, basically a refined type of Wheatstone bridge circuit, which accurately measures the change of resistance in the thermistor with impinging rf energy.

All the examples cited so far deal with energy absorption by the thermistor. But we can also use them in another fashion, by measuring the loss of energy of the thermistor body. Thus a thermistor suspended in an air or gas stream whose temperature and humidity is known will tell us how fast

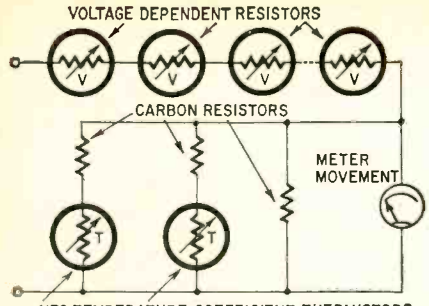


Fig. 6—How thermistors can be used to expand a voltmeter scale.

the thermistor is cooling. From this the velocity of the stream can be determined. This principle is used in anemometers (wind-strength indicators), and gas and liquid flow meters.

It is also used in gas analyzers. When the gas streams past the thermistor, its cooling effects depend on the composition of the gas. For example, certain hydrocarbons such as gasoline have a stronger cooling effect than air (as you well know, if you've ever spilled gas or alcohol on your hand). Thus by calibrating a thermistor instrument for air, and then sucking through an air mixture (with temperature known or compensated for), we can with fair accuracy detect the presence of gasoline or other vapors and gases. The cooling effects of various substances differ widely enough so that, if we know approximately what to expect, we can detect their presence quite well. However, in a mixture of many gases (which is not really a logical occurrence in industry) the instrument could be confounded.

Two thermistors in a bridge circuit can form a humidity meter if one of them is enveloped in a sheath which absorbs water from a reservoir. At each temperature the difference in cooling effect of the surrounding air on the wet and dry thermistors (analogous here to wet- and dry-bulb thermometers) indicates humidity. Naturally, the wet thermistor has 100% humidity.

Thermistors can be used as time delays too. In series with a relay coil, the thermistor can block current through the coil until it reaches the self-heat point. Then its resistance drops enough to allow energizing current to flow through the relay.

Thermistors are also used as temperature modulators for telemetering transmitters. Our satellites and rockets use many thermistors for temperature indication. A thermistor can vary the frequency of an R-C oscillator, which then modulates the transmitter carrier. Thermistors in very simple FM transmitter circuits can vary the carrier frequency directly. In oscillators, thermistors are used to remove higher harmonics or rounding off the waveform. Any peaks of energy are absorbed by the thermistor which more or less promptly (depending on the time constant) lowers its resistance, thus shunting the energy. This application is generally limited to very low frequencies, since thermistors have a relatively long time constant.

When we mention time constant, two

Simpson

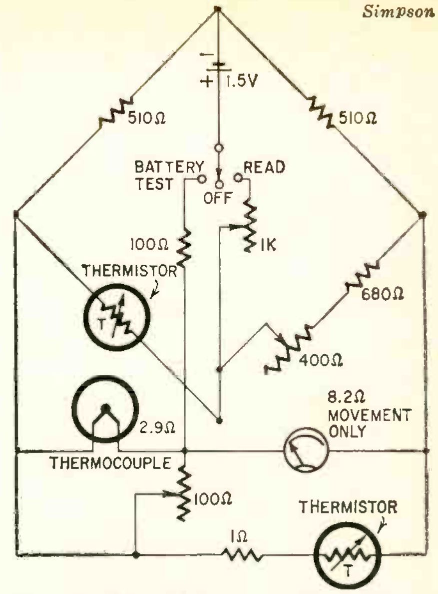
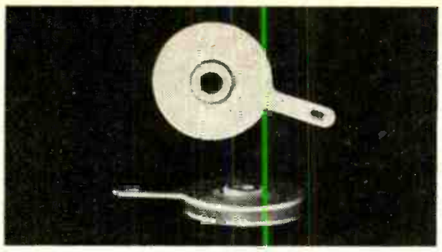


Fig. 7—Thermistors are used in accurate instruments to compensate for ambient temperature changes.

types must be considered. The first is the time required to raise the temperature, at its rated dissipation, 1° above a previous temperature. This is called a dissipation time constant. Then there is the thermal time constant, which is the time required for the thermistor to cool, in an open circuit, from 100°C to a specific temperature which varies somewhat with the manufacturer. Dissipation constant may also be listed as the amount of power required to raise the thermistor 1°C.



Two views of a G-E industrial type thermistor.

Here we have listed only a few thermistor applications. There are many more. Some are used every day—for example, protective elements in TV sets and other appliances. They also serve as detectors in fire-alarm systems, voltage regulators, overvoltage and overload protectors, volume limiters, automatic temperature controls, refrigeration controls, surge suppressors, and remote-control switches.

Here is a brief list of manufacturers who can furnish additional information on thermistors:

General Electric Co., Magnetic Materials Div., Edmore, Mich.

Ferroxcube Corp. of America, Saugerties, N. Y.

Carborundum Co., Globar plant, Niagara Falls, N. Y.

Walter Kidde & Co. Inc., 675 Main St., Belleville, N. J.

END

References

Hardy and Emes, "Thermistors in Transistor Circuits," *Semiconductor Products*, August 1960.

Becker, Green and Pearson, "Properties and Uses of Thermistors," *Electrical Engineering*, November 1946.

Smith, "Thermistors," *Review of Scientific Instruments*, September 1949.

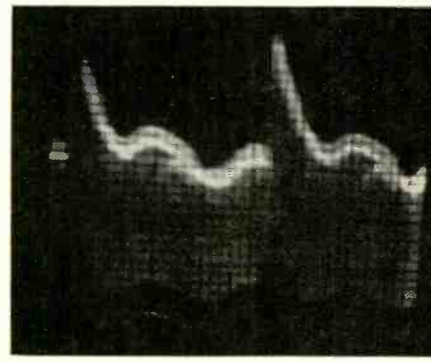
What's Your EQ? *February Solutions*

Simple(?) Ac Problem

This looks like a deceptively simple ac circuit problem, and it is, provided one keeps very strict account of the signs or polarities of the four voltages (voltages E_1, E_2 and the voltage drops across R and X_C). The voltage between points A and B is of course $100 \times \sqrt{2} = 141.42$ volts. This voltage drives a current through the series connection of the resistor and the capacitor. Interchanging the two will, of course, not change the voltage between points A and B, and therefore the current will also be the same. But the voltage between points D and G will be 141.42 for the connection shown, and will be zero after the interchange!

Service Stinker No. 3

Neither horizontal phase diode nor horizontal oscillator is at fault! Look at the picture. This is what a scope will show you on the B-plus line! The output electrolytic capacitor is open!



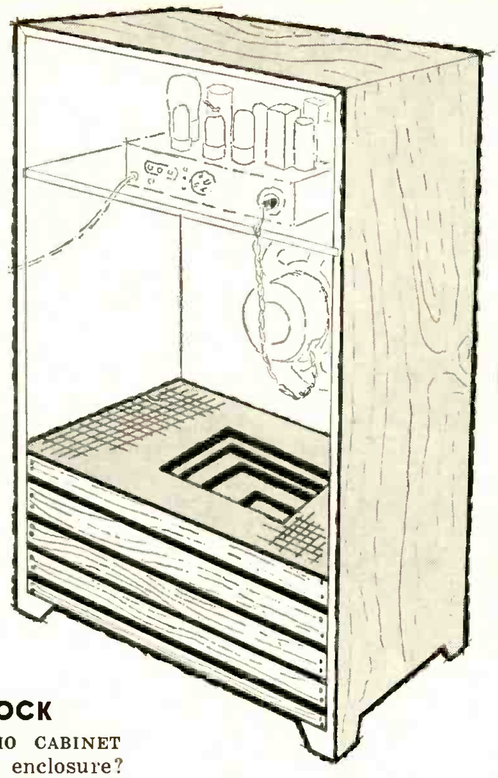
The horizontal hash feeding back into the power supply is upsetting the horizontal hold action.

Forbidden Current Path Answer

When the clapper is at the end of its swing and completing the contact through the lamp, the voltage and current in the line are at zero and about to reverse direction. Therefore, both terminals of the lamp are at approximately the same voltage and the lamp does not light.

NEW LIFE for CONSOLE RADIOS

Bofflize the speaker compartment to improve fidelity



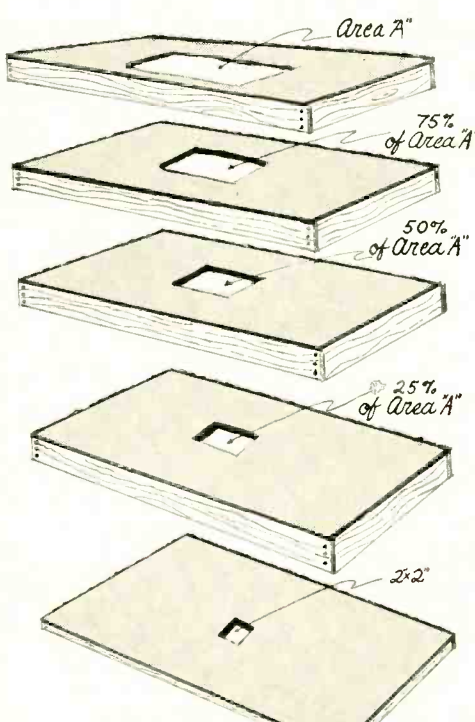
By WALT WHEELOCK

CONVERT AN OPEN-BOX RADIO CABINET into an acceptable speaker enclosure? Yes, contrary to popular belief, it can be done.

Many older radios enclosed in sturdy, well constructed hardwood consoles are still in use. Often they are treasured as choice pieces of furniture. Almost always the electronic circuit uses a transformer power supply. General design is stable and conservative. Coupling and bypass capacitors are unfortunately designed for limited frequency response, and filter-capacitor design is no better than necessary for such response. Since it will be advisable to replace these capacitors anyway, response may be improved and, by using filter capacitors many times larger than the originals, the increased hum hazard may be eliminated. This will then justify a higher-quality speaker of modern construction.

It is evident that the console cannot accommodate a horn no matter how skillfully it is folded, bent or twisted. A bass-reflex enclosure requires a nicety of balance between enclosure volume, speaker resonance and port size that may be difficult to attain. An infinite baffle might be constructed, but usually the volume available is much less than desirable. Quite a bit of the possible low-frequency response may also be lost. But if we substitute acoustical resistance for physical space, a much smaller volume will do. For example, if the rear of the speaker cone works into a limited space and that space is coupled to an acoustical sink which kills the back wave, the old radio console will satisfactorily house a new speaker. One such design is that of Hartley's *Boffle*, described in RADIO-ELECTRONICS, February, 1956.

Before attempting such treatment, check to make sure that the cabinet is constructed of wood, at least ½ inch thick. Luckily, fiberboard imprinted with a woodlike pattern was not used in these older cabinets. Examine all joints; they must be tight. If necessary, reglue and screw, adding additional corner blocks where needed. Also add corner blocks to support a tight-fitting back panel. If doubtful about vibrations occurring in certain areas, coat them with automotive fender underseal or roof mastic containing asbestos fiber. These substances are acoustically dead and also are an excellent material for cementing rug padding or other sound-absorbing materials to the enclosure walls.



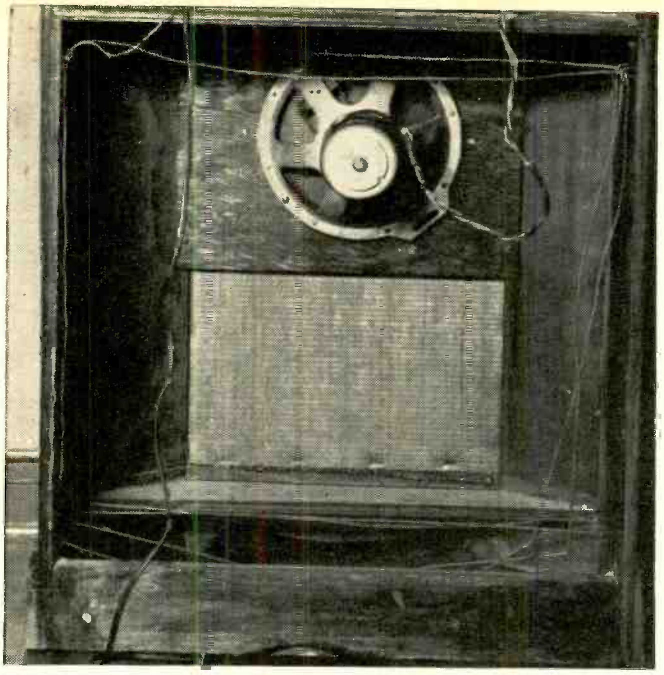
Details of the acoustical sink.

The acoustical sink consists of a series of rug-padding baffles spaced about 1½ inches apart. The first baffle (the one nearest the speaker) should have an opening approximately equal to or slightly smaller than the effective area of the speaker cone. This area is determined by the actual working area, whose diameter is somewhat less than the advertised diameter (which represents the maximum overall diameter of the speaker basket). Use the following values to determine this area:

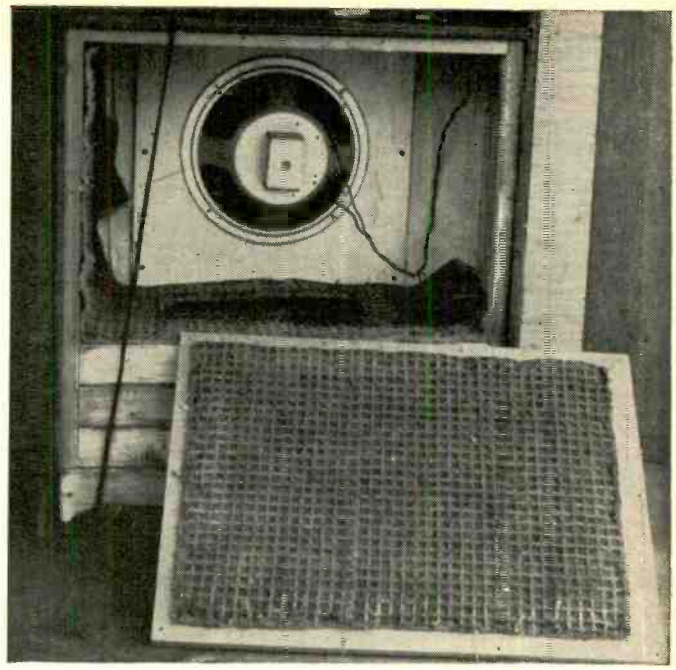
Advertised Diameter (in.):	6 x 9	8	10	12
Effective Diameter (in.):	5 x 8	7	9	10½
Effective Area (sq. in.)	30	40	64	80

Build a frame, of ¾ x 1½-inch wood, the same shape as the horizontal cross-section of your console. It should be set up so that, when the padding material is attached to the outside of the frame, it will fit snugly into the opening. The padding is fastened to the outside of the frame to prevent annoying buzzes where pieces of bare wood would meet.

The next frame is similar, but its opening is equal to about 75% of the first one. The third has an opening equal to 50%, and the fourth 25%, while the final frame merely has a 2 x 2-inch vent hole. Fasten this final baffle to the bottom of the previous frame, eliminating one frame. Of course, the bottom shelf, if any, must be removed. The bottom of the assembly should be at least an inch or two from the floor, so the baffle can vent into the



Original appearance of the console radio.



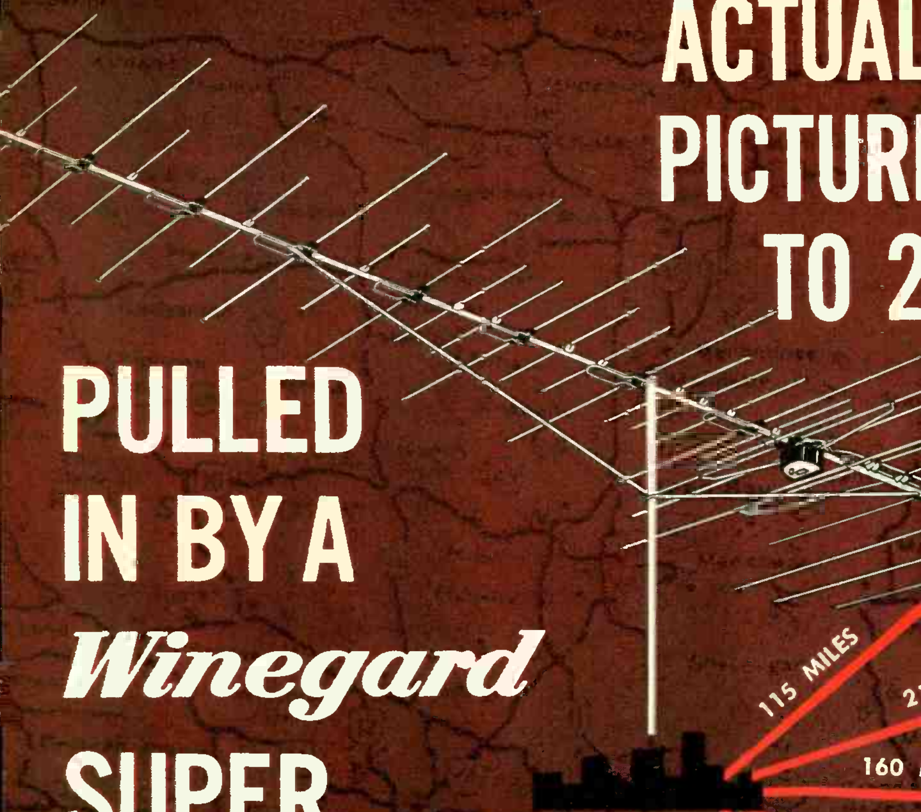
After modification: Note new speaker and solid front panel.

room itself. Incidentally, it is neither necessary nor even desirable for these holes to be aligned or be similar in shape. The purpose of the system is to add increasing acoustical resistance as the sound wave progresses. If space permits, and the builder desires, additional frames may be used. For example, Hartley in his Boffle uses two complete sets of frames. Some additional absorption will be obtained if the console is placed upon a carpet-covered floor.

At least one of each of the opposing pairs of surfaces of the remainder of the enclosure is lined with sound-absorbing material, again using asphaltic mastic if additional damping appears to be needed. A snug-fitting solid panel is cut for the rear opening, lined with padding and securely screwed to the rear of the console.

After enclosing the console and turning on the set, you will find none of the resonating peaks common to an open-box cabinet, nor any of the annoying cancellations between front and back waves that were formerly present. Instead, the rear of the cone pours its energy into the acoustical sink where it is forever lost, while the unhampered front wave is that designed by the speaker manufacturer. END

ACTUAL PHOTOS OF TV PICTURES RECEIVED UP TO 248 MILES AWAY



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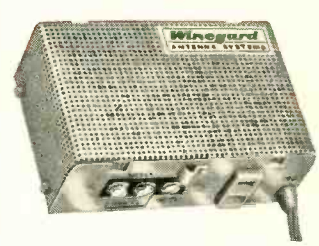

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Read what Charles J. Milton of Moyer TV, Milwaukee, has to say about the Winegard Super Powertron...

Charles Milton and [illegible]m Moyer
In front of Moyer TV

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Burlington, Iowa

Gentlemen:

I would like to thank the Winegard Company for building the Super Powertron SP-44X.

With this antenna, reception at the local station level is perfect in both black and white and color. At medium range, the Powertron outperforms all others. Channel nine from Chicago, about 90 air miles, comes in clear and regularly. This is the Cubs baseball station and the one Milwaukeeans are willing to pay big money to get.

When the "Big Winegard", as it is affectionately called around the shop, is on long range it probes the unknown alone. All other antennas have fallen far behind. I have picked up eleven stations over 100 air miles away. The farthest of these is WWJ, Channel Four, Detroit, an unbelievable 251 miles. I have included a few pictures that I took off the TV with a Rolliflex F 3.5 at one second using Verichrome Pan.

We use the pictures in a window display and I use a set of pictures to explain the advantages of a Winegard to prospective customers. Believe me the pictures work -- and so does the "Big Winegard."

Sincerely,

Charles J. Milton

Of course, everyone can't get reception results like Charles Milton has experienced. Each area has its own unique reception characteristics and problems. But one thing we can promise, the Powertron will deliver more clean pictures on your TV screen than any antenna you can own.

POWERTRON IS 100% CORROSION-PROOFED

ANTENNA IS GOLD ANODIZED
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PHOTOGRAPH YOUR OWN TV STATION PICTURES AND SEND THEM IN!

If you own a Powertron, chances are you too are experiencing unusual results. Why not photograph the stations you receive and send them in to us. We are always interested in hearing from Winegard antenna dealers and owners. We will be glad to enlarge your camera shots so that you can make your own window or store display like Moyer TV has done. The photos make great sales persuaders to prospects and can be used in many ways to sell more Powertrons.

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Winegard ANTENNA SYSTEMS

Winegard Co., 3013-3A Kirkwood St., Burlington, Iowa

industrial electronics dictionary

By ED BUKSTEIN

From resistance welding to self-latching relay

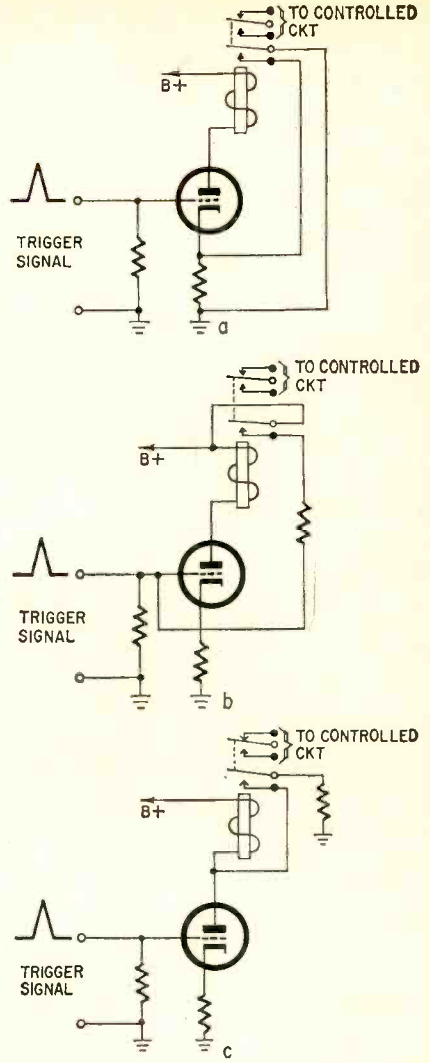


Fig. 26—Relay circuit can be made self-latching by shorting tube bias (a), by applying positive potential to tube grid (b) or by providing an alternate pathway for relay current (c).

Resistance welding: A method of joining metals by passing a high current through them. The heat (power losses) in the metals melts them together. The metals are placed between a pair of electrodes connected to the secondary of the welding transformer. Since a large value of secondary current is required, the transformer has a stepdown voltage ratio; secondary voltage is generally in the range of 5 to 20. If rod-shaped electrodes are used, the weld is produced over a circular area corresponding to the end area of the electrodes. This technique is known as *spot welding*. If roller-shaped electrodes are used and the metals passed between them, a *line* or *seam weld* is produced.

To prevent the electrodes from becoming welded to the metals they must be cooled. This can be done by using hollow electrodes and circulating water through them, or by turning the power alternately on and off (see Pulsation welding).

A complete welding operation consists of: 1. *Squeeze* time (the metals are placed in position between the electrodes); 2. *weld* time (current flows through the metals); 3. *hold* time (current does not flow but the metals remain under pressure of the electrodes while the weld sets or hardens).

The welding current is controlled by a back-to-back ignitron circuit in series with the primary of the welding transformer. The ignitrons are controlled by thyratrons, and delayed firing permits control of the welding current. (See Back-to-back circuit, Ignitron and Phase-controlled rectifier.)

Resolving time: The time during which a circuit or component does not respond to an input signal because it has not yet recovered from the effect of a previous input. A one-shot multivibrator, for example, will not respond to a second input pulse while the circuit is still going through its operating cycle as a result of an earlier input pulse. Resolving time is also known as *dead time*.

Ring Counter: A circuit consisting of a number of flip-flop stages connected as a complete loop or ring, as in Fig. 25. At the start, the first stage is *on* and all others are *off*. This condition is established by a manual reset switch. The input pulse is applied in such a way that any stage previously *on* will be switched *off*, and the interstage coupling is such that a stage switching to the *off* condition generates a trigger pulse that turns *on* the following stage. As a result, the *on* condition is transferred to the following stage each time an input pulse is applied. In this respect, the circuit is the electronic equivalent of a rotary multiposition switch and is used in applications requiring greater switching speeds than can be obtained with a motor-driven mechanical switch.

Roentgen rays: Same as X-rays (named after Wilhelm Roentgen, the discoverer of X-rays).

Saturable reactor: A saturable-core component having the properties of a variable inductance. Direct current is passed through one of the reactor windings to saturate the core, and the inductance of the other winding depends upon the degree of core saturation (see Light dimming control).

Scintillation counter: An instrument used to detect and measure radioactivity with a phototube and a fluorescent crystal. In the presence of radioactivity, the fluorescent crystal (usually thallium activated sodium iodide) illuminates the cathode of a photomultiplier tube. The output of the photomultiplier is amplified and applied to a counting rate meter, binary counter or other indicating device.

Seam welding: A form of resistance welding involving roller-shaped electrodes. As the metals are passed between the rollers, a continuous seam weld is produced (see Resistance welding).

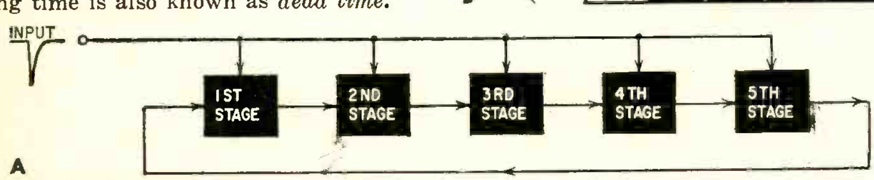
Self-latching relay: A type of relay in which the armature becomes mechanically locked in the down (energized) position. Once energized, the relay remains energized until deliberately reset. Such relays are used in applications in which the relay must energize in response to a brief triggering signal and remain energized even after the trigger signal is completed.

As shown in Fig. 26, the same thing can be done with a conventional relay (no mechanical lock) by using additional contacts on the relay to (a) short out bias resistor, (b) apply positive potential (B-plus) to the grid or (c) provide alternate pathway for relay current.

TO BE CONTINUED

INPUT PULSES	1ST STAGE	2ND STAGE	3RD STAGE	4TH STAGE	5TH STAGE
START	ON	OFF	OFF	OFF	OFF
1	OFF	ON	OFF	OFF	OFF
2	OFF	OFF	ON	OFF	OFF
3	OFF	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	OFF	ON
5	ON	OFF	OFF	OFF	OFF

B



A

Fig. 25—Stages of ring counter turn on in succession as input pulses are applied. Circuit is electronic equivalent of multiposition switch.

HALF-POCKET RADIO

Tiny 4-transistor receiver packs a wallop

By NICHOLAS A. TAX

Through the years radios have become smaller and smaller. Here is a radio I believe to be one of the smallest completely portable pocket sets for the do-it-yourselfer. About the size of a petite ladies' cigarette lighter, it is smaller than some hearing aids. It uses four transistors, requires no external antenna or ground wires and receives local stations with plenty of volume and good clarity.

The set is only 1 11/16 x 1½ x 11/16 inches, and there is no wasted space on the tiny chassis. The key to its small size is the use of 2N207 audio transistors and hearing-aid type electrolytic capacitors and resistors. The 2N207's are little fellows as large as the head of a kitchen match. A 2N345 (SB100) surface-barrier transistor is used as the regenerative detector. These transistors were selected, not only for their small size, but because of their very low operating voltage and current drain. The 2N345's collector will operate at almost zero voltage, at least down into millivolts. You will note that the collector load resistance is made up of a 500,000-ohm potentiometer and a 33,000-ohm series limiting resistor (Fig. 1). This hookup is somewhat unusual for a regenerative circuit, but has proved itself very effective. The collector load does not go through the tickler coil as in most regenerative circuits.

How it works

The set has a common-emitter regenerative detector. L1 and C1 pick up the desired rf signal, which is fed through C2 to V1's base, where it is amplified. Part of the rf returns to L1 through R2 and R1 and the mercury cell. The detected audio and some rf are taken off V1's collector and fed through tickler coil L2 and C3 to V2's base. The rf in L2 has a regenerative effect. The remaining stray rf is cancelled out through V2's emitter to ground. With this arrangement, no rf bypass capacitor is needed.

Two more audio stages follow, giving the receiver good volume. By adjusting potentiometer R1 we control regeneration by changing V1's collector voltage. R2 limits this potential. R4 and R5 act as a voltage divider to help stabilize the audio section for varying temperatures. The tiny 1,000-ohm impedance phone (with a dc resistance of 250 ohms) is made by Telex. This low-resistance phone is absolutely essential in a low-voltage receiver of this type. A higher dc resistance might mismatch the output stage.

Construction hints

A 1 7/16 x 1⅝ x 1/16-inch piece of perforated Bakelite board is used for the chassis. The holes are spaced 3/16 inch apart. See Fig. 2 for various cuts made in it to mount components.

Because the receiver is so small and components so close together, it is wise to breadboard the set. After you have it working right, proceed with the actual construction. I found that swapping the 2N207's around can improve the set. One of the 2N207's caused slight distortion when used in the output stages, but worked well in either of the other stages. This is due to slight vari-

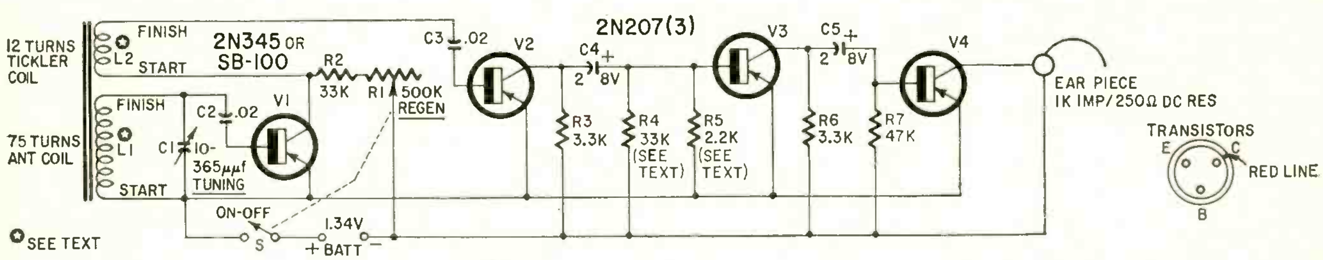
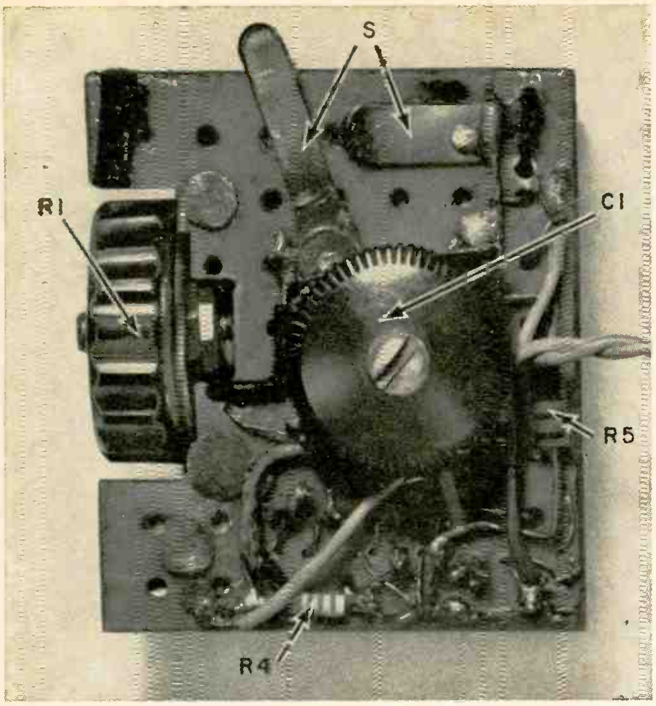
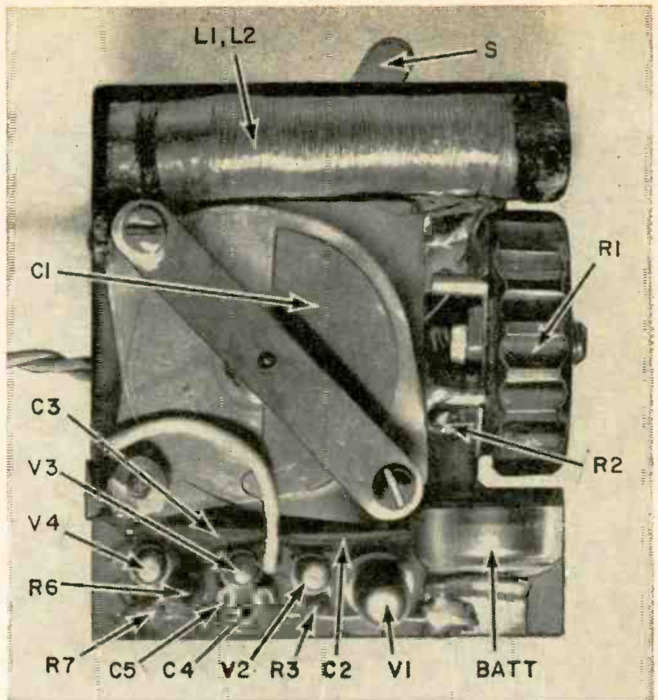


Fig. 1—Circuit of the tiny receiver.

R1—pot, 500,000 ohms, miniature with switch (Centralab B16-218)
R2, R4—33,000 ohms, 1/10 watt
R3, R6—3,300 ohms, 1/10 watt
R5—2,200 ohms, 1/10 watt
R7—47,000 ohms, 1/10 watt
C1—10-365 μμf, variable, miniature (Lafayette MS-445 or equivalent)
C2, C3—.02 μf, subminiature, 75 volts (Lafayette C-613 or equivalent)
C4, C5—2 μf, B volts, subminiature electrolytic
BATT—1.34-volt mercury cell (Mallory RM-675 or equivalent)
L1, L2—antenna coils, see text
S—on R1
V1—2N345 (SB-100)
V2, V3, V4—2N207 (Philco)
Perforated Bakelite board (Lafayette MS-304 or equivalent)
Litz wire (100-ft spool) (Belden 8817 or equivalent)
Earphone, 1,000-ohm impedance (Tele EPX-2 or equivalent)
Piece 25-gauge sheet metal
Piece 30-gauge sheet metal
Piece 1/32-inch-thick cardboard
Miscellaneous hardware
Ferrite core from Lafayette BS-754 antenna





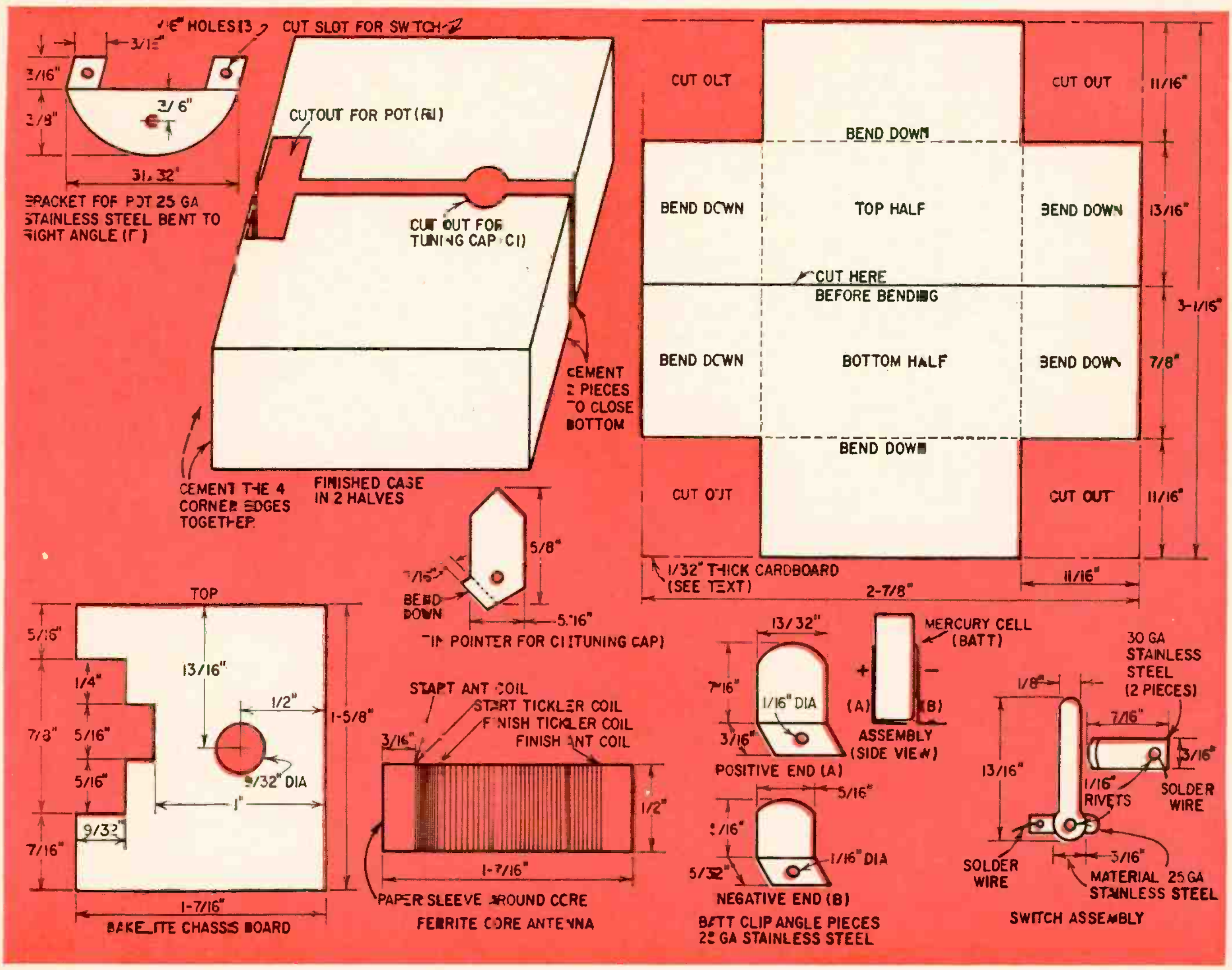
ations in the transistors. If motorboating is heard, swapping them around will generally cure the trouble. If motorboating persists, try reducing the value of R5 to 1,800 ohms. If you still have motorboating, put the 2,200-ohm resistor back for R5 and raise the value of R4 to 47,000 ohms.

Unfortunately, the potentiometer I used did not come equipped with a

Top view of the radio chassis (left). Note on–off switch construction.

The working side of the half-pocket radio (above).

Fig. 2—Construction details (below) must be followed to build the set.



switch, so I made a knife type switch from 25- and 30-gauge sheet metal. See Fig. 2 for details. However, I have listed a potentiometer with switch in the parts list for your convenience. This control has a threaded shaft in the center and is bolted to a bracket (Fig. 2). The shaft is the rotor side of the potentiometer and contacts the bracket. Solder a wire to the bracket and connect its free end to the negative side of the battery.

Battery clips were hand-made from 25-gauge sheet metal. I found it is easy to make small holes in these clips by center-punching them, and then grinding or filing off the underside.

Because small rivets were not readily available, I used screen wire tacks instead. Grind the heads almost paper-thin, then, with a three-cornered file, dress their shaft diameter to fit the holes in the various parts. The two rivets that hold the battery clips must have their heads dressed to a diameter of about 1/8 inch so they do not touch and short the battery.

Some holes in the perforated chassis must be drilled to suit. To make a strong rivet joint, cut down the length of the rivet so about 1/32 inch extends above the metal part. Then peen it down with a very small ball-peen hammer. Some must be peened with a 1/8-inch prick punch. The head of the rivet, it goes without saying, rests on a flat metal object.

To make the antenna, use only the flat ferrite core from a Lafayette MS-754 antenna. The coil is discarded. Cut the core to a length of 1 7/16 inches. (Score it all the way round with a three-cornered file, then it will break at this point.) The core is 3/16 inch thick and 1/2 inch wide. Next, wrap a piece of heavy paper around the core. Cut the paper to the length of the core. Then, over the paper, wind a new antenna winding of 75 turns of Litz wire, starting 3/16 inch from one end. Secure this winding with a coat of hot wax.

Now wind 12 turns of the same wire over the coil you just wound (tickler coil), again starting 3/16 inch from the same end of the core. Both coils should be close-wound and in the same direction. Coat the tickler winding with wax, too. Dab a little fingernail polish on the lead at the start of the antenna winding so it can be distinguished from the start of the tickler winding, as they are right together.

The core can be moved in or out of the paper sleeve so the entire broadcast band can be tracked with the tuning capacitor. If the instructions are followed closely, no movement of the core will be necessary. As mentioned before, there are slight variations in transistors, so if you don't get oscillation at the low end of the band (750 to 550 kc when the potentiometer is turned all the way up), add a few turns to the tickler winding. You should get oscillation at any dial setting with the regeneration control all the way up. If you get no oscillation at all, you have probably connected the leads of the tickler coil incorrectly and they will have to be reversed.

Capacitors and resistors in the set stand on end, taking up very little space. A common bare negative wire runs across the chassis for close tie-in. Drill twelve 1/32-inch holes in the chassis for the four transistors. These small drills are available from most hardware stores. Space the hole for each collector a little farther away for better recognition of this lead from the other side of the chassis.

The transistors stand up with their leads through the holes. When soldering, hold them with a pair of needle-nose pliers to prevent heat from damaging the transistor. I had to grind the end of an old pair of needle-nose pliers to about 1/32 inch to get in between the leads to do this. A magnifying glass is very helpful when making up the connections, as they are so close together.

The leads are stiff enough for you to have some of them cross over others, making sure they do not touch. Plastic insulation can be slipped on some of them. A pencil type soldering iron is best for making connections.

Place the antenna on its long edge at the top of the chassis, resting against the edge of the phenolic base of the tuning capacitor. Anchor it with about three strands of No. 50 thread looped around it and through holes in the chassis at each end. Coat the threads with cement to stiffen and strengthen them.

Although the tuning capacitor comes with a calibrated dial and you may want to use it, I didn't because its large diameter made the set look a little out of proportion. I made a knob with a pointer, grinding off most of the threaded part of a toothpaste cap. Then I drilled a hole in the center of the knob, and inserted a screw to hold it to the tuning-capacitor shaft. The shaft has a flat side, and the tin pointer has a corner bent down on this flat side to lock the whole thing together (Fig. 2).

To mark the tuning dial, use an ordinary ink pen dipped in black paint (thinned down with a little paint thinner) to write the numbers. I marked my set with the numbers 16, 10, 8, 7, 6, 5, in a half circle.

Making the case

The tiny case that houses the receiver is made of cardboard about 1/32 inch thick. See Fig. 2 for layout. The case is made in two halves. Only the lower half has to be removed to change the battery. The seams are cemented with Duco cement. After they are all thoroughly dry, apply three coats of model-airplane dope.

You are now ready to enjoy your favorite radio programs. The set will tune the entire broadcast band. As for all regenerative sets, careful adjustment of both knobs is essential. If the regeneration control is turned up too high, the set will burst into oscillation and reception will be spoiled. After most of the locals go off the air late at night, I have received stations several hundred miles away. END

new PATENTS

RADIO PILL
Patent No. 2,958,781

Maurice Marchal and Marie T. Marchal, 12 Rue Jacques-Bingen, Paris 17, France.

This pill, small enough to be swallowed, contains a receiver-transmitter. As shown in Fig. 1 the pill contains a tiny crystal shunted by a coil. It functions as follows:

External transmitter T sends pulsed signals (from antenna A1) to A2, inside the stomach. Energy absorbed one instant by the crystal is returned to the circuit the next instant as the crystal vibrates. The reradiated signal is picked up by external receiver R.

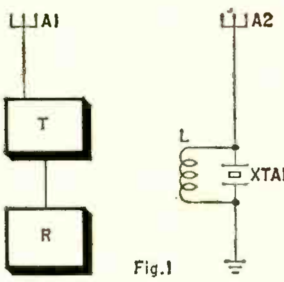


Fig.1

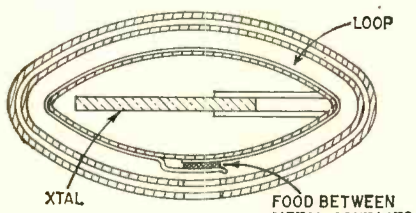


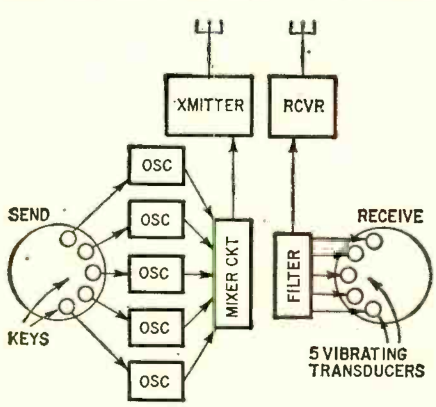
Fig.2

In an actual pill (Fig. 2), the crystal is surrounded by an inductance which also acts as antenna. A bit of food placed between ends of the loop disappears when digestion is complete. The exact instant is made known to the doctor because the loop shorts and interrupts the signals.

TOUCH COMMUNICATION
Patent No. 2,972,140

Joseph Hirsch, Pacific Palisades, Calif. (Technion, Haifa, Israel)

As pianists and typists know, finger movement can be very rapid. Here the fingers of the right hand control five keys on a transmitter



board. When a key is depressed, a tone is generated. For example, the five frequencies may be 20, 50, 120, 270 and 700 cycles. The tones modulate a carrier and may be transmitted either by radio or land wire.

At the receiving end, the carrier is detected and filtered. Each tone is fed to a corresponding transducer upon which rest the five fingers of the left hand. Thus the thumb of the sender's hand corresponds to the thumb of the receiver's hand, etc. A complete system requires two complete sets of the setup shown so each operator can receive and transmit at will.

Each tone may symbolize a letter of the alphabet or other information. To increase the number of tones available, two or more keys may be depressed at the same time.

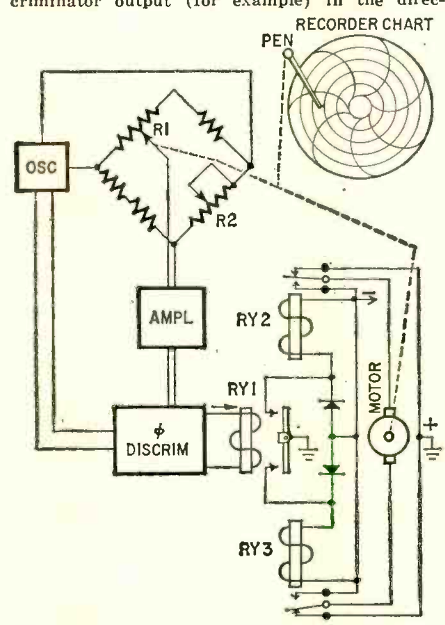
Blind or deaf persons can use this communication system since only the sense of touch is involved.

PORTABLE PEN RECORDER
Patent No. 2,972,103

Leo C. Cunniff, Cedar Grove, N.J. (Assigned to Industrial Instruments, Inc., Cedar Grove, N.J.)

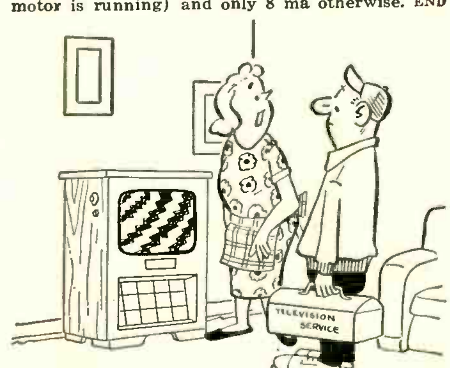
This unit measures only 14 x 11 x 9 inches and operates from batteries. Its recording chart is driven by a spring motor.

R1 is a balancing slide wire. When the device is used to test liquids, R2 is a conductivity cell whose electrolyte ranges from strong acid to distilled water. When R2 unbalances the bridge, a tone is fed to the amplifier and phase discriminator. At one side of balance, the output will be in phase with the oscillator and the discriminator output (for example) in the direc-



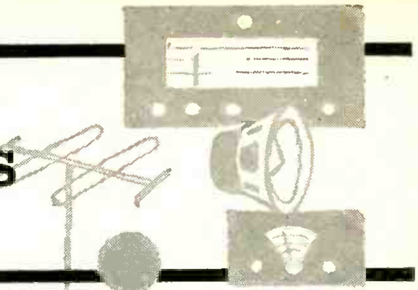
tion of the arrow. RY 1 will close its upper contact, energizing RY 2 and operating motor. This drives the pen and also adjusts R1 toward balance. At the other side of bridge balance, the current through RY 2 reverses, causing the lower contacts to close. RY 3 is energized and the motor reverses.

The diodes damp out induced voltages across the relay coils to prevent arcing. The battery delivers 600 ma during rebalance (while the motor is running) and only 8 ma otherwise. END



"That's nothing—just wait till I plug it in."

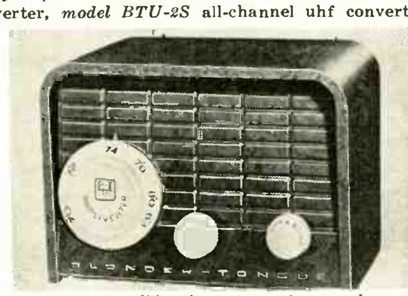
NEW PRODUCTS



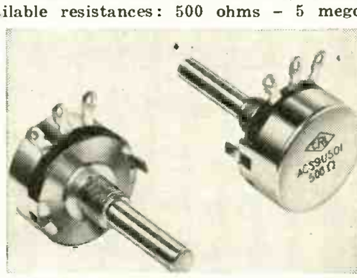
CLOSED-CIRCUIT TV CAMERA, *model V-400*. Operates with home type rf or industrial video receivers. Electronic self-adjustment to lighting conditions; rugged chassis mounting for shock-protection; turret mounting to accommodate normal, wide-angle and telephoto lenses. May be operated from printed instructions by laymen.—**Sylvania Electric Products, Inc.**, 730 3rd Ave., New York 17, N. Y.

DEFLECTION YOKE, *model DY-44A*, replacement for Westinghouse yokes 490V006H01 and H02, 490V006M01 and 490V007H01 in 29 chassis and 173 models. Horizontal coil inductance 18.5 mh, vertical inductance 34 mh. Horizontal coil resistance 33 ohms, vertical resistance 34 ohms.—**Stancor Electronics**, 3501 W. Addison St., Chicago 18, Ill.

UHF CONVERTER/AMPLIFIER, *model BT-70* (illus). Converts uhf channels 70–83 to 5 or 6. Minimum gain 8 db, tube compliment 6AF4-A oscillator, 6ER5 if. Power 117 volts, 60 cycles, 20 watts. *Model 99R* all-channel uhf converter, *model BTU-2S* all-channel uhf converter with extra amplification stage for weak areas and *model UB* mast-mounted booster for channels 70 through 83.—**Blonder-Tongue**, 9 Alling St., Newark, N. J.

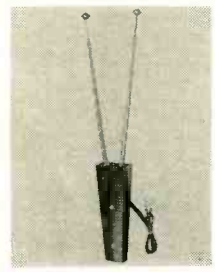


2-WATT POTENTIOMETERS, *model A*. Hot-molded carbon composition. 1-3/32 x ⅝ in. Available resistances: 500 ohms – 5 megohms, linear taper; 10,000 ohms – 2.5 megohms, log taper.—**Centralab**, Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

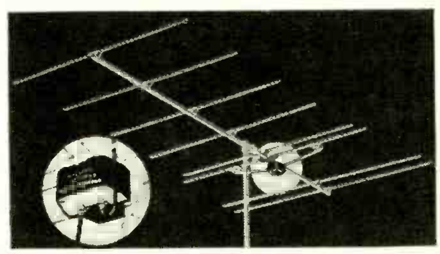


CAPACITORS. *EK-5 Verti-Lytic Assortment*, 30 miniature single-ended electrolytic capacitors with molded phenolic cases and moisture-resistant resin end seals.—**Sprague Electric Co.**, 125 Marshall St., N. Adams, Mass.

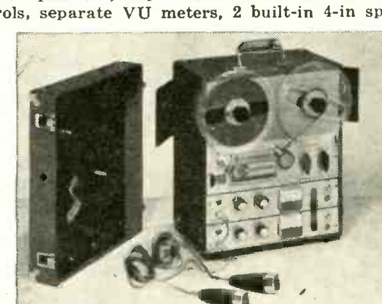
INDOOR ANTENNA. *Power-Pak* attaches behind the set, eliminates top-of-set antenna. Pulls in all uhf, vhf and FM signals.—**Clear Beam Sales Corp.**, 21341 Roscoe Blvd., Canoga Park, Calif.



FM ANTENNAS for fringe FM and FM stereo. Yagi antenna, gold anodized, minimum gain 26 db over folded dipole, flat response ¼ db 88 to 108 mc. Built-in TV–FM coupler, 8 elements with tapered T driven element directly coupled to transistor amplifier. *model PF-8* for 300-ohm lead, *model PF-8C* for 75-ohm coax. Turnstile antenna, *model PF-4*, gold anodized, nondirectional, 16-db gain in all directions over folded dipole. Offset mount, transistor amplifier, built-in TV–FM coupler, 300-ohm output.—**Winegard Co.**, Burlington, Iowa.



4-TRACK STEREO TAPE RECORDER, *model 73-T*. Tracks record independently, playback simultaneously. Interlocked controls, full-stop brakes. Plays vertically or horizontally, monaural to 4-track stereo recording, 2-track and 4-track stereo playback. Heavy-duty motor, dynamically balanced rotor and flywheel, pushbutton operation, separate volume and tone controls, separate VU meters, 2 built-in 4-in speak-



ers, 2-speed operation. Response 7½ cycles, ±2 db, 40 – 15,000 cycles; 3¾ cycles, ±2 db, 40 – 11,500 cycles. Output 10 watts per channel, wow and flutter less than 0.18% rms, signal-to-noise ratio 42 db. Record inputs: 2 high-impedance mike and 2 high-level line. Playback outlets: 2 high-impedance, independent of volume control, two 8-ohm for external speakers or headphones.—**Rheem Califone Corp.**, 5922 Bowcroft St., Los Angeles 16, Calif.

STEREO CARTRIDGE. Variable-reluctance *Orthonetic* response 20–20,000 cycles ±2 db at 1,000 cycles, plus tracking force of 1 to 3 grams. *Model VR1000-5*, for professional and automatic

turntables, 0.5-mil diamond stylus. *Model VR1000-7* 0.7-mil version for high-quality changers.—**General Electric**, Electronics Park, Syracuse, N. Y.

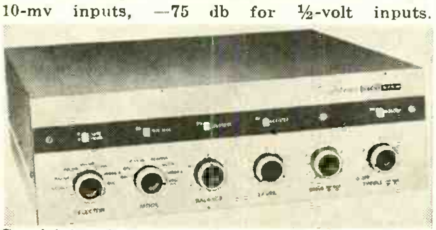
SNAP-IN STEREO CARTRIDGES, *models "S" and "T"*. Replacements for all crystal stereo cartridges. Complete with two needles, price

about the same as two quality needles alone. "*S*" has 2-volt output, "*T*" has 0.8-volt output. Split yoke drive allows super channel separation.—**Jensen Industries**, 7333 Harrison St., Forest Park, Ill.

PUSHBUTTON STEREO PREAMP, *model AA-11*. Front-panel primary controls: volume, bass, treble stereo phonograph, tape head, mikes, FM, auxiliary input; monophonic AM and FM

tuners, monophonic auxiliary and off–on switch. Concealed secondary controls: blend and balance controls, scratch and rumble filter switches, stereo–mono switch, channel and phase reversal switches.—**Heath Co.**, Benton Harbor, Mich.

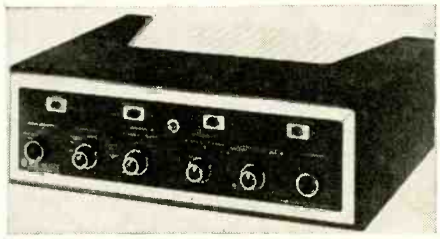
STEREO PREAMP, *model ST84*. .05% distortion or less. Input and mode selectors 7 positions each; bass and treble controls for each channel for variable crossover; switches control high- and low-frequency filtering, equalization of 3¾ and 7½ tape speeds. Response ±0.3 db from 5 to 25,000 cycles. Harmonic distortion .06% 20–20,000 cycles at 2-volt output. IM distortion (60 and 7,000 cycles at 4:1) .04% at 2-volt output. Hum and noise —65 db for 10-mv inputs, —75 db for ½-volt inputs.



Sensitivity (minimum input for 1 volt at 1,000 cycles) 1 mv for tape head, 1.6 mv for magnetic phono, 2.8 mv for mike and 170 mv for tuner and auxiliaries. Tone controls provide 15-db cut and boost at 50 and 10,000 cycles. Tube complement: five 12AX7/ECC83 plus one 6X4.—**Electronic Instrument Co., Inc. (EICO)**, 3300 Northern Blvd., Long Island City, N. Y.

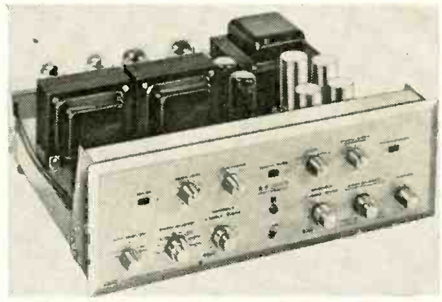
STEREO AMPLIFIER, *kit model LK-48*.

Separate bass and treble on each channel, stereo balance control, front-panel tape monitor facilities and derived center-channel output. Rated 24 watts per channel, delivers 28 watts IHFM



low-end power. All wires precut and prestripped. —H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass.

STEREO AMPLIFIER, *model 296.* Patented rumble suppressor, variable phono level control, stereo selector switch, front-panel stereo headphone output and derived center-channel level

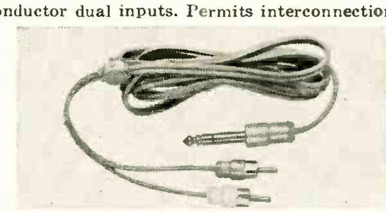


control. Each output stage delivers 50 watts IHFM, 20–20,000 cycles.—H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass.

COMPACT STEREO TUNER, *Knight model KN-250M.* Built-in multiplex circuit for stereo FM broadcasts and monophonic FM. Four RCA 6CW4 nuvistors in rf amplifier, oscillator, mixer

and afc circuits; completely transistorized if and multiplex circuitry, signal strength meter. Usable IHFM sensitivity 2 μv for 30-db quieting; distortion negligible at listening levels.—Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

MOLDED STEREO CABLE ASSEMBLY, *part No. 10FK25.* For stereo recorders with 3-conductor dual inputs. Permits interconnection of

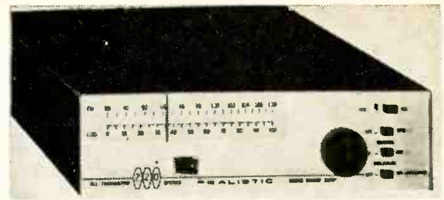


stereo mixer to stereo or mono recorders without soldering, wiring or use of tools.—Switchcraft, Inc., 5555 N. Elston Ave., Chicago 30, Ill.

VHF-UHF OMNIDIRECTIONAL ANTENNA, *"Big Wheel".* Pattern: 360° horizontal, variations ±2 db or less. Band width SWR 1—1.2 or less over 4 mc. Gain: Single bay, approx. 5 db over halo; two bay, approx. 5.5 db over single

bay: four bay, approx. 7.5 db over single bay. *Model ABW-420* for ¾ meter; *model ABW-220* for 1¼ meters; *model ABW-144* for two meters. All models for 52-ohm feed.—Cush Craft, 621 Hayward St., Manchester, N. H.

FM STEREO MULTIPLEX TUNER, *model TM-220.* Transistorized. One dual tube, self-powered transformer supply. Response 15–100,000 cycles ±1 db. Front-panel controls: afc, interstation muting and multiplex on/off,



local/distant range switch. Rear-panel controls: muting level, two sets of outputs for multiplex and parallel tape record, antenna input and power input for 12–28-volt dc operation.—Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass.

MULTIPLEX TUNER, *kit model LT-110,* Receives FM stereo or FM mono. Multiplex section and silver-plated front end prewired and

factory-tested. IHFM sensitivity 2.2 μv; all wires precut and prestripped. Copper-bonded aluminum chassis.—H. H. Scott, Inc., Dept. P, 111 Powdermill Rd., Maynard, Mass.

FM STEREO ADAPTER KIT, *model KS-10,* for any FM or AM–FM tuner with multiplex output. Self-powered. Noise filter and separation

controls. Three 36-inch connection cables, metal case, tubes and all necessary parts, precut wire and solder.—Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

FM–AM STEREO TUNER–AMPLIFIER, *model RA-491.* 30-watt amplifier and snap-in multiplex adapter. Controls: multiplex, balance, ganged loudness, noise filter and mode; separate bass and treble. Response ±1 db, 20–20,000

cycles; sensitivity 4 μv for 20-db quieting; distortion less than 1%, channel separation 30 db.—Olson Electronics, 260 S. Forge St., Akron 8, Ohio.

AM/FM RECEIVER, *Stereo Festival III, model TA5000X.* AM/FM tuner, stereo adapter for FM reception, mono and stereo control facilities. Silicon diode power supply, 17 tubes. Audio section: music power output 25 watts per channel; peak power output 50 watts per channel: response ± 1 db 12–70,000 cycles at 1 watt; hum 85 db below rated output. FM section: sensitivity 3.2 μv IHFM, 0.9 mv for 20-db quieting; response ±1 db 10–35,000 cycles; hum 60 db below 100% modulation; 300-ohm antenna. AM section: Sensitivity 80 μv per meter, 10-kc bandwidth, 6 db down; built-in an-

(*Continued on page 94*)

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- Advanced Servicing Technique
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- Picture Book of TV Repair
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HOW TO GET THE MOST OUT OF YOUR VOM—Reg. Price $4.60
By Tom Jaski • This book shows you how to make your VOM stand up and do tricks! Tells how and why it works, how to choose the best one for your needs, how to use, care for it, put it to new uses, extend its range, increase its accuracy. It analyzes commercial types and kits and tells you how to build your own.

RAPID TV REPAIR — Reg. Price $4.60
By G. Warren Heath • One of the most valuable servicing books ever written! Lists hundreds of tough TV problems, alphabetically for easy reference. Tells you how to find 'em and fix 'em in minutes. No theory—just practical hints, plus many time-saving trouble-shooting charts.

THE VTVM —Reg. Price $4.60
By Rhys Samuel • How to get the most out of this electronic workhorse! Suggests many new time-saving uses. Tells how and why the VTVM works, describes meter scales, probes and cables and explains the use of the VTVM in TV troubleshooting, AM-FM alignment and repair, servicing audio amplifiers, etc.

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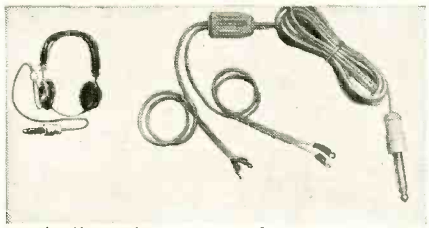
Prepares You for an FCC License

(*Continued from page* 88)

tenna; harmonic distortion less than 1%; hum level 45 db below 80% modulation. FM stereo adapter section: response ±1 db 15–15,000 cycles; distortion less than 1%.—**Harman-Kardon, Inc.**, Ames Court, Plainview, N. Y.

HEADPHONE CORDS. Replacement for Brush and RCA phones and most monaural headset cables. Plastic-covered parallel cable with 2-conductor phone plug and cable clamp molded to one end, Y junction, four eyelet lugs



terminating other end of cable assembly. *Model O5KF88:* has 2-ft cable from plug to Y-junction. *Model O5KJ88:* 4-ft cable from phone plug to Y-junction, 1-ft cable from Y to eyelet plugs.—**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago.

MOBILE MIKE, *model 714SR.* For paging, CB and ham radio applications. Hand-held model delivers —55-db output. Sensitivity —55 db, response 60 to 7000 cycles. 10-in, 3-conductor,

coiled cord extends to 5 ft.—**Electro-Voice, Inc.**, Buchanan, Mich.

CB MICROPHONE, *Model 254C.* Desk type ceramic mike, touch-bar on–off switch, level lock on–off switch. Wired for relay operation.

Response 80–7,000 cycles, output —54 db.—**Turner Microphone Co.**, 901 17th St. N.E., Cedar Rapids, Iowa

CB TRANSCEIVER, *Littlefone model CB-4.* Hand-held, 7 transistors, 1 diode. 27-mc (class-D) service, for field, mobile or base stations. Average range 2 miles. Power input 100 mw, sen-

sitivity 1 μv. Plug-in crystals and transistors.—**Hallicrafters Co.**, 4401 W. Fifth Ave., Chicago.

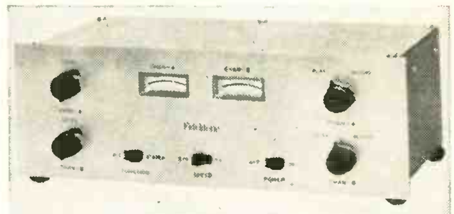
EARPHONE–MIKE COMBINATION for language labs. Liquid-filled circumaural ear cushions for comfort, easy removal and noise-exclusion. Attenuates —40 db of ambient noise, eliminates need for private booths. Response 30–10,000 cycles. Boom-mounted mike element

free-floating in foam mounts within cage. Response 15–15,000 cycles. Attenuates —43 db of sound from source 4 feet away.—**E. J. Sharpe Instruments, Inc.**, 965 Maryvale Dr., Buffalo, N.Y.

RECORD PLAYER/EARPHONE COMBO, *Personal Listener,* eliminates need for loudspeaker in classrooms. 4-speed player, diamond-sapphire turnover cartridge, four-pole motor

and separate volume controls.—**Koss, Inc.**, 2227 W. 31st St., Milwaukee, Wis.

RECORDING AMPLIFIER. Channel separation above 40 db. Designed for use with stereo tape equipment. Two record level meters, two lever controls, mike and line inputs. Trap for recording stereo FM. Colpitts oscillator for 72-kc bias and erase current. Separate record-playback channels for sound-on-sound recording



with headphone jacks.—**Fidelitone, Inc.**, 6415 Ravenswood Ave., Chicago 26, Ill.

1-MIL MYLAR-BASE TAPE. 3-in, 5-in and 7-in reels, 225, 900 and 1,800 feet of tape, respectively. Available soon in lengths for pro-

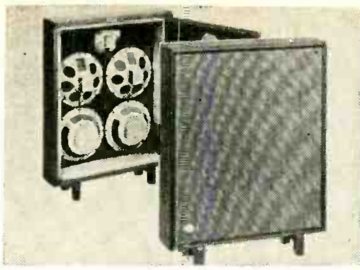
fessional use. Mylar base.—**Sarkes Tarzian, Inc.**, 415 N. College, Bloomington, Ind.

CONSOLE SPEAKER, *model AD-1AS.* 12-in woofer and 3½-in tweeter, wired through crossover network to 8-ohm terminals on back. Tube-vented cabinet design increases base without booming, boosts effective power output.—**Argos Products Co.**, 301 Main St., Genoa, Ill.

HI-FI SPEAKER SYSTEM, *Ravinia.* One 12-in woofer, one 8-in cone mid-range speaker, one 2½-in ring-radiator supertweeter. Crossover

points 600 and 3,500 cycles with 12-db/octave attenuation. Level controls for optimum mid-range and tweeter balance. Response within ±2 db 45 to 17,500 cycles.—**Sherwood Electronic Labs, Inc.**, 4300 No. California Ave., Chicago 18.

SPEAKER SYSTEM, *model S-468.* Two 8-in free-cone speakers, two 8-in mid-range speak-

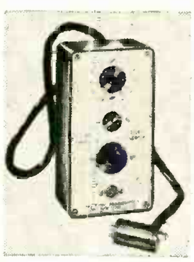


ers, 3½-in cone tweeter. 26¼ x 19⅞ x 5 in.—**Olson Electronic Corp.**, 260 S. Forge St., Akron 8, Ohio

TRANSISTORIZED TAPE RECORDER. Compact. Single control for rewind, off, play and record. Crystal mike and built-in Alnico V dynamic speaker. Two size-D and one 9-volt

transistor battery (not included). Two 3-in reels and 150-ft magnetic tape.—**Edmund Scientific Co.**, Barrington 74, N. J.

SOCKET ADAPTER, *model SA*. Use with any tube checker, including mutual-conductance type, for same tests on 12-pin compactrons, nuvistors, Novars and 10-pin tubes as on older



types. Test by plugging unit into 9-prong socket of present tube tester.—**Electronic Measurements Corp.**, 625 Broadway, New York 12, N. Y.

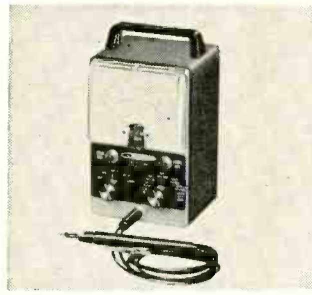
REGULATED POWER SUPPLY, *model RS-24*. Dc plate voltages plus bias and ac filament voltages. Dc output variation less than 1/3 of 1% or 0.3 volt from no load to full load; less than 0.4% or 0.5 volts output variation for ±10-

volt line-voltage variation from 117 ac input. Ripple less than .003 volt rms.—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale, N. Y.

TRANSISTOR AUDIO GENERATOR, *model TE-28*. Sinusoidal output 1,000 cycles. Distortion less than 0.5%, output amplitude adjustable to

0.5 volt rms. Powered by 9-volt battery. May be used for linearity adjustment and low-frequency power measurements of audio amplifiers, testing and adjustment of AM and SSB amateur transmitting equipment, etc.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

VTVM, *Kit model IM-11*. Tests ac volts (rms and peak-to-peak), dc volts, resistance and db measurements. 7 ranges for dc plus, dc minus and ac volts from 1.5 to 1,500 full scale. Meas-

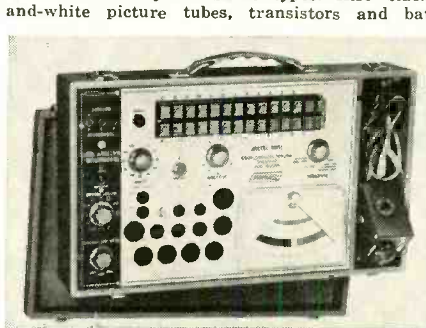


ures resistance 1 to 1,000 megohms in 7 ranges, also 7 ranges for db (−10 to +70), 1 milliwatt into 600-ohm line. 1% resistors, 11-meg input resistance; 4½-in. 200-μa meter. Front-panel controls: rotary function switch, rotary range selector, zero adjust and ohms adjust. All-purpose test probe for all measurements. Component circuit board included.—**Heath Co.**, Benton Harbor, Mich.

MARKER GENERATOR, *model TE-24*. Aligns any tuned circuit within its range; built-in loudspeaker for use as adjustable heterodyne frequency meter. Use 400-cycle audio output

and rf signal tracer. 6 bands for rf output of 120 kc to 130 mc on fundamentals, 120 to 260 mc on calibrated harmonics. External modulation −20 to 15 kc, audio output 0–10 volts. Tube complement: 6CB6, 6BM8, 12AU7, 6X4, two 6J6's. Available at extra cost: marker crystals for calibration of dial to within .005%, rf probe. —**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

TUBE TESTER, *model 1200*. Dynamic mutual-conductance type, pushbutton settings. Tests nuvistors, Novars, compactrons and new 10-pin types; foreign and hi-fi tubes, voltage regulators, battery type tubes, auto radio hybrid tubes, thyratons and many industrial types. Also black-and-white picture tubes, transistors and bat-



teries. Checks for dynamic mutual conductance, shorts and leakage between elements, gas and grid emission. 4½-in panel meter and 7-pin and 9-pin straighteners.—**Mercury Electronics Corp.**, 111 Roosevelt Ave., Mineola, N. Y.

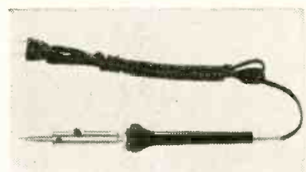
COMPONENT SUBSTITUTOR, *model RC121*. For on-the-spot substitution of carbon and power resistors, capacitors, electrolytics and rectifiers. Each section offers complete range to be used independently and simultaneously, and is identical to manufacturer's equivalent single unit *(H36, ES102, PR111 and RS106)* except

for an improved electrolytic section.—**Sencore, Inc.**, 426 S. Westgate Dr., Addison, Ill.

PORTABLE TUBE TESTER, *model 350*. 86 sockets wired through selector switch and load system, cover 2200 types. Vtvm type meter circuit prevents meter damage. Short-proof power circuit. Automatic constant voltage-regulated transformer for 100–130 volts, 50–60

cycles. Accessory panel: electronic battery analyzer, fuse and lamp continuity check and vibrator tester.—**Seco Electronics, Inc.**, 5015 Penn Ave. So., Minneapolis 19, Minn.

SOLDERING-IRON TIP. Coated copper. ⅛- and ¼-in sizes to fit manufacturer's 18HD,



14HD and 14T irons. Later sizes will include ⅜, ½, ⅝ and ⅞ in.—**P. Wall Mfg. Co.**, Grove City, Pa.

SCREW AND NUT DRIVERS in counter displays. *Assortment RA-48:* 48 round-blade plastic-handle screwdrivers in self-contained

shipping carton. *Assortment SA-75:* 40 hollow-shaft nut drivers, color-coded for size, in self-contained shipping carton.—**Vaco Products Co.**, 317 E. Ontario St., Chicago 11, Ill.

CLEANING SOLUTION for glass tube faces, safety glass, plastic masks, cabinets, etc.

Mask-N-Glas Cleaner is anti-static, nonstaining and nonabrasive.—**Chemtronics, Inc.**, 870 E. 52 St., Brooklyn 3, N. Y. END

All specifications from manufacturers' data

NEW LITERATURE

CATALOGS • BOOKLETS • CHARTS

RECORD CLEANER, CARTRIDGES AND TONE ARM offered in 6-page pamphlet. Photos, specs and full technical details provided.—**Grado Laboratories, Inc.**, 4614 7th Ave., Brooklyn 20, N.Y.

MINIATURE FM TUNERS, *models 310* and *311*, are described in 1-page looseleaf insert. Illustration, specs and schematic diagram included.—**General Instrument Corp.,** F. W. Sickles Div., 165 Front St., Chicopee, Mass.

SEALED CELLS, 13 models, are presented in 10-page fully illustrated *Technical Data Catalog* with complete description of construction and other characteristics, plus list of applications. Physical and electrical summary tables list full specs, and separate technical data sheets are included for each model.—**Sonotone Corp.,** Battery Div., Elmsford, N.Y.

TRANSFORMERS, 57 varieties, listed in illustrated *Catalog TR-62.* Detailed charts give applications and specs. — **Triad Transformer Corp.,** 305 N. Briant, Huntington, Ind.

SEMICONDUCTOR SHORT FORM CATALOG lists 2,550 semiconductor devices, including glass Zener diodes, silicon controlled rectifiers and SCR triggers, silicon small-, medium-, high- and super-power rectifiers plus Zener reference elements. Ratings, characteristics and descriptive data shown, plus full listing of JEDEC rectifier types.—**International Rectifier Corp.,** 233 Kansas St., El Segundo, Calif.

EVERYTHING ELECTRONIC, 384-page 1962 catalog, offers varied equipment for construction, operation, maintenance and repair, plus 12 pages of technical publications. — **Cameradio Co.,** 1121 Penn Ave., Pittsburgh, Pa.

POWER TUBES offered in illustrated 41-page *Form No. PG-101E.* Gives selection Charts by CW and rf-pulse applications. Commercial and Development Tube-Types Section highlights specific features for given requirements; Tabulated Data Section provides information on over 200 types of commercial power-tube types; feature articles offer information on power-tube technology.—**RCA,** Electron Tube Div., Harrison, N.J.

1940 RADIO DIAGRAMS AND SERVICING INFORMATION, plus other manuals on old-time sets from 1926 through 1961, for the radio technician. — **Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill. Most volumes priced at $2.50.

STEREO HI-FI GUIDE contains 138 pages of data on components, accessories and complete systems for audio, amateur radio and CB applications. 78 manufacturers represented.—**Airex Radio Corp.,** 85 Cortlandt St., New York 7, N.Y.

HI-FI LITERATURE includes five pieces: *Catalog No. 145* presents E-V and Wolverine speakers, enclosures and systems, plus hi-fi cartridges. A 6-page brochure features Wolverine speakers, with data on new 3-way LT12. *Catalog No. 141,* 12-page component guidebook, provides description and illustration of 70 systems, from basic arrays to deluxe stereo systems. *Catalog No. 144* offers 20 pages of mikes, loudspeakers, PA equipment, receivers, transceivers, etc. Specs on nearly 200 replacement cartridges are contained in 32-page *Catalog No. 149.*—**Electro-Voice, Inc.,** Buchanan, Mich.

BI-PHONIC COUPLER, 2-inch-thick speaker system illustrated in 2-color catalog sheet, *Form No. 601.* Mini-Wafaire unit fully described, with specs and application data.—**Advanced Acoustics Co.,** 67 Factory Pl., Cedar Grover, N.J.

END

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

TECHNICIANS' NEWS

PICTURE-TUBE LAWS

The states of New York, Pennsylvania and Ohio have enacted laws requiring exact labeling of picture tubes and their cartons. These states also require that the dealer selling to the ultimate consumer must advise the consumer, in writing, the exact nature of the particular tube, such as "All new," "Reused envelope," "Repaired with new electronic parts only," "Envelope and screen are used, electron gun is new," etc.

The laws were designed to permit prosecution of those selling partially rebuilt and rejuvenated picture tubes for full new-tube prices and conditions. What was formerly called a rebuilder goes through many of the same motions in making tubes as do the major manufacturers. Their quality is not necessarily as good as the majors but not necessarily bad either. It has been our experience that all too often the local "independent" tube factories fail to get good enough vacuums, seals, facings or gun placements. Some of these plants try hard but too often come up with a product that is not "first line" but on the other hand, they don't get "first-line" prices.—*The Supreme Effort*

MISSOURI ELECTS OFFICERS

Jefferson City, Mo.—The 1962 slate of officers for TESA-Missouri lists Marion Crane, St. Joseph, president; Howard Wigg, Wellsville, Wm. Pryor, Mountain Grove, Vincent Lutz, St. Louis, Walter Round, St. Joseph, vice presidents; Gene Love, St. Louis, secretary; Carl Adcock, Aurora, treasurer. Six board members were also elected.

A special feature of the annual meeting was an excellent seminar on Zenith color television, presented by Jack Mulford.

SOUTH BEND HAS LICENSE LAW

South Bend, Ind.—The City Council, by a 7 to 2 vote, passed an ordinance requiring licenses for TV service technicians and antenna installers. The ordinance provides for a chief TV inspector, who must be a qualified technician, with five years' experience, and is charged with enforcing the law and inspecting all complaints. An examining board is also created. It is composed of two technicians, one antenna-installer, one TV dealer and one layman. Apprentices must be registered, and must work only under the direct supervision of licensed technicians. The ordinance covers only home entertainment equipment, amateur apparatus and industrial equipment being specifically exempted. Nothing in the ordinance affects a person working on his own equipment. Fines range to $500 for violations.

TV SHOPS FACE CASCADING COSTS

Accountants of local TV servicing firms are arriving at what once would have seemed fantastic amounts necessary to provide businesses to pay overhead and show a reasonable profit. Accountants state that very few TV shops fully realize that costs include depreciation reserve and profit. Those reporting also state that the average shopowner is fabulously generous with his time, and is more likely to give it away, perishable as it may be, than to charge for it.

One TV shop recently received a contract which pays $8.25 per hour, portal to portal. The owner was elated, even though, in order to handle the contract, he was required to avail himself of special training. He was amazed to find that his accountant wasn't nearly as exuberant. He stated, "That's what I've *been* telling you is necessary for your conversion from the status of a slave to business man. Even at $8.25 per hour, your profit, after wages, is only 8%!"

In 1951, it was determined that $5 an hour for shopwork was the minimum necessary for maintaining a sensible profit and overhead. It is unnecessary to dwell on subsequent increased costs amounting to some 59%, for the average shop, reflecting labor and other overhead.

Accountants — men who spend their lives studying business just as the TV man studies TV service—say that it takes $8.25 per hour to make a profit in the TV service business.—*The Supreme Effort*

TRUE STORY FROM MIAMI

Although it's been some 40 years since the first radio knob was turned on by a breathless populace, we, as servicers, are still in a nebulous period in our profession. It's still obsessed with growing pains. It is endeavoring to reach maturity. It is in an age of puberty. Here the adolescence in us is striving hard to break the bonds of babyhood and become a man. This is an age of uncertainty in what's still considered a new and untried profession.

So we need help.

And help we did get. When all about us opportunists were exploiting the electronic service profession; when "wholesalers" patted us on the back and picked our pockets at the same time, one man rose to the occasion. He swore by all that's good and holy that he would protect us, that he would sell only to us and not to our customers. And this he did, and kept his word to the best of his ability.

DX-16 Super Deluxe TV KIT

70° or 90° — operating all 17", 21", 24" and 27" PICTURE TUBES

Dimensions 17½" W x 16" D
Shipping weight 40 lbs.

★ Produces a 16-Tube Chassis with 30-Tube performance.
★ Latest Intercarrier Circuitry and Multi-section Tubes.
★ Standard Neutrode Tuner for Selectivity & Fine Definition.
★ All Video and I.F. Coils factory pre-aligned and tuned.
★ Large 250ma Power Transformer for dependable service.
★ 12" Speaker or Twin-cone 6" x 9" Speaker.

Includes ***LIFE-SIZE*** step-by-step Building Instructions
Most Up-To-Date and Practical Course in Television

COMPLETE KIT with SET of WESTINGHOUSE TUBES $93.49
4—6CB6, 6U8, 6T8, 6C4, 12BH7, 6SN7, 6BQ6, 6W4, 6K6, 1X2B, 5U4. 6BN4, 6GC8, incl. in the Tuner (less CRT)

Also sold on **EASY-PAYMENT-PLAN** Buy LIFE-SIZE Instructions—$2.49—and buy Parts as you build.

BUILD YOUR OWN CABINET FOR ANY TV CHASSIS

Comparable to the type that Top Mfrs. use on high priced TV sets.

CABINET KIT with 90% of the job done, Includes—
FRONT SECTION in Solid Mahogany, Walnut or Blond Korina. **TOP, SIDES, BACK, MASK, SAFETY GLASS, ETC.**
And EASY-TO-FOLLOW ASSEMBLY INSTRUCTIONS

Front, Top and Sides supplied in a beautiful Piano Finish ● Knob panel undrilled ● For matching Mask specify type or number of CRT used. Same price—Mahogany, Walnut or Blond. (Shipping weight 36 lbs.)

21" CABINET KIT 26"H, 25"W, 22"D $26.97

23" TV CABINET KIT .. $28.47
21" or 23" FRONT SECTION for flush to wall mounting.... $19.45
24" or 27" FRONT SECTION for flush to wall mounting $24.97

90° TV CONVERSION KIT all Essential Parts $13.97
110° TV CONVERSION KIT all Essential Parts 15.98
70° TV CONVERSION KIT all Essential Parts $11.97
12" UNIVERSAL TWIN-CONE SPKR. 6.8 magnet 5.97

TECH-MASTER for 1962 ★

CONSTELLATION TV CHASSIS #6015 Complete ready to play (less CRT) $159.50
Brochure on request

EICO Debunks the idea of high prices—on HI-FI, STEREO & TEST EQUIPMENT. See page 30—send order to us on any items shown. Free Surprize Gift with each Purchase. Catalog on request.

TUBULAR CONDENSERS—85°C TOP QUALITY—Equally as good for Radio or TV work

.0047-400v, .01-400v, .015-400v, .02-400v, .047-400v, .001-600v, .005-600v, .01-600v, .015-600v 5¢ ea.
.1-400v, .25-400v, .47-400v, .02-600v, .047-600v, .1-600v, .25-600v, .47-600v, .001-1000v... 8¢ ea.
.0047-1000v, .01-1000v, .035-1000v, .047-1000v, .001-1600v, .007-1600v, .01-1600, .02-1600.14¢ ea.

PACKAGE DEAL #1—52 TUBULAR CONDENSERS (2 of each) .. $3.00

ELECTROLYTIC CONDENSERS—85°C

1-50v, 1-150v, 2-450v, 25-50v, 4-150v..16¢ ea.
10-150v, 20-150v, 40-150v, 50/30-150v, 10-450v, 20-450v, 30-450v, 40-450v, 80-400v........34¢ ea.

PACKAGE DEAL #2—14 ELECTROLYTIC CONDENSERS (1 of each) .. $3.00

CARBON RESISTORS—Regular factory stock in Stackpole, Speer, IRC, etc.

½ WATT 10% 10, 22, 39, 47, 68, 100, 120, 150, 270, 330, 390, 470, 560, 680, 820 1k Ω.....3¢ ea.
½ WATT 10% 1800, 2200, 2700, 3300, 3900, 4700, 5600, 6800, 8200, 10k, 15k, 18k, 22k Ω....3¢ ea.
½ WATT 10% 27k, 33k, 39k, 47k, 56k, 68k, 82k, 100k, 120k, 150k, 180k, 220k, 270k, 330k Ω..3¢ ea.
½ WATT 10% 390k, 470k, 560k, 680k, 820k, Ω 1, 1.2, 1.5, 2.2, 4.7, 6.8, 10, 15 MEG Ω....3¢ ea.

1 WATT 10% 3.3, 10, 39, 68, 82, 100, 120, 150, 270, 330, 390, 470, 560, 680, 820, 1k, 1800 Ω .4¢ ea.
1 WATT 10% 2700, 3300, 3900, 4700, 5600, 6800, 8200, 10k, 15k, 18k, 22k, 27k, 33k, 39k Ω...4¢ ea.
1 WATT 10% 47k, 68k, 82k, 100k, 150k, 220k, 470k, 560k, 680k Ω 1, 2.2, 2.7 meg Ω......4¢ ea.

2 WATT 10% 18, 22, 47, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820 Ω.5¢ ea.
2 WATT 10% 1k, 1500, 1800, 2200, 2700, 3300, 3900, 4700, 6800, 8200, 10k, 15k, 18k, 22k Ω..5¢ ea.
2 WATT 10% 27k, 33k, 39k, 47k, 68k, 100k, 150k, 220k, 270k, 330k, 470k, 680k Ω 1, 10 meg Ω 5¢ ea.

PACKAGE DEAL #3—200 CARBON RESISTORS (½w—2 ea.) (1 & 2w—1 ea.) .. $6.00

WIREWOUND RESISTORS

5-10w, 7-10w, 10-10w, 15-10w, 20-10w, 28-10w, 36-10w 12¢ ea.
40-10w, 50-10w, 56-10w, 60-10w, 70-10w, 85-10w, 100-10w, 150-10w, 180-10w, 200-10w.....12¢ ea.
250-10w, 350-5w, 470-10w, 560-10w, 650-10w, 680-10w, 820-5w, 1k-10w, 1500-5w, 2k-10w....12¢ ea.
2500-10w, 3k-10w, 5k-10w, 6k-10w, 7k-10w, 8k-10w, 9k-10w, 10k-10w 15k-10w, 20k-10w......12¢ ea.

PACKAGE DEAL #4—37 WIREWOUND RESISTORS (1 of each) .. $3.40

CERAMIC CONDENSERS

1, 2, 3, 5, 6, 10, 20, 22, 25, 30, 33, 47, 50, 56, 68, 75 mmf...4¢ ea.
82, 100, 150, 220, 250, 270, 330, 470, 1k, 1200, 1500, 2k, 3300, 3900, 5k, 6800, 10k mmf.....4¢ ea.

PACKAGE DEAL #5—66 CERAMIC CONDENSERS (2 of each) .. $1.90

MICA CONDENSERS

5, 22, 25, 50, 60, 65, 68, 75, 80, 100, 120, 150, 220, 270, 33S mmf..4¢ ea.
350, 470, 510¢ 560, 680, 820, 1k, 1500, 2k, 2500, 3300, 3900, 4700, 6k, 6800, 8k, 10k mmf.....4¢ ea.

PACKAGE DEAL #6—64 MICA CONDENSERS (2 of each) .. $1.90

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- ☐ 100 – ASSORTED TUBE CARTONS $1
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- ☐ 30 – ASST. PILOT LIGHTS 44, 46, 47, 51, etc. .$1
- ☐ 20 – PILOT LIGHT SOCKETS bayonet, wired ...$1
- ☐ 5 – TRANS. 9 VOLT BATTERIES same #216 ...$1
- ☐ 100 – ASSORTED FUSES choice asst 3AG, etc....$1
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- ☐ 20 – ASST. WIREWOUND RESISTORS 10w. ...$1
- ☐ 100 – ASST. ½ WATT RESISTORS some 5% .$1
- ☐ 70 – ASST. 1 WATT RESISTORS some 5% ...$1
- ☐ 35 – ASST. 2 WATT RESISTORS some 5% ...$1
- ☐ 100 – CERAMIC COND. 2, 25, 33 or 47 mmf . .$1
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- ☐ 60 – ASST. MICA CONDENSERS some 5% ...$1
- ☐ 50 – ASST. MICA TRIMMER CONDENSERS . .$1
- ☐ 60 – ASSORTED TUBULAR CONDENSERS . . .$1
- ☐ 25 – TUBULAR CONDENSERS .047-600v $1
- ☐ 75 – TUBULAR CONDENSERS .001-400v......$1
- ☐ 40 – TUBULAR CONDENSERS .193-600v $1
- ☐ 25 – TUBULAR CONDENSERS .1-600v $1
- ☐ 15 – ASST. RADIO ELECTROLYTIC COND. . .$1
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- ☐ 1 – 5½" PM SPEAKER 1.47 oz. Alnico magnet . .$1
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- ☐ 3 – VOLUME CONTROLS ½meg w/switch 3" shaft. $1
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- ☐ 75 – OCTAL WAFER SOCKETS 8 pin $1
- ☐ 75 – NOVAL WAFER SOCKETS 9 pin $1
- ☐ 100 – LOCTAL WAFER SOCKETS 8 pin $1
- ☐ 60 – ASSORTED SOCKETS all types $1
- ☐ 50 – ASST. TERMINAL STRIPS 1, 2, 3 and 4 lug .$1
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- ☐ 5 – 50' SPOOLS HOOK-UP WIRE asst. colors .$1
- ☐ 50 – STRIPS ASST. SPAGHETTI best sizes ...$1
- ☐ 1 – LB. ROSIN CORE SOLDER 40/60 ....$1
- ☐ 100 – RUBBER FEET for cabinets best sizes $1
- ☐ 300 – SELF TAPPING SCREWS #6, 7 and 8 . .$1
- ☐ 10 – ASST. LUCITE CASES handy for parts $1
- ☐ 1000 – ASST. HDWRE screws, nuts, rivets, etc. . .$1

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Therefore, in turn, he prospered. Or did he?

Boundless gratitude on the part of practitioners of our profession should have overwhelmed him with success, automatically. True, much praise and commendation came to him and his fame traversed the nation. Here, at last, was a man among men, deliberately proclaiming his exclusive dedication to the success of our livelihood. Therefore, we must support him and contribute nobly to his own livelihood.

But, the "saddest words of tongue and pen are: 'It might have been'."

We didn't support him!

Small numbers of us supported him—small, that is, in comparison to the volume of business we handled. We gave him of our business as best we could, knowing full well we were helping a friend of ours who was a friend indeed. A minority of us stood by him, steeling ourselves against the withering onslaughts of discounts and more discounts from cut-throat, competing parts wholesalers. But most of us just gave him lip service. And lip service fits but poorly in the till. The vast majority of us, in and out of TESA-Miami, just did not support our hero. Our adolescence would not be shed.

In time, the doldrums have come upon us. Business is poor. So, our man, in full stride, helped us in our quandary, and carried us on his books, and supplied us with merchandise, even though we could not (and some *would not!*) pay him. But still he carried us —the "rubber band" just stretched, and stretched, and stretched.

Eventually rubber bands break. So did this one—

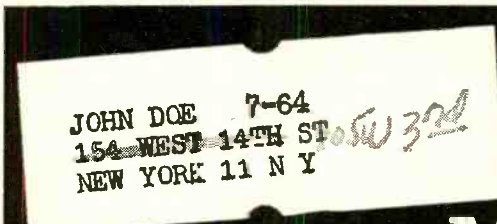
Now, disillusioned, but not embittered, he seeks the meekest way out of a business which promised much and gave so little. He still has faith in the cause of the independent electronics servicer, and he sympathizes with our problems. *He still believes in us.*

Too bad we didn't believe in him.

A.E.S.

P.S. No need to ask him about the touchy details. Gentleman that he is, he'll never admit that we let him down.
—TESA-Miami News editorial END

Sorry—I must have dozed off!



MOVING?

Please send us your old address as it appears on the latest copy of the magazine. Include the numbers shown beside your name. If possible send the actual address label pasted on the lower right hand corner of the front cover. Be sure to include postal zone number (if any) with your new address. If we receive this information before the 20th of the month, you will continue to get Radio-Electronics without interruption.

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Technotes

DOUBLE TROUBLE

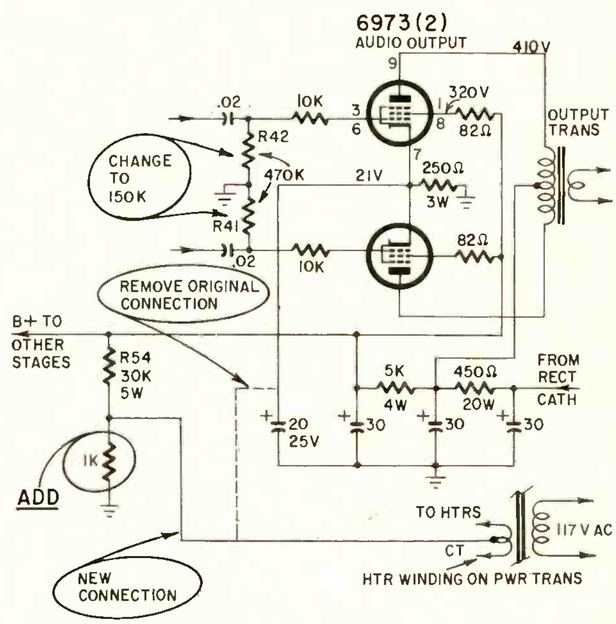
This RCA KCS92 was really a headache. At first glance the job was simple—no pix or sound on some stations. Others were barely there. Others were overloaded. Obviously the 12AU7 agc amplifier was at fault. But when it was changed, the symptoms appeared unchanged. The original tube was replaced and the symptoms examined again.

The second time around, it looked like the 6BQ7 rf amplifier might be bad. So we went ahead and replaced it. Again no apparent change in symptoms. To be on the safe side, a second 12AU7 and 6BQ7 were tried. This time both were replaced simultaneously to save time. The result was a perfect picture and good sound.

Not wanting to charge the customer for two tubes when only one was needed, we pulled the 6BQ7 and replaced the original one. Our trouble reappeared. So we again installed the new 6BQ7 and pulled the new 12AU7. Again the original symptoms appeared. Seems that both tubes went bad at about the same time.—*C. S. Lawrence*

KNIGHT KIT 18-WATT AMPLIFIER

A somewhat puzzling trouble develops in the output stage of the Knight No. 83YX786 amplifier kit. In my case, it occurred after about 6 months of excellent service when suddenly the volume dropped to nothing except for occasional "breaks" of distorted sound. Checking to make sure that the trouble was in the amplifier and not in the FM tuner or phono, I noticed that the two 6973 output tube plates were red hot, indicating excessive plate current. Upon turning the set on again later, it would operate normally for 5 minutes to several hours before the same condition would recur.



Although the instruction manual says that rosin from the rosin-core solder can be left on the printed-circuit boards after soldering the various components, after a time the residue of rosin causes leakage across the conductor foils and leads to the condition described above. The grids of the 6973 tubes go positive because of leakage across the circuit boards, resulting in excessive plate current, distortion and loss of volume.

The remedy is simple. Remove all rosin from both circuit boards with a service chemical or a stiff brush, being careful not to damage the conductors. (If you are building any piece of equipment that uses a printed-circuit board, always clean the board after soldering). Then replace the 6973 grid resistors R41 and R42 (470,000 ohms) with lower-value units. I used 150,000-ohm resistors and there is no noticeable change in bass response.

Since 6973 tubes are rather expensive, I would recommend disconnecting their cathodes from the center tap of the heater winding. If a short should occur between the heater and the cathodes of the ECC83/12AX7 which are grounded, all bias would be removed from the 6973's causing heavy plate current which would damage the tubes.

The heater-winding center tap is connected to the cathodes to bias the heater's 21 volts positive to lower the hum level. You can do the same thing by disconnecting the lead on R54, which goes to ground. Now wire this lead to an insulated tie lug and connect a 1,000-ohm ½-watt resistor from the tie lug to ground. Wire the heater center-tap lead (green-yellow) to the tie lug. This places a bias of about 10 volts positive on the heaters.—*R. P. Anderson*

G-E CHASSIS M5

Complaint: Intermittent loss of horizontal sync. Hold control would not bring set into sync, nor would horizontal stabilizer slug.

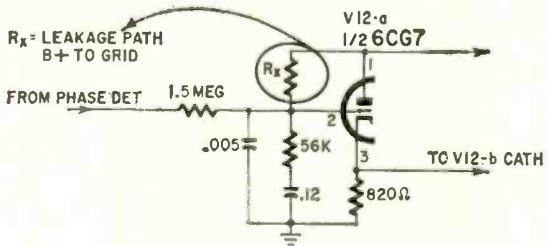


Fig.1

Cure: The grid of the first section of the horizontal multivibrator was found to be intermittently 2 volts positive, rather than the usual 0.5 volt. No component faults could be found. Close inspection of the etched-wiring board

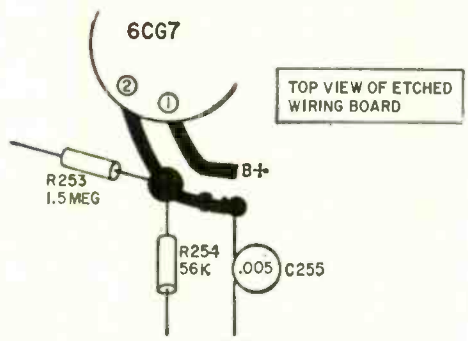


Fig.2

revealed that a small area of the board was intermittently breaking down between B-plus and the grid line of V12-a. This caused it to conduct heavily, which in turn killed the horizontal sync. The solution was to scrape the area around the grid line of the etched-wiring board and apply corona dope.—*F. R. Wuensche* END

WANTED: INDUSTRIAL TECHNOTES

RADIO-ELECTRONICS wants Industrial Technotes. These should cover equipment (including closed-circuit television) actually used in industrial work, or technotes on counters, controls and other apparatus whose users are largely industrial. Unillustrated Technotes pay $5; circuit diagrams raise the price to $9 and acceptable photos are worth $7 each. Send your technotes from industry to Technotes Editor, RADIO-ELECTRONICS, 154 W. 14th St., New York 11, N. Y.

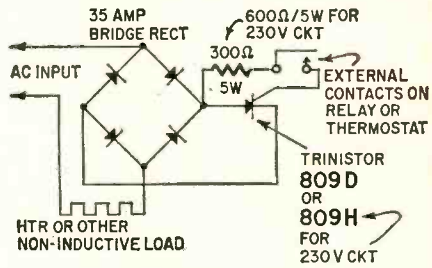
NOTEWORTHY CIRCUITS

SOLID-STATE RELAY

Many small temperature-controlled heaters and ovens operate through an on–off temperature control consisting of a heavy-duty thermostat or a light-duty thermostat and a power relay. Rapid cycling of heavy load currents shortens relay or thermostat life and leads to early failure. When the load is a non-inductive type, circuit failure can be minimized and rf interference and mechanical noise eliminated by replacing the contactor with a silicon-controlled rectifier such as the Westinghouse Trinistor.

A controlled rectifier conducts when the gate circuit is closed and blocks when the gate circuit is open. This circuit, taken from Westinghouse *Tech Tips*, shows how a Trinistor is used as a power relay or contactor controlled by a low-power relay or thermostat. Components listed handle non-inductive circuits drawing up to 35 amps.

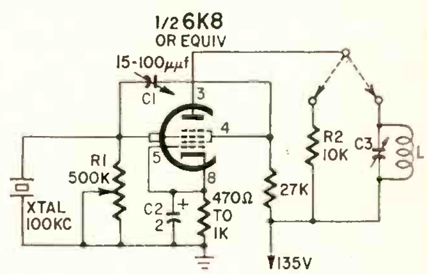
The full-wave bridge acts as a one-way valve that permits the Trinistor to conduct on both halves of the ac cycle. When the thermostat or control relay contacts open the gate circuit, the ac circuit to the load is blocked by

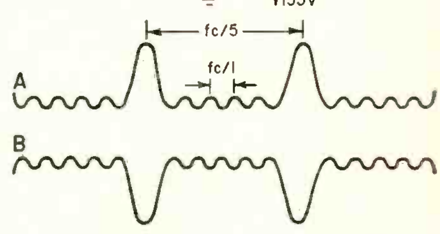


the bridge rectifier and load voltage is zero. When the contacts close, the Trinistor conducts and feeds full line voltage to the load. Components are shown for 115- and 230-volt operation. For 115-volt operation the bridge rectifier is made up of four 35-amp 400-volt piv sections. The bridge for 230 volts has 35-amp 1-kv piv rectifiers in each leg.

FREQUENCY DIVIDER

This crystal-controlled frequency divider provides high output pulses at submultiples of the crystal frequency. I used the hexode section of a 6K8. [Any rf pentode should work equally well. Try





the circuit with the suppressor connected to the plate and to the cathode to see which works best.—*Editor*]

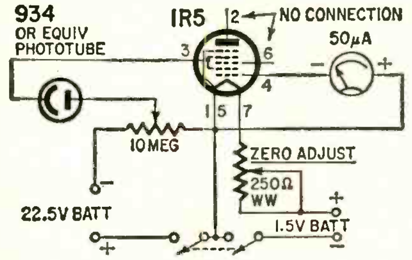
Tune L–C3 to the desired submultiple frequency and adjust R1 and C1 for optimum performance. If C1 is too small, the circuit operates as a fundamental oscillator without submultiple output. A plate load resistor may be substituted for the tuned circuit. Increase its value for higher submultiple output. C2 must be large enough to bypass the submultiple frequency fully.

Waveform A appears at the screen grid when dividing by 5. Pattern B appears at the plate when using R2 instead of the tuned circuit.—*Albert H. Taylor*

ULTRASENSITIVE LIGHT METER

This simple light meter has approximately the sensitivity of a photomultiplier tube with its circuit complications. The circuit is based on the theory developed in my article "Contact Potential for Loadless Metering" in the April 1957 issue.

The circuit is so simple that very little explanation is needed. First, observe the polarities closely as some are not what would normally be used.



The entire circuit may be put in a small steel box. If the photocell is to be located away from the box, mount it in a steel housing connected to the box with a shielded cable. The shield must be connected to the anode of the photocell and the slider of the 10-meg pot. The 50-μa meter will appear to read backward (right to left) but this can be overcome by mechanically zeroing the pointer on the right side of the meter instead of the left, and reversing the meter leads. Almost any high-vacuum photocell can be used; the 934 in the drawing is just an example. Do not use tube sockets. Solder all wires direct to the terminals of the 934 and 1R5.

After final assembly, wash the area surrounding the cathode of the photocell and pin 3 of the 1R5 with service cleaner and then wipe with a clean paper towel. The 250-ohm pot is to zero-adjust the meter. The circuit works very well in low light intensities.
—*Thomas L. Bartholomew* END

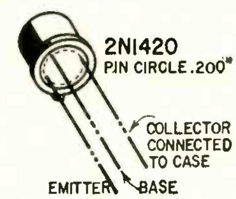
Just an unusual kind of interference—now get it fixed!

NEW TUBES and SEMI-CONDUCTORS

THINGS ARE POPPING THIS MONTH. WE have a new nuvistor triode, a medium-power switching transistor and a group of tubes for FM radios. Several other interesting items round out the column.

2N1420

A silicon n-p-n medium-power transistor for high-speed switching and high-frequency amplifier applications.



The reliability of each transistor is assured by an in-process environmental testing program.

Design limits of the Honeywell 2N1420 are:

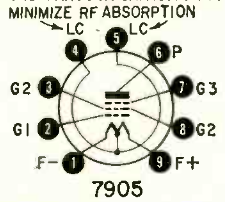
V_{CB}	60
V_{CE} (R_{BE} = 10 ohms)	30
V_{EB}	5
P_{total} (watts)	
25°C ambient	0.6
25°C case	2
100°C case	1

Electrical characteristics are:

h_{FE} (minimum)	100
(maximum)	300
h_{fe} (minimum)	2.5

7905

A beam-power pentode in a 9-pin miniature envelope intended for use in mobile and emergency communications equipment. It is particularly useful in rf power amplifier, oscillator and frequency-multiplier service at frequencies



7905

up to 175 mc. At 175 mc, the RCA 7905 can deliver 7 watts of useful power under ICAS (intermittent commercial and amateur service) conditions.

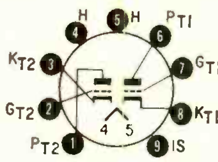
Typical operating characteristics for the 7905 as a 175-mc rf power amplifier under ICAS conditions:

V_P	300	300

V_{G2} (dc)	160	185
V_{G1} (dc)	−36	−39
(peak rf)	41	43
I_P (dc ma)	50	60
I_{G2} (dc ma)	2.5	4
I_{G1} (dc ma)	2	2.2
Driving power (watts)	1	1
Useful power output (watts)	5.5	7

6JK8, 8JK8, 17JK8

These are a series of dissimilar dual triodes in 9-pin miniature envelopes designed especially for FM tuners. They include a strap frame grid rf amplifier and an oscillator–mixer. Except for their heater ratings, the tubes are identical. The 6JK8 has a 6.3-volt 400-ma heater; the 8JK8—8.4 volts, 300 ma; the 17JK8—16.8 volts, 150 ma.



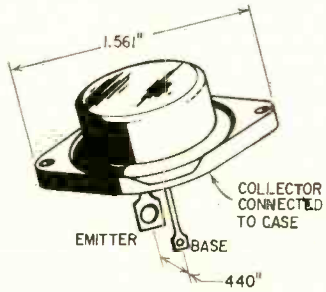
6JK8,8JK8,17JK8

Typical ratings of these Sylvania tubes when used as class-A1 amplifier:

	Oscillator (Triode 1)	*Rf amplifier (Triode 2)*
V_P	100	135
V_G	−1	−1.2
I_P (ma)	5.3	10
g_m (μmhos)	6,800	13,000
μ	55	70
R_P (ohms)	8,000	5,400

2N514, -A, -B

A series of p-n-p alloy-junction germanium high-power transistors intended for high-power conversion, high-current switching or audio amplifier output circuits.



2N514,-A,-B

Maximum ratings for these Texas Instruments devices are:

I_C (amps)	25
I_B (amps)	5
P_{total} (watts)	150

Electrical characteristics are:

	2N514	*2N514-A*	*2N514-B*
BV_{CBO}	40	60	80
BV_{CEO}	30	40	80
BV_{CES}	50	60	65

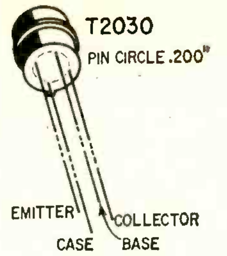
T2030

A germanium micro-alloy diffused-base transistor (MADT) for use in vhf and uhf oscillator circuits. Polarities are similar to those of p-n-p junction transistors.

Maximum ratings of this Philco transistor are:

V_{CB}	20
V_{CES}	20

V_{EB}	0.2
P_{total} (mw)	60

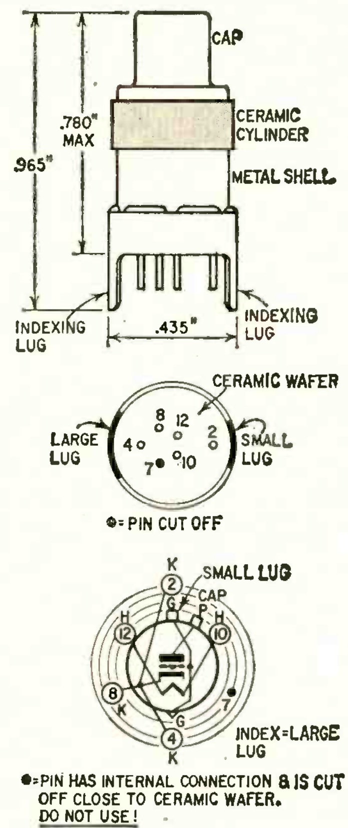


Electrical characteristics are:

h_{FE} (dc amplification factor)	33
PO (power output, mw) (V_{CC}=—12)	2.5

8058

A nuvistor hi-mu triode of a double-ended type, intended for use in cathode-drive rf-amplifier service up



8058

to 1,200 mc in a variety of applications.

Maximum ratings for the RCA 8058 nuvistor are:

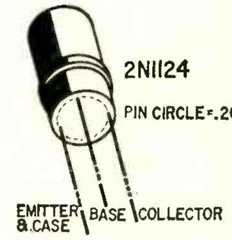
V_P	150
V_G (pos bias value)	0
(neg bias value)	55
P_P (watts)	1.5
I_K (ma)	15

Characteristics when used as a class-A1 amplifier are:

V_P (supply voltage)	110
V_G (supply voltage)	0
R_K (ohms)	47
μ	70
R_P (ohms)	5,600
g_m (μmhos)	12,400
I_P (ma)	10

2N1124

A p-n-p high-voltage medium-power germanium alloy-junction transistor for industrial use in general-purpose amplifier and switching applications in the frequency range from audio to 100 kc. It is particularly useful in teletypewriters, control amplifiers, ignition systems, mobile radios and desk calculators.



Maximum ratings of the Philco 2N-1124 are:

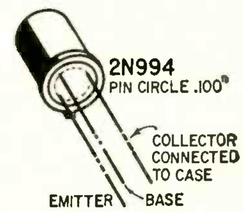
V_{CB}	40
V_{CES}	35
V_{EB}	40
I_C (ma)	250
I_C (peak ma)	500
P_{total} (mw)	300

Electrical characteristics are:

h_{fe} (typical)	125
f_{hfb} (typical cutoff frequency, kc)	1,300

2N994

A germanium epitaxial mesa p-n-p transistor for high-speed switching in industrial and military equipment.



Absolute maximum ratings of the G-E 2N994 at 25°C are:

V_{CES}	15
V_{CEO}	6
V_{CBO}	15
V_{EBO}	4
I_C (ma)	150
P_{total} (mw)	200

Switching characteristics are:

t_{on} (typical turn-on time)	17 nanoseconds
t_{off} (typical turn-off time)	28 nanoseconds

END

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Some larger libraries still have copies of Modern Electrics on file for interested readers.

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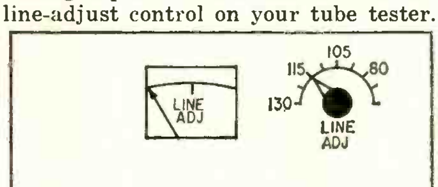
HORNS AND TRUMPET SPEAKERS WITH COMMUNICATIONS RECEIVERS

If you have a communications receiver with a low-impedance output between 3 and 6 ohms, you'll find a horn-type trumpet speaker far more efficient than the usual regular small or large speaker. The signal-to-noise ratio also seems to improve. To use the regular speaker, the receiver's audio gain had to be turned up very much higher than when the horn trumpet was used.

Any small horn or trumpet will do the job quite nicely and a larger PA trumpet horn also does a nice job. Horn type trumpets are by far more efficient in power transfer because of the large magnet used and the beaming of the sound.—*G. P. Oberto, K4GRY*

TUBE TESTER ADDITION MONITORS LINE VOLTAGE

How many times do you call at a customer's home, for complaints of insufficient sweep width, intermittent rolling, drifting focus, horizontal sync pulling, varying contrast, etc., and waste time checking tubes only to find that the line voltage is low or fluctuating in that particular area? You can save quite a bit of wasted time by adding a pointer knob and scale to the line-adjust control on your tube tester.



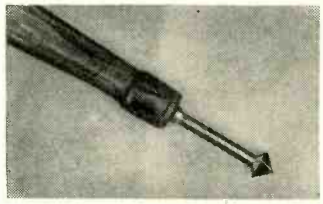
With this addition, you can easily check and monitor the line voltage on the tester. It also serves as a constant reminder not to forget possible trouble due to incorrect or varying line voltage.

Remove the plain knob from the line-adjust potentiometer of the tube tester and replace it with a pointer knob. Then with a Variac or other line regulator, calibrate the pointer indication for the various voltage values from about 80 to 130. Calibrate the control by turning it for a given line voltage to bring the pointer on the meter to the line-adjust mark on the meter scale. Then, mark the voltage value on the new scale for the pot. It's only a 20-minute job, and will save a lot of aspirins on house calls.—*Robert G. Middleton*

HOLE DEBURRING TOOL

A worth-while adjunct to the constructor's tool kit is a hole deburring tool. It eliminates many finger cuts from drill flutes, and considerable pressure may be applied comfortably to remove heavy burrs. The tool is assembled from two easily obtained items—a file handle and a wood countersink.

The hole in the file handle is enlarged to prevent splitting. The countersink is



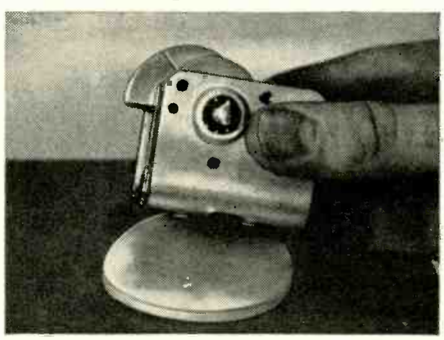
set in the hole and seated with a couple of hammer taps, with the point protected by a scrap block of wood. Of course, the hole can be drilled for a loose fit and the countersink seated in wood putty or a mixture of sawdust and glue, iron cement or similar filler.—*Carl Remel*

SOLDERING-IRON KINKS

When the tip of your soldering iron freezes tight, merely dip the tip into a small glass of undiluted household ammonia for about 5 minutes to loosen it. To keep it from sticking in the first place, coat the tip with a very light grease. Then rub the tip in some powdered graphite. Now you can insert the tip into the end of the soldering iron. Old, but good, tips can be given the same type of treatment. It will keep tips from ever freezing in the ends of your soldering irons.—*A. von Zook*

PAD IS SHOCK MOUNT

A foam-rubber callus pad like the one pictured makes a good resilient shock mounting for a small variable



capacitor or other part. The adhesive of the pad will stick almost anywhere for quick and easy mounting.—*Charles A. Cunningham*

PRECHILL THAT PART

Before soldering leads of a transistor or diode into a circuit, prechill the part with a chilling chemical such as Zero Mist. The prechilling will almost eliminate the possibility of heat from the iron or gun causing damage to the component. But use the chemical sparingly. A too rapid change in temperature might harm some components.—*J. C. Alexander* END

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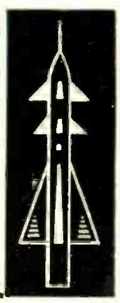

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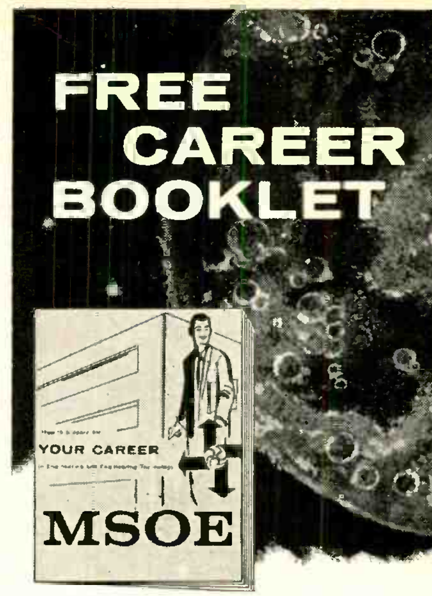

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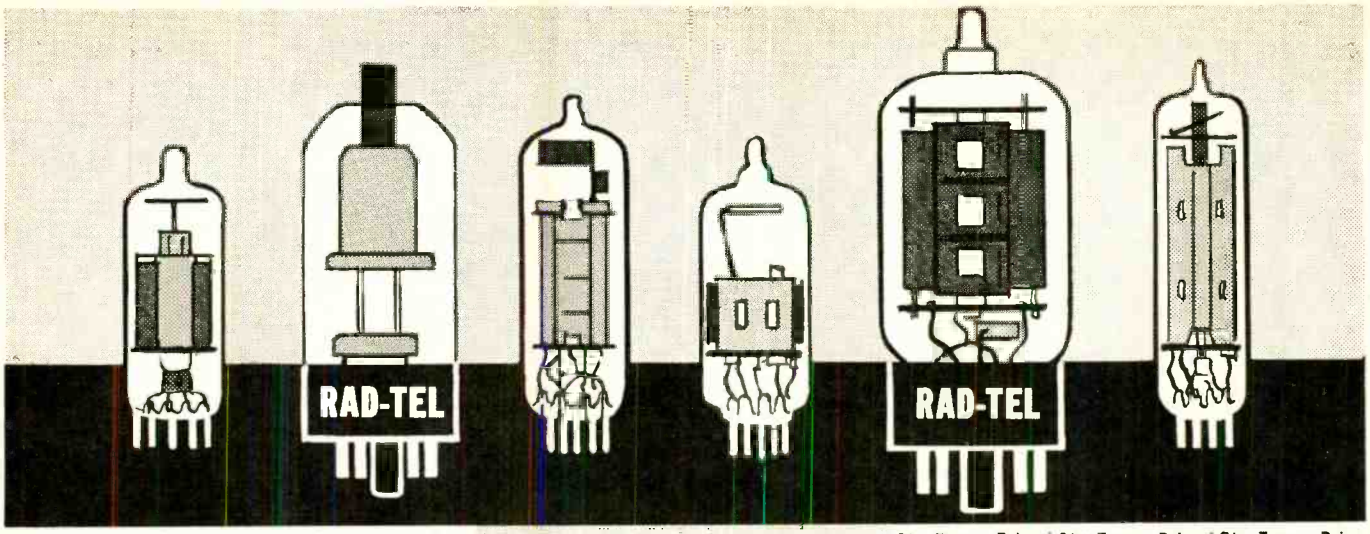
ELECTRONIC DRAFTING HANDBOOK, by **Nicholas M. Raskhodoff.** *The MacMillan Co., 60 Fifth Ave., New York 11, N. Y. 6 x 9 in. 395 pp. $14.75.*

Starting with a chapter explaining electronics to the possibly non-electronic draftsman, the book covers the whole field of schematic and mechanical drawings for electronics. An excellent series of appendices, consisting of 165 pages, is included. END



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8CS7	.74	12DT8*	.79	25W4	.68
8CX8	.93	12DU7	1.01	32ET5	.55
8EB8	.94	12DW8*	.89	32L7	.90
8SN7	.66	12DZ6	.56	35B5	.60
9CL8	.79	12ED5	.69	35C5	.51
11CY7	.75	12EG6	.54	35L6	.57
12A4	.60	12EK6	.56	35W4	.42
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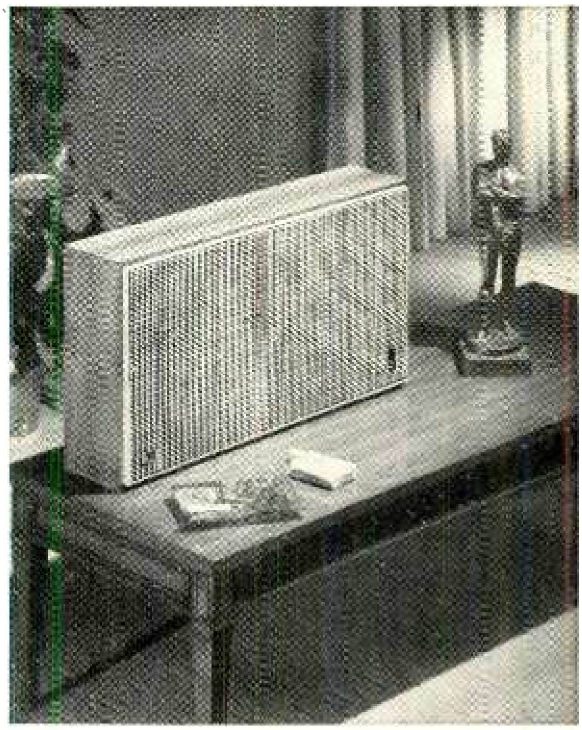

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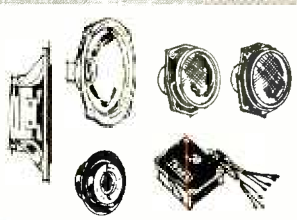
7 

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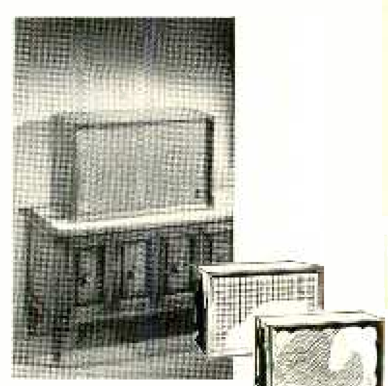

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21AMP4A	21ACP4 21ACP4A 21AMP4	21AMP4A 21AQP4 21AQP4A	21BSP4 21CUP4
21ZP4B	21ZP4	21ZP4A	21ZP4B
21YP4A	21YP4	21YP4A	21AFP4

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