SPECIAL REPORT—New Stereo Pickups and Arms

SEPTEMBER

Radio-Electronics

HUGO GERNSBACK, Editor

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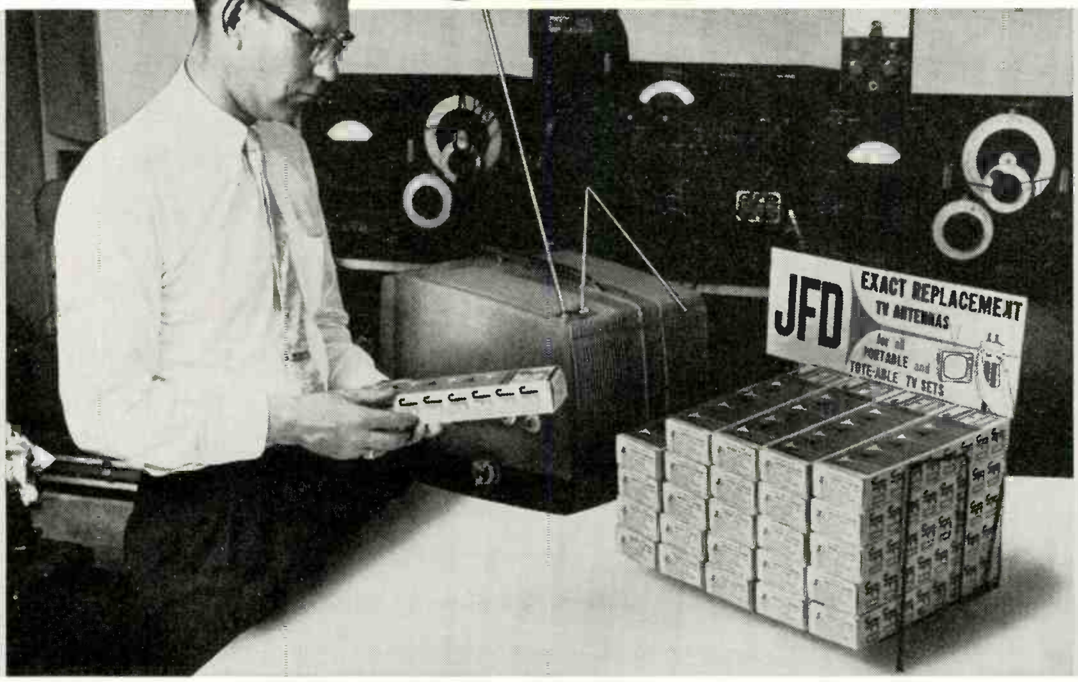
See Page 46

Why are more Service-Dealers Switching to JFD EXACT REPLACEMENT TV ANTENNAS?



because

50 per cent of all TV sets made in the last 4 years are portables—sending *more* antenna replacement business to service-dealers every day.

because

with the JFD PA500 and PA515 Exact Replacement Kits, dealers are ready and able to service *90%* of antenna replacements for portables and tote-ables.

because

as JFD Exact Replacement Specialists, service-dealers can get out of the unprofitable "rabbit-ear" business—earn a *profit* on the antenna *sale* (at full mark-up) *and* on the *installation*.

because

with JFD guides, streamers, and sales helps, service-dealers get the merchandising *know-how* that nets them a bigger slice of the *3,500,000* dollar portable antenna replacement market.

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because

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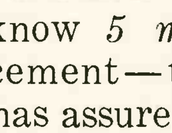
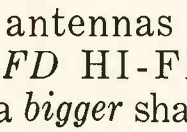
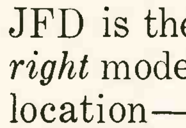


HI-FI BANSHEE
Silver or Gold Anodized



HI-FI FIREBALL
Silver or Gold Anodized



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RADIO

WHAT'S NEW

INDUSTRIAL ELECTRONICS

TELEVISION

TEST INSTRUMENTS

ON THE COVER

(Story on page 46)

The swing-back and lock-in chassis units on this piece of radar apparatus installed at Newark (N.J.) Airport prove that electronic equipment can indeed be so designed that it is easy to service.
Color original by Habershaw Studios

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Average Paid Circulation Over 174,000

RADIO-ELECTRONICS is indexed in *Applied Science & Technology Index* (Formerly *Industrial Arts Index*)

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SUBSCRIPTIONS: Address correspondence to Radio-Electronics. Subscriber Service, 154 West 14th St., New York 11, N.Y. When requesting a change of address, please furnish an address label from a recent issue. Allow one month for change of address.
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ADVERTISING REPRESENTATIVES and **FOREIGN AGENTS** listed on page 134.
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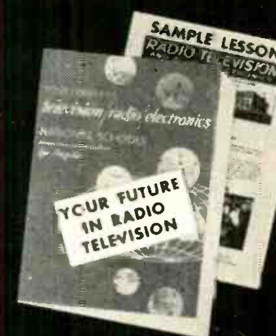

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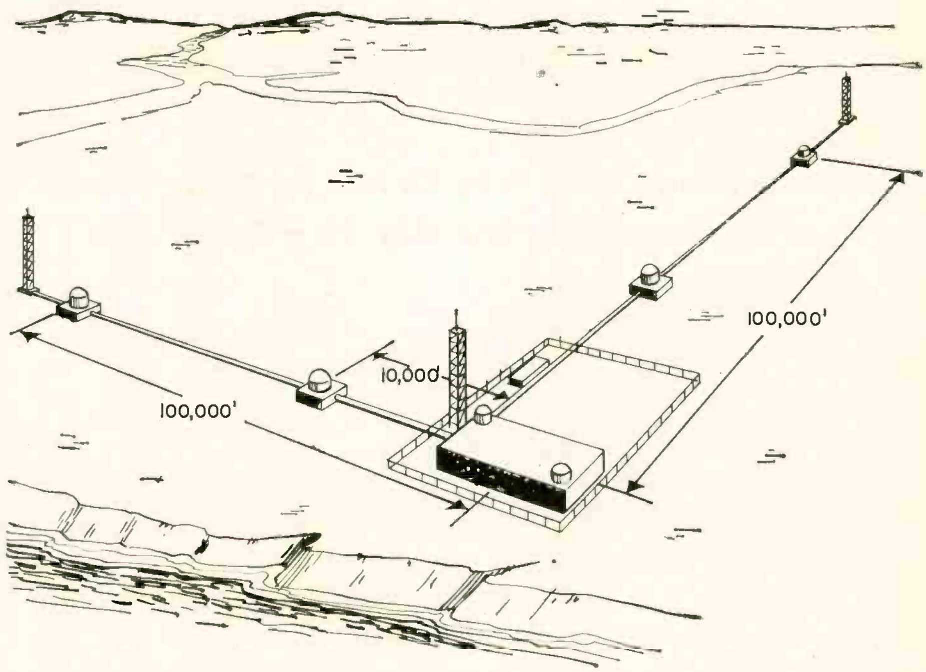
News Briefs

Flattest Speaker?

A new speaker–microphone considerably flatter than conventional speakers has been announced by Emerson Radio & Phonograph Corp. A unit demonstrated by Benjamin Abrams, president of Emerson, was 16 inches in diameter and only ⅜ inch thick.

The speaker is made up of two perforated metal plates. Between them lies what is believed to be a diaphragm with a printed-circuit voice coil. It can be made as small as a button for use as a hearing-aid speaker or microphone or almost any other size and shape.

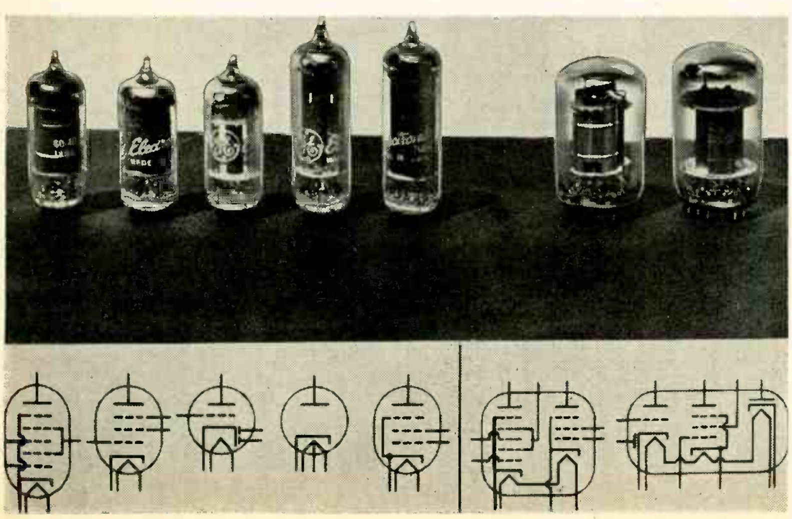
The device was developed at the Weizmann Institute in Israel under a research and development program performed jointly by Emerson and a French company. Emerson has exclusive rights to the invention in the Western Hemisphere, according to Mr. Abrams.



Three Tubes in One Envelope

A new group of electron instrumentalities made by G-E combine the functions of up to three separate tubes in a single 12-pin envelope. These Compactrons will make possible size and price reductions in radios, TV's, hi-fi sets and many other types of electronic equipment. For an example of Compactron savings see the photo. The two units on the right replace the five standard radio tubes on the left, and represent a saving in cost, size and operating power.

Development engineers at G-E also said that other circuit elements could be included in evacuated Compactrons, giving a hint of a receiver where all smaller components (resistors and capacitors) would be combined with tubes in plug-in packages.



Accurate Missile Tracking

A missile tracking system, so accurate that its most serious errors are due to our not knowing the exact speed of light, will be built near Cape Canaveral by General Electric. The MISTRAM system (*MIS*sile *TRA*jectory *M*easurement system) is designed to determine, with extreme accuracy, the guidance performance of missiles fired from the Cape.

The basic system, which should be completed and in operation by January, 1962, will consist of a group of five receiving stations arranged in an L (see diagram). Antennas at the five stations (one central station and four remotes) will follow the flight of a missile and receive signals from a radio beacon in the missile. Measurements will be made on a CW carrier to get an exact indication of phase difference of extremely high-modulation frequencies.

The range measured by the central station using these signals, and that from each remote is used to determine the position of the missile.

The unusual part of the MISTRAM system is that it does not require huge tracking antennas since azimuth and elevation data can be derived by computers from the range and range-difference information.

Uhf Tests

Experiments that may change the whole face of our TV allocations system will commence as two uhf test stations go into operation about July 1, 1961. Congress approved the FCC project when it appropriated $2 million for the stations. One of the stations will be in the heart of New York City—the other about 10 miles away.

With the vhf channels (2 to 13) getting scarce, the FCC intends to

(*Continued on page* 10)

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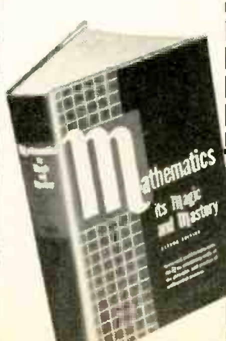

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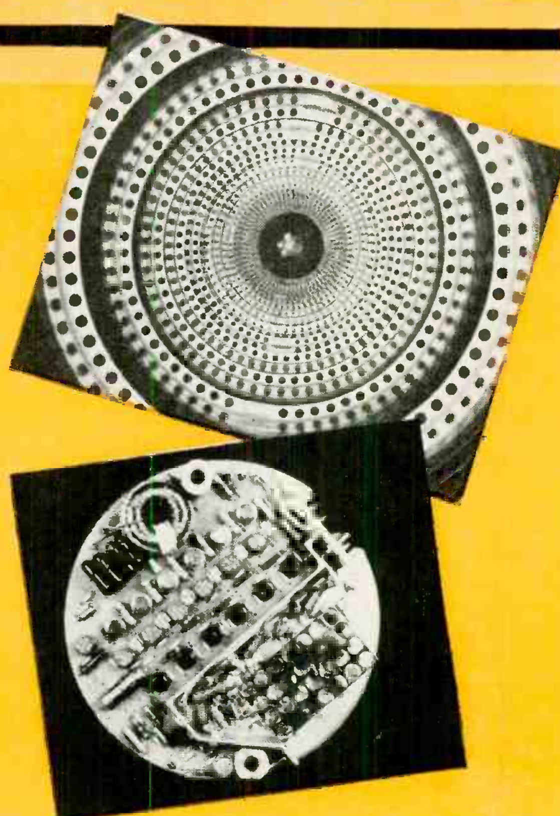

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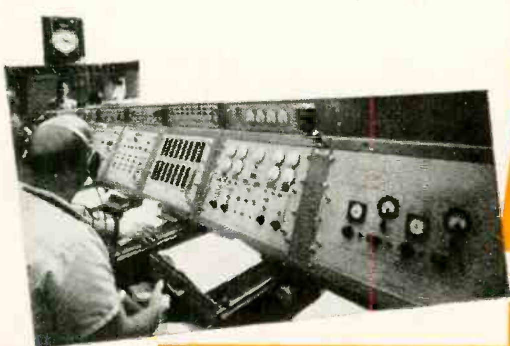

As the count-down ticks off, every detail must be perfect. It is electronic technicians who help make this possible; and who install, repair and maintain such equipment as this.

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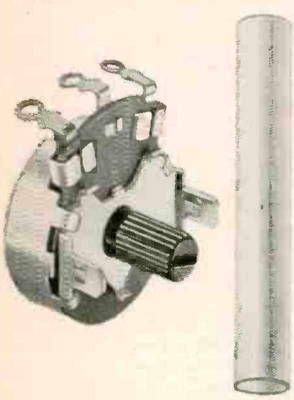

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find out if uhf (channels 14 through 82) is practicable in difficult reception areas such as a skyscrapered city.

Uhf signals are supposed not to travel as far as those of vhf. Ghosts caused by reflections off buildings are considered more troublesome with uhf.

Some of the points to be covered are uhf signal strength as compared with vhf signal strength at the same location and the most practical tuner design.

Teeners and Radios

The great majority of teen-age girls have their own radios, according to a survey taken by *Seventeen* magazine.

The survey shows that 93.5% (4,500,000) of the magazine's readers (under 20) personally own a radio; 90.8% listen to the radio during the average day (70.2% at night); 76% report disc-jockey shows as their favorites and 715,000 expect to get a new radio within the next 12 months.

Laser—A Light Amplifier

The first device actually to amplify visible light was announced by Dr. Theodore H. Maiman of Hughes Aircraft. He developed the laser (*l*ight *a*mplification by *s*timulated *e*mission of *r*adiation) that does the amplifying. The device could be used as a light radar that would use

light waves (up to 500,000 billion cycles) in place of microwaves. Another possible application is in TV and voice communications where the needle-sharp beam (if projected from the earth to the moon the beam would spread to only 10 miles in diameter) offers a static-free line that resists jamming. The high resolution due to its sharp beams permits detailed pictures of any area—

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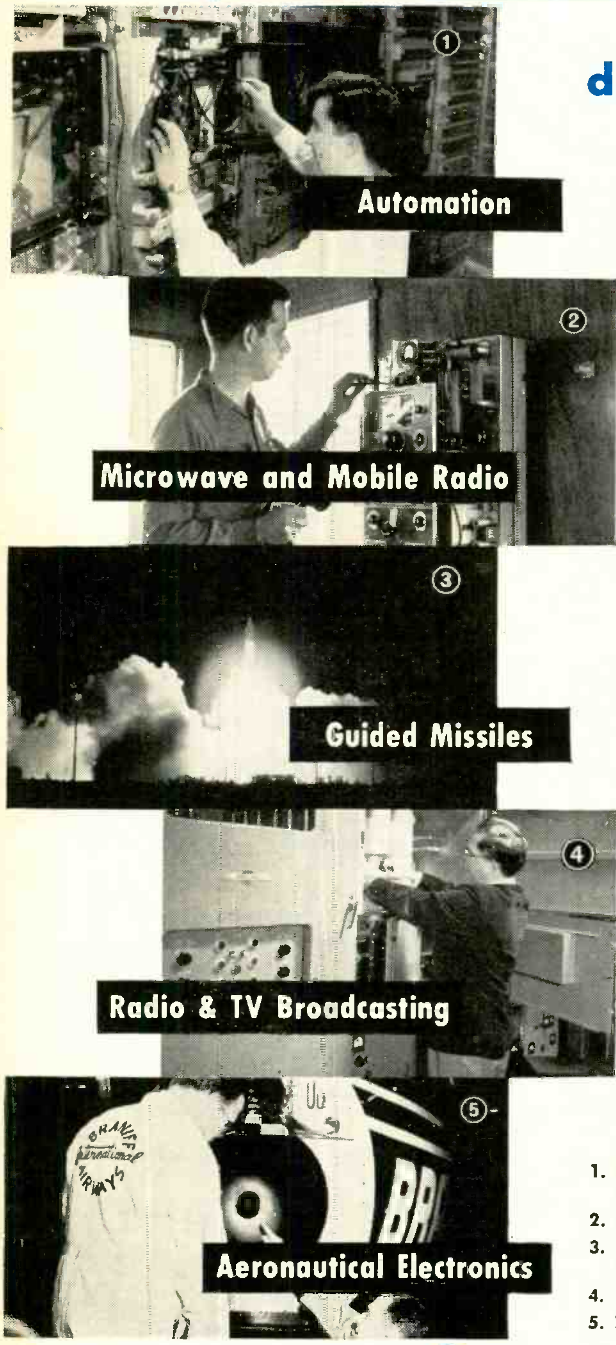

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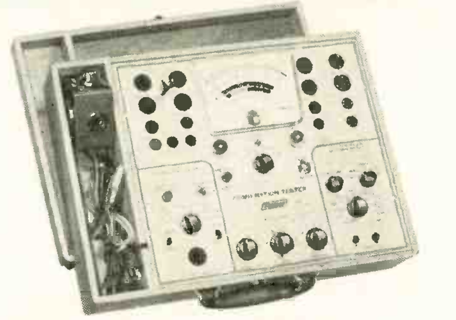

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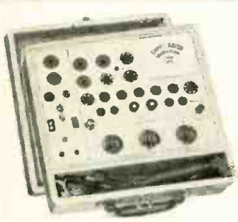

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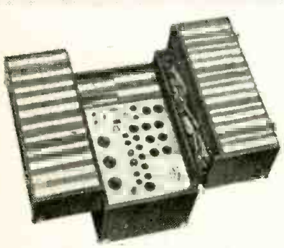

A deluxe tube tester and compact tube caddy . . . all-in-one.
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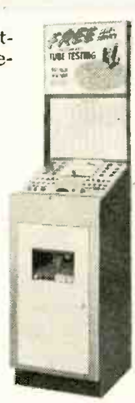

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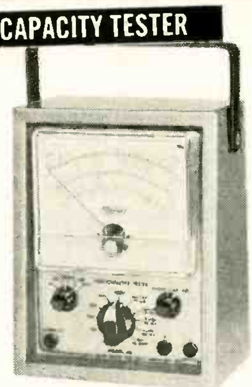

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Two-Color TV for Japan

A Japanese TV manufacturer is planning to put a two-color-system color set on the market in Japan. Mr. Saburo Soda, president of the Chuo Musen Co., Tokyo, claims that the cost of the set will be about one-third that of a standard three-color set.

The set converts the ordinary three-color signal to a two-color signal. It is then fed to a black-and-white picture tube. To get color effects, a two-color wheel (red and green) is spun in front of the tube face. The reproduced colors are said to be not as natural as those obtained on a standard receiver, but they are "at least serviceable." Adjustments and maintenance are said to be easier.

While two-color TV systems have been demonstrated in the past, Mr. Soda made it clear that his is an independent system, developed on a theory put forward by a Tokyo engineer on the basis of the two-color theory announced last year by Dr. Edwin Land of the Polaroid Corp.

Acoustic Thermometer

An acoustic thermometer to measure high-altitude air temperature has been used by Soviet scientists at a height of 16 miles, according to Tass, the Soviet press agency.

The device consists of two parts. One is a radiator and two microphones; the other is a generator and electronic "device for measuring the time of sound propagation."

According to Tass: "Once the time sound takes to travel from the radiator to the microphone is known, the exact temperature of the air can be computed."

The thermometer depends on the principle that the speed of sound through air increases as the air temperature rises. It was developed at the Radio Physics Laboratory of the Soviet Academy of Sciences' Institute of Physics of the Stratosphere.

Asks 50 Satellites

A plan calling for placing about 50 communications satellites in orbit has been presented to the FCC by the Bell Telephone System. The

(*Continued on page* 18)

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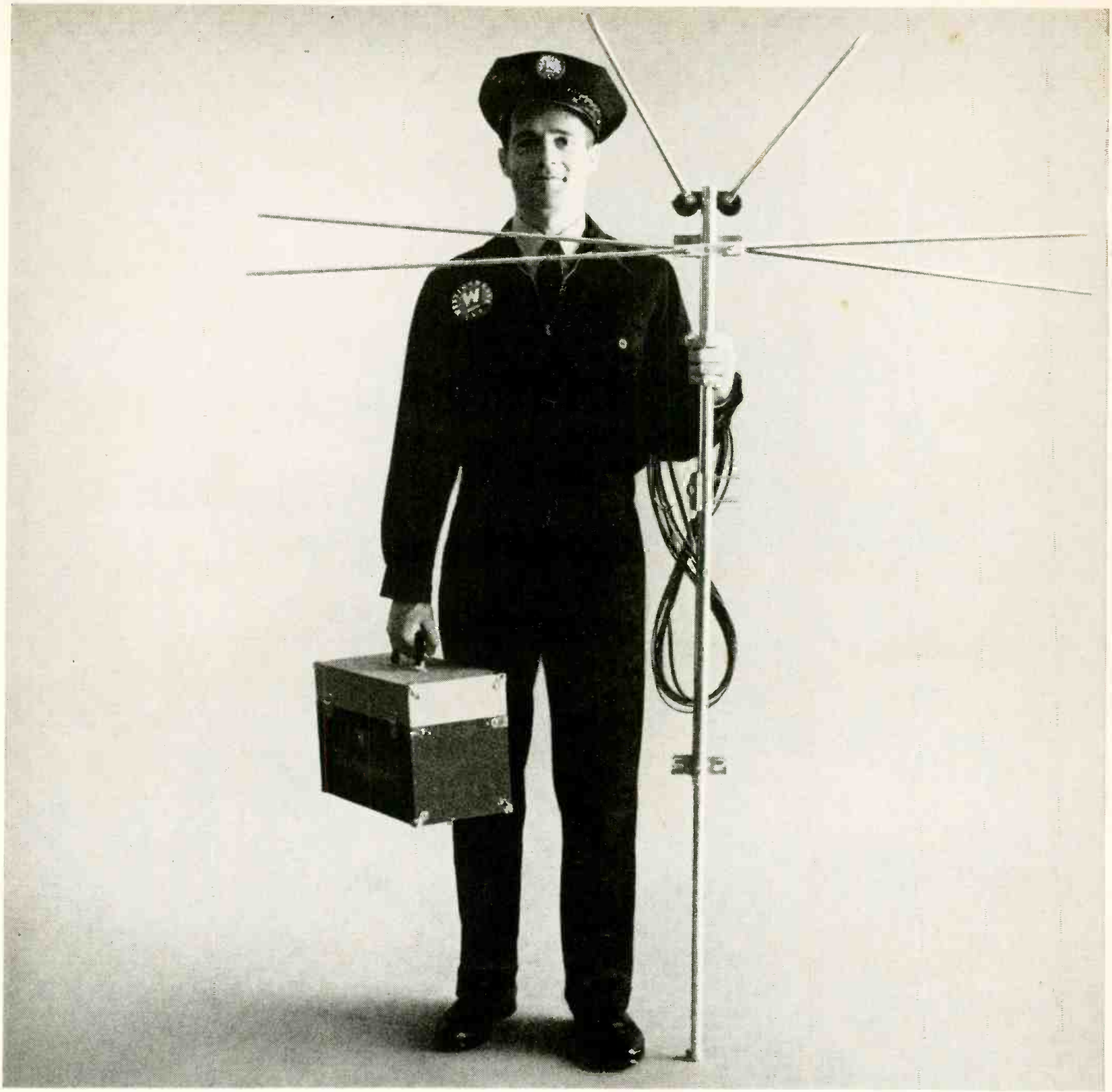

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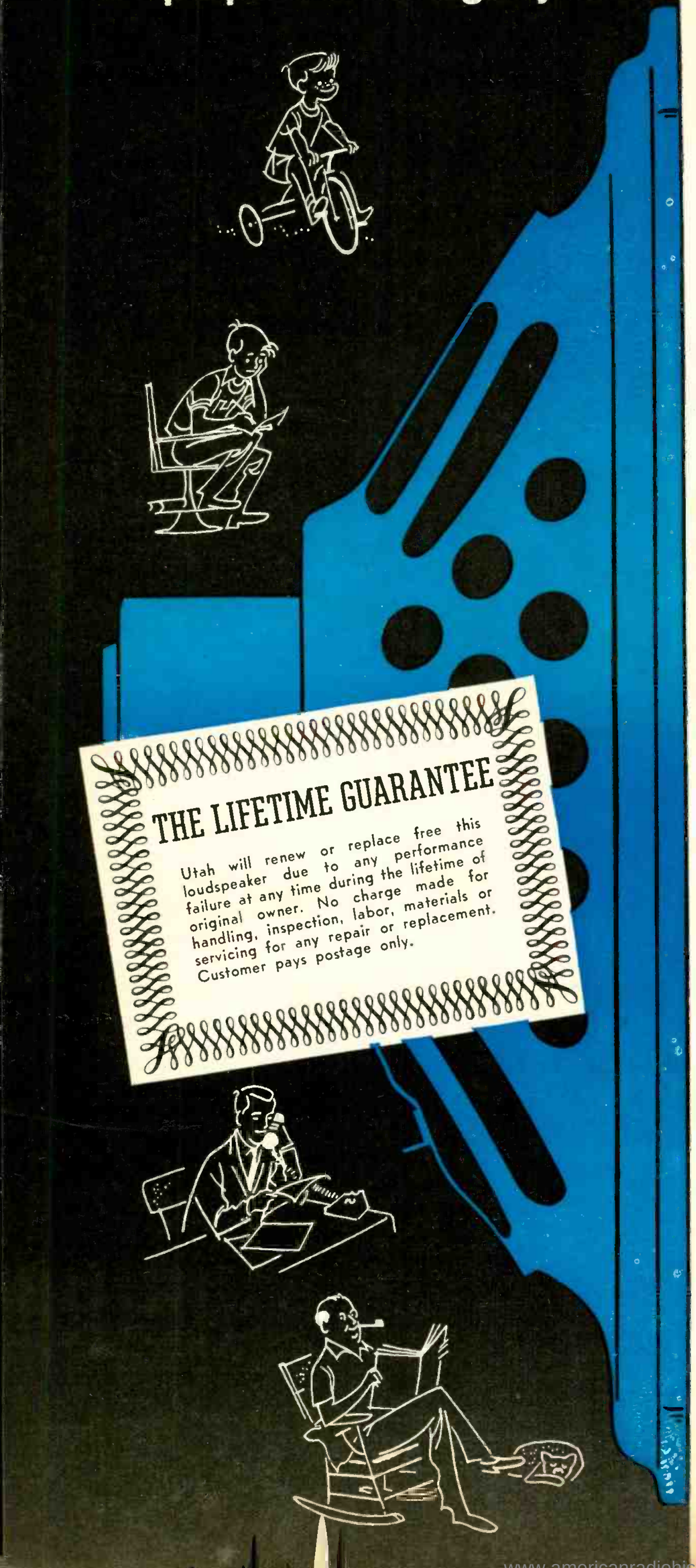

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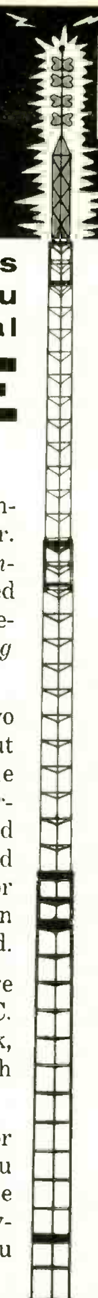

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Robert Watson, Star Route, Box 24, Renovo, Pa.	1st	12
William H. Patchin, 3865 Westview Ave., NW, Canton, Ohio	1st	12
V. Dean DeVore, 309 Bess Street, Washington, Ill.	1st	16
Edward T. Wall, Box 184, Kenly, N. C.	1st	12
James W. Wranich, 4236 Michigan Street, Kansas City, Mo.	1st	20
Robert E. Sullivan, 2475 E. Douglas, Des Moines, Iowa	1st	12
Nelson S. Kibler, 1413 Patrick Henry Dr., Falls Church, Va.	1st	18
Barry L. Ulrich, 1110 Chestnut Ave., Barnesboro, Pa.	1st	14
Jerry E. Milligan, 707 Ragsdale Dr., Milan, Tenn.	1st	12
Robert S. Davis, 2100-10 Ave., So., Apt. 12, Birmingham, Ala.	1st	13

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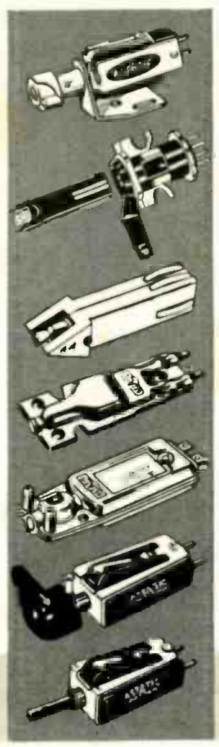

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NEWS BRIEFS *(Continued from page 12)*

satellites, spaced about 3,000 miles apart, would provide communication facilities between the US and all other world areas. In most instances, a direct hookup could be made with no intermediate stations in any other country. The proposal indicated that the Bell system would expect to share in the cost of the program.

The best frequencies for space use would be between 1,000 and 20,000 mc. "Our future in world communications and our future in the exploration and exploitation of space depend on the wise use of the very limited range of frequencies in the electromagnetic spectrum which is suitable for satellite communication and for other space purposes," Mr. James B. Fisk, president of Bell Telephone Laboratories, said.

Calendar of Events—September 1960

Joint Automatic Control Conference, Sept. 6–8, M.I.T., Cambridge, Mass.

New York High Fidelity Music Show, Sept. 6–11, New York Trade Show Bldg., New York, N.Y. (RADIO-ELECTRONICS and GERNSBACK LIBRARY will exhibit in Room 525).

Conference on Communications, Sept. 9–10, Roosevelt Hotel, Cedar Rapids, Iowa.

EIA Fall Conference, Sept. 13–16, French Lick, Ind.

Joint Military Industrial Electronic Test Equipment Symposium, Sept. 14–15, Museum of Science & Industry, Chicago, Ill.

Eighth Annual Engineering Management Conference, Sept. 15–16, Morrison Hotel, Chicago, Ill.

Upper Midwest Electronic Trade Conference, Sept. 15–17, Minneapolis Auditorium, Minneapolis, Minn.

New England High Fidelity Show, Sept. 16–18, Boston, Mass.

ERA Business Management Institute, Sept. 18–23, Urbana, Ill.

International Symposium on Data Transmission, Sept. 19–21, Technische Hogeschool, Delft, Netherlands.

National Symposium an Space Electronics and Telemetry, Sept. 19–22, Shoreham Hotel, Washington, D.C.

Industrial Electronics Symposium, Sept. 21-22, Manger, Cleveland, Ohio.

Symposium on Broadcasting, Sept. 23–24, Willard Hotel, Washington, D.C.

High Fidelity Show, Sept. 23–25, Palmer House, Chicago, Ill.

ISA Fall Instrument-Automation Conference & Exhibit and 15th Annual Meeting of Society, Sept. 26–30, Coliseum, New York, N.Y.

National Communication Symposium, Oct. 3–5, Hotel Utica and Utica Municipal Auditorium, Utica, N.Y.

Conference on Radio-Interference Reduction, Oct. 4–6, Chicago, Ill.

EIA Conference on Value Engineering, Oct. 5–6, Disneyland Hotel, Anaheim, Calif.

National Electronics Conference, Oct. 10–12, Hotel Sherman, Chicago.

Engineering Writing and Speech Symposium, Oct. 13–14, Bismarck Hotel, Chicago, Ill.

Symposium on Adaptive Control Systems, Oct. 17–19, Garden City Hotel, Garden City, N.Y.

Symposium on Space Navigation, Oct. 19–21, Deshler-Hilton Hotel, Columbus, Ohio.

International Congress & Exhibition for Instrumentation and Automation, Oct. 19–26, Dusseldorf, Germany.

East Coast Aeronautical and Navigational Electronics Conference, Oct. 24–26, Lord Baltimore Hotel, Baltimore, Md.

Conference on Non-Linear Magnetics and Magnetic Amplifiers, Oct. 26–28, Bellvue-Stratford Hotel, Philadelphia, Pa.

1960 Electron Devices Meeting, Oct 27–28, Shoreham Hotel, Wash. D.C.

Conference on Electronic Techniques in Medicine and Biology, Oct. 31–Nov. 2, Sheraton Park Hotel, Washington, D.C.

IRE-EIA Radio Fall Meeting, Oct. 31–Nov. 2, Syracuse Hotel, Syracuse, N.Y.

END

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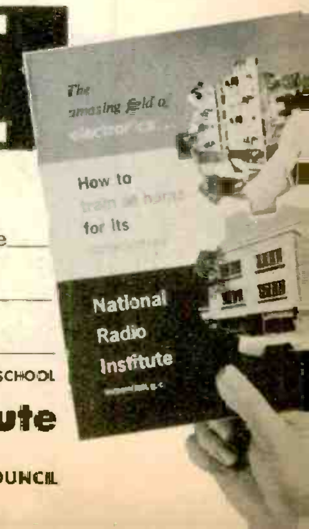

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Correspondence

MIDDLETON–MACK FEUD

Dear Editor:

Regarding the Mr. Mack–Bob Middleton feud:

There are not six readers of the magazine who know what Mr. Middleton was talking about, much less what Mr. Mack yacks about.

The only one who knows what Mr. Mack was talking about is Mr. Mack.

Mr. Mack is sticking his nose into a business that does not appreciate his comments.

If Mr. Middleton thinks no one reads and appreciates his general run of articles, he is mistaken. I recently heard a technician say that he swears by Bob's articles.

However, I will agree with Mr. Mack on one point—Mr. Middleton shouldn't have started this particular issue in the first place. At least, not in a publication catering to technicians and experimenters. The further a technician stays away from this line of thinking, the better. It only adds to the existing confusion.

HAROLD DAVIS

Jackson, Miss.

[The article on "Characteristic Impedance" by Mr. Middleton in which "Eggy" was attacked appeared in the March, 1960, issue. Mr. Mack's letter defending "Eggy" appeared in the June issue. Mr. Middleton answered Mr. Mack in the July issue of RADIO-ELECTRONICS.—*Editor*]

METAL DETECTORS

Dear Editor:

Your "Underwater Metal Detector" article, by Kenneth Richardson (July, page 30) shows once again how simultaneous invention can occur in widely separated places and minds.

Since my "retirement" here in sunken-treasure-rich Florida, I've been fooling around with a number of metal-detector principles, including the very one described by Mr. Richardson. To make test work easier, I used a plastic water pail with a salt solution on my desk top.

One trouble with such bridge circuits is that they indicate *any* change in resistance between the probe (single or multiple) and the larger area plate. Such changes are caused by variations of salinity, polarization of electrodes, galvanic voltages, etc. I also found that the bridge circuit can be eliminated by using a 1.5-volt flashlight cell, a 5-ma. meter, a very-minute-area probe electrode and another larger electrode of

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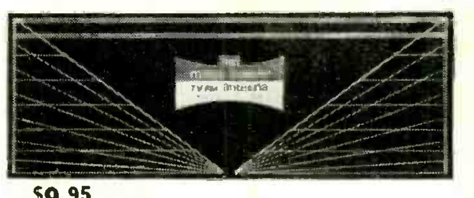

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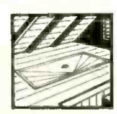

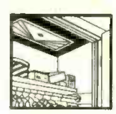

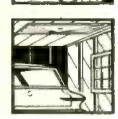

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the same metal (the probe electrode should be positive). If this probe has an area of only 1/64 square inch or less, the normal current in the milliammeter will be practically zero, due to a layer of gas which quickly forms on it (the probe). But when it contacts a piece of metal of larger area, the current increases. The head of a pin is easily detected and larger metal objects cause strong or off-scale indications. The multiprobe rake scheme was found to be excellent for probing larger ground areas.

I also tried another scheme using no battery, one small-area probe electrode, another large-area electrode (both of zinc) and a 5- to 10-ma meter, using salt (sea) water as the electrolyte. This develops no voltage unless the probe electrode contacts another and different metal object.

The meter reading varies with the kind of metal object contacted. Some typical values are: aluminum—0.2 ma, steel or iron—18 ma, brass—8 ma, copper—4.5 ma, lead—14.7 ma, carbon—1 ma and nickel—8 ma.

Of course, any detection device which requires direct, conductive contact with the sought-for metal object is beset with the difficulty of obtaining such contact in many underwater locations, especially after prolonged submergence. Calcerous deposits of coral, etc. soon enclose all objects in a hard coating. For this reason inductive devices are preferable. These also operate through sand and other covering material such as mud, coral, etc.

Using the Hughes induction-bridge circuit with a foot-diameter air-core coil, a 6-volt battery and buzzer and headphone indicator, a half-dollar coin can be detected at about 2 inches, a silver spoon somewhat farther and still larger metal objects at greater distances.

A radio-frequency heterodyne system (a fixed-frequency oscillator beating against another oscillator whose frequency is modulated by the presence of a metallic object in the field of an air-core search coil) can be made much more sensitive and is also unaffected by submersion even in salt (sea) water. This type is necessarily more complicated and it is more difficult to maintain a normal zero beat. The sensitivity and criticalness of adjustment increase with the oscillator frequencies.

I am working on still another and more effective principle but cannot disclose it now.

BENJAMIN F. MEISSNER
Miami Shores, Fla.

ON STATIC CONTROLS

Dear Editor:

The article "Static Controls In Industry" on page 63 of the April (1960) issue was very interesting. However, it should be brought out that the magnetic amplifier system of the Westinghouse CYPAK is not the latest in static control. While CYPAK has many advantages over electromechanical devices such as relays and timers, it leaves a

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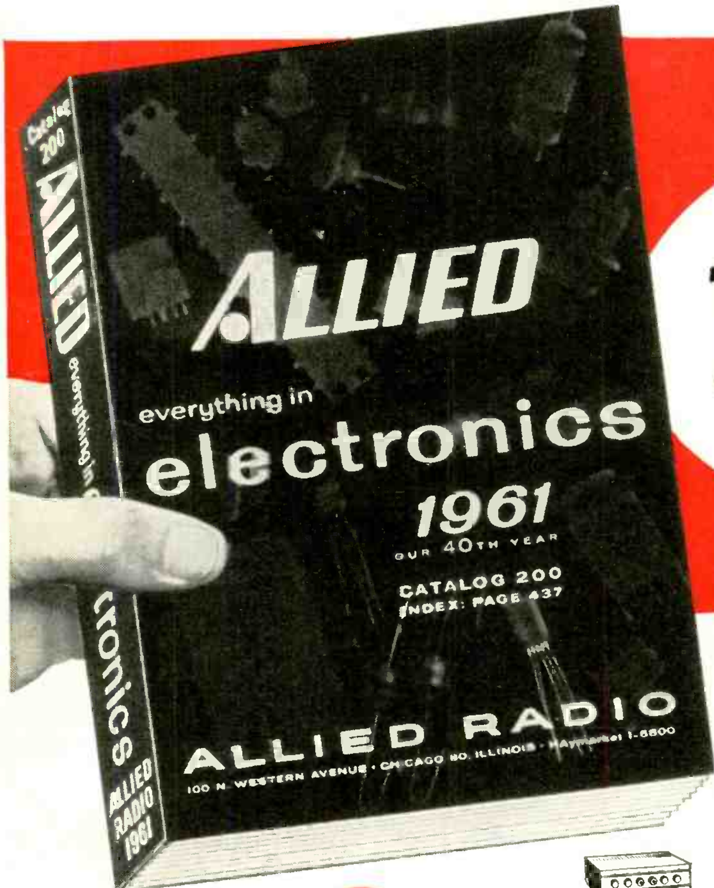

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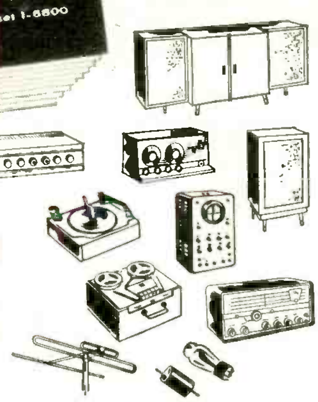

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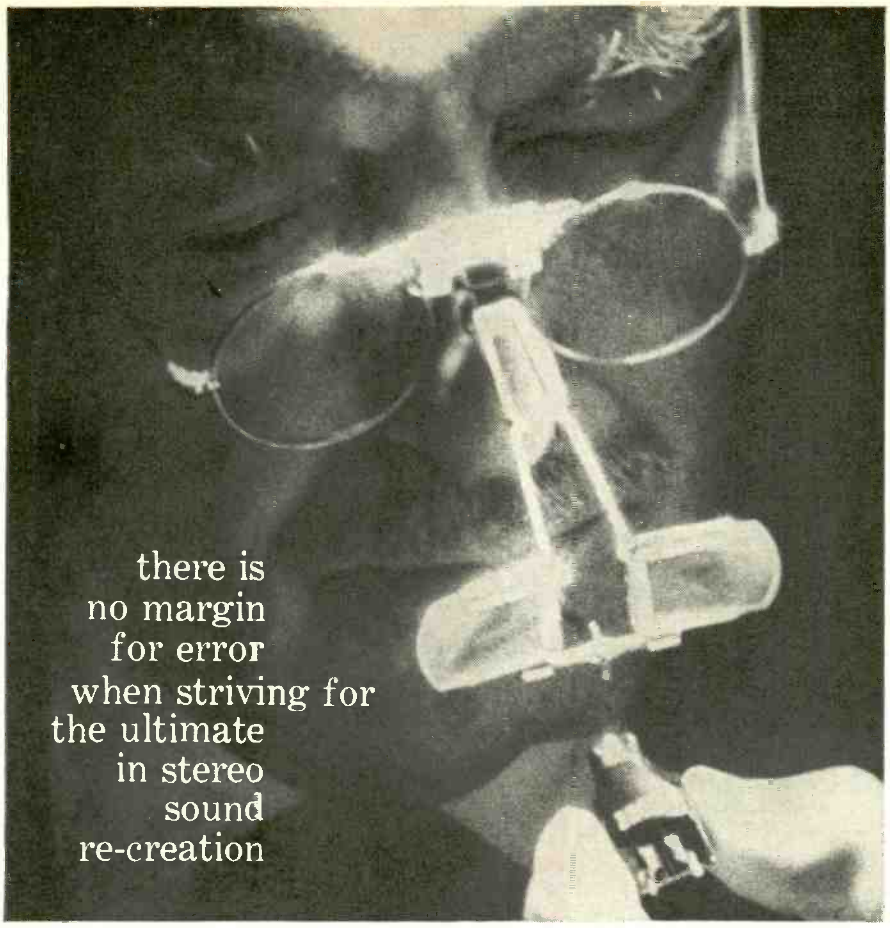

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lot to be desired when compared with transistorized static units such as the Square D Co. NORPAK.

The NORPAK system is smaller and lighter than an equivalent CYPAK system. Another advantage of the NORPAK is its response speed, up to 25,000 times per second.

The logic functions *and, or* or *not* can be accomplished by combinations of one unit, the *nor* unit. A number of *nor* circuits are encapsulated into a module and (with a power supply and signal converter) marketed for user assembly into his own control system. Almost any configuration can be used in grouping these modules; they can even be laid out on a piece of plywood.

I think you will find that the NORPAK is the best answer to the static-control problem on the market at this time.

W. K. Penhallegon
Field Engineer, Square D Co.
Lutherville, Md.

[Mr. Jaski's article was only the first of a three-article series. The section that deals with transistors in industry appeared in the July issue, page 43. —*Editor*]

CHECK VOLTAGE

Dear Editor:

The dear public and others have been led to expect a reasonably accurate 1.34 volts from the Mallory mercury cell. I have just seen a memo from Mallory in which they mention two batches, one 1.34 volts and the other 1.4 volts. Tell the boys to be sure of the voltage of the ones they use.

Ed W. Logan, Jr.
Memphis 12, Tenn.

["Transfer Standard Calibrates Voltmeters," page 100, June, 1960, refers to the type RM cell as having a voltage of 1.345.—*Editor*]

SETS WANTED

Dear Editor:

As part of a program of community service, I teach (and financially help) youngsters, within the territorial limits of my club, radio and TV theory and repair.

Most of the students come from poor parents and are willing to learn something that may someday help them. In my home, I have test equipment (meters, generators, vtvm's and scopes) for their use. We have a couple of electronic service shops here whose profits are used to buy surplus parts that the students need to learn their trade.

I would appreciate it very much if you could help us contact technicians, hams, etc., in the Philippine area, who would like to help us out in this venture. If they have old unserviceable radios, TV sets or the like, *let us know*. I am willing to pay the postage.

Augusto (Gus) Salva
President, Batangas Rotary Club
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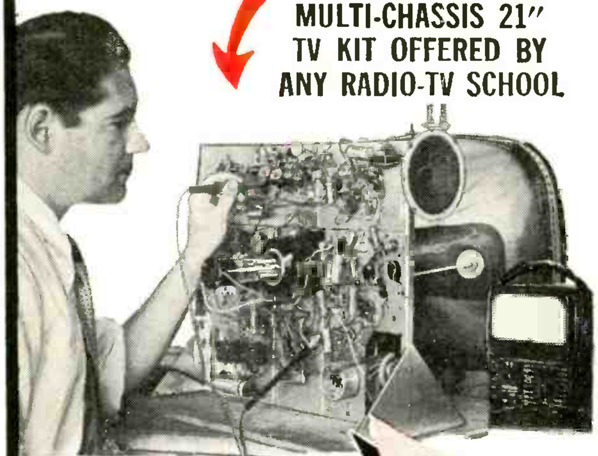

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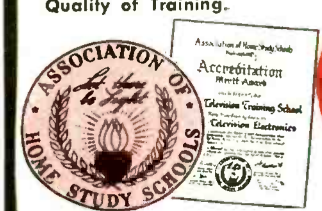

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Lists original equipment TV tuners with the Standard Coil equivalent replacement for each. Also includes major mechanical replacement parts for all Standard Coil Tuners —those used in original equipment as well as the universal replacement. Eliminates all guesswork—minimizes your tuner repair and replacement problems.

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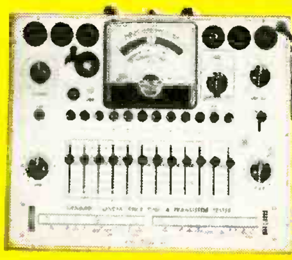

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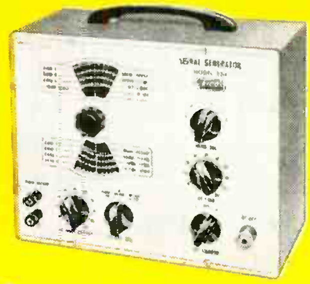

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A **Tests all receiving tubes** (picture tubes with adapter), n-p-n and p-n-p transistors. Composite indication of Gm, Gp & peak emission. Simultaneous selection of any one of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot.). Sensitive 200 ua meter. 10 six-position lever switches: freepoint connection of each tube pin. 10 pushbuttons: rapid insert of any tube element in leakage test circuit. Direct reading of inter-element leakage in ohms. New gear-driven rollchart. CRA Adapter $4.50.

B **Entirely electronic sweep circuit** with accurately-biased increductor for excellent linearity. Extremely flat RF output. Exceptional tuning accuracy. Hum and leakage eliminated. 5 fund. sweep ranges: 3-216 mc. Variable marker range: 2-75 mc in 3 fund. bands, 60-225 mc on harmonic band. 4.5 xtal marker osc., xtal supplied. Ext. marker provision. Attenuators: Marker Size, RF Fine, RF Coarse (4-step decade). Narrow range phasing control for accurate alignment.

C **150 kc to 435 mc with ONE generator** in 6 fund. bands and 1 harmonic band! ±1.5% freq. accuracy. Colpitts RF osc. directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 v needed for 30% mod. Turret-mounted, slug-tuned coils for max. accuracy. Fine and Coarse (3-step) RF attenuators. RF output 100,000 uv, AF output to 10 v.

D **Uni-Probe — exclusive with EICO** — only 1 probe performs all functions: half-turn of probe tip selects DC or AC-Ohms. Calibration without removing from cabinet. Measure directly p-p voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 4½" meter, can't-burn-out circuit. 7 non-skip ranges on every function. Zero center.

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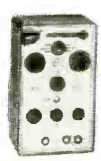

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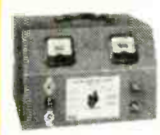

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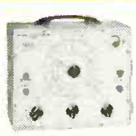

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HF87 70-Watt Stereo Power Amplifier. Dual 35W power amplifiers identical circuit-wise to the superb HF89, differing **only** in rating of the output transformers. IM distortion 1% at 70W; harmonic distortion less than 1% from 20-20,000 cps within 1 db of 70W. **Kit $74.95. Wired $114.95.**

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FM Tuner HFT90: Prewired, prealigned, temperature-compensated "front end" is drift-free. Prewired exclusive precision eye-tronic® traveling tuning indicator. Sensitivity: 1.5 uv for 20 db quieting; 2.5 uv for 30 db quieting, full limiting from 25 uv. IF bandwidth 260 kc at 6 db points. Both cathode follower & FM-multiplex stereo outputs, prevent obsolescence. Very low distortion. **"One of the best buys in high fidelity kits."** — AUDIOCRAFT. **Kit $39.95*. Wired $65.95*. Cover $3.95.** *Less cover, F.E.T. incl.

AM Tuner HFT94: Matches HFT 90. Selects "hi-fi" wide (20-9000 cps @ —3 db) or weak-station narrow (20-5000 cps @ —3 db) bandpass. Tuned RF stage for high selectivity & sensitivity. Precision **eye-tronic®** tuning. **"One of the best available."** —HI-FI SYSTEMS. **Kit $39.95. Wired $65.95.** Incl. cover & F.E.T.

New FM/AM Tuner HFT92 combines renowned EICO HFT90 FM Tuner with excellent AM tuning facilities. **Kit $59.95. Wired $94.95.** Incl. cover & F.E.T.

New AF-4 Economy Stereo Integrated Amplifier provides clean 4W per channel or 8W total output. **Kit $38.95. Wired $64.95.** Incl. cover & F.E.T.

HF12 Mono Integrated Amplifier (not illus.): Complete "front end" facilities & true hi-fi performance. 12W continuous, 25W peak. **Kit $34.95. Wired $57.95.** Incl. cover.

New HFS3 3-Way Speaker System Semi-Kit complete with factory-built 3/4" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion 12" woofer (22 cps res.) 8" mid-range speaker with high internal damping cone for smooth response, 3 1/2" cone tweeter. 2 1/4 cu. ft. ducted-port enclosure. System Q of 1/2 for smoothest frequency & best transient response. 32-14,000 cps clean, useful response. 16 ohms impedance. HWD: 26 1/2", 13 7/8", 14 3/8". Unfinished birch. **Kit $72.50. Wired $84.50.** Walnut or mahogany. **Kit $87.50. Wired $99.50.**

New HFS5 2-Way Speaker System Semi-Kit complete with factory-built 3/4" veneered plywood (4 sides) cabinet. Bellows-suspension, 5/8" excursion, 8" woofer (45 cps. res.), & 3 1/2" cone tweeter. 1 1/4" cu. ft. ducted-port enclosure. System Q of 1/2 for smoothest freq. & best transient resp. 45-14,000 cps clean, useful resp. 16 ohms. HWD: 24", 12 1/2", 10 1/2". Unfinished birch. **Kit $47.50. Wired $56.50.** Walnut or mahogany. **Kit $59.50. Wired $69.50**

HFS1 Bookshelf Speaker System complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range, 8 ohms. HWD: 23" x 11" x 9". **Kit $39.95. Wired $47.95**

HFS2 Omni-Directional Speaker System (not illus.) HWD: 36", 15 1/4", 11 1/2". **"Fine for stereo"** — MODERN HI-FI. Completely factory-built. Mahogany or walnut **$139.95.** Blond **$144.95.**

New Stereo Automatic Changer/Player: Jam-proof 4-speed, all record sizes, automatic changer **and** auto/manual player. **New extremely smooth**, low distortion moisture-proof stereo crystal cartridge designed **integrally** with tonearm to eliminate mid-range resonances. **Constant 4 1/2** grams stylus force is **optimum** to prevent groove flutter distortion. **No** hum, turntable attractions, acoustic feedback, center-hole enlargement. Only 10 3/4" x 13". **Model 1007D:** 0.7 mil diamond, 3 mil sapphire dual styli, **$59.75. 1007S:** 0.7 mil, 3 mil sapphire, $49.75. **Incl.** FET.

†Shown in optional Furniture Wood Cabinet **WE71:** Unfinished Birch, **$9.95;** Walnut or Mahogany, **$13.95.**

††Shown in optional Furniture Wood Cabinet **WE70:** Unfinished Birch, **$8.95;** Walnut or Mahogany, **$12.50.**

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INTERSTELLAR COMMUNICATION

. . . The Riddle of Life Among the Stars Will Be Solved . . .

SLOWLY, many of our most responsible astrophysicists and other scientists have come to the inevitable conclusion which thousands of science-fiction fans have reached decades ago: Man, inhabiting a very minor planet, is not alone as an intelligent–intellectual creature.

Indeed, such scientists as Prof. Donald H. Menzel, director of the Harvard Observatory and one of the world's leading astrophysicists; Prof. Giuseppe Cocconi, and Prof. Philip Morrison of Cornell University, to name only a few, now are certain that among the hundreds of billions of stars flung throughout the vastness of space are hundreds of millions of planets similar to our own earth which orbit around stars like our own sun. The inevitable conclusion, therefore, must be that evolution on like planets under parallel conditions must in time produce intelligent–intellectual creatures. That such creatures may not be manlike at all seems certain, but their shape and appearance need not worry us for the present. Such creatures may be on a lower or on a much higher plane than man among the far-flung myriads of inhabitable planets at this very moment.

Evolution of suns and their planets, when compared to man's time scale, is an unimaginably long process—it may be from 10 to 20 billion years, depending upon the dimension of each particular sun. Nor do we as yet know even vaguely what the exact development time of the various types and sizes of different suns is.

But we *do* know that not all suns and their planets evolve alike. Hence, evolution on some planets in various universes must be far behind our own, in others far ahead.

On the other hand, scientists have incontrovertible proof that suns are born and die; in time their nuclear energy runs down. Then such a sun stops giving off light and other radiation—it becomes a cold burned-out cinder. Its planets, deprived of light and radiant energy, die soon, too, as nothing can grow any longer on their icy surfaces. Unless, of course, their intelligent populations—if there are any—withdraws into the planets' interiors, there to subsist in an artificial, nuclear-heated subsurface world. Yet such an underworld civilization cannot last forever either—atomic and hydrogen energy will give out, too, because in a calculable time, the available fuel—*the planet itself*—will be consumed.

Many ages before that, the intelligent inhabitants will have taken measures to emigrate to another neighboring sun-lit world, if they can. But this—anywhere in any universe—is a formidable undertaking. Suns are inevitably far apart on a planetary distance scale. Our own *nearest* neighbor sun, *Alpha Centauri*, is four and one-third light years away, i.e., the time it takes light constantly traveling at 186,000 miles a second to reach us, or a distance of 25½ trillion miles. And the nearest star may not be suitable for emigration purposes—it may be too hot, too large, or it may have no planets. Thus our marooned-world people may have to select a star 1,000 light years away—6 quadrillion miles distant! Naturally they would first wish to explore the distant sun's planets to ascertain if one or some of them were suitable or inhabitable for their race. So they would try to communicate by radio with such a distant planet, even if it took a message 1,000 years to go to its destination and another 1,000 years to come back. Does that make the project impossible? No. In a few thousand years they would have their answer. It might even come from a much nearer world, if they kept signaling long enough. Some habited world, sooner or later, would be bound to intercept the steady, powerful stream of messages.

Does this sound like romantic science-fiction? It does—indeed. The present writer published dozens of stories of this genre, beginning with World War I, in his former publications, *Science and Invention, Amazing Stories, Wonder Stories* and others.

Nor is the idea of communication with alien worlds a novelty. Fifty-one years ago, the writer authored a serious article, "Signaling to Mars." It appeared in his magazine *Modern Electrics* for May, 1909.* This was *before* radio. We calculated that it would take 70,000 kilowatts to span the 35 million miles to the planet Mars! A lot of energy, but this was in the crude wireless days when Dr. de Forest's vacuum tube was still in the laboratory.

Since then our scientists have successfully bounced radio signals against the moon (1946), the planet Venus (1958) and lately (1959) even against the sun, 92 million miles distant, and in the latter case have received the signals back in a little over 16½ minutes.

Thus we can no longer be too surprised that serious scientists are now actually beginning to listen for interstellar communications.

As this is written, the new National Radio Astronomy Observatory at Green Bank, W. Va., has already gone into operation. The observatory's 85-foot parabolic reflector antenna will be directed at the stars *Tau Ceti* and *Epsilon Eridani*, somewhat less than 12 light years away from the earth. Specially designed supersensitive receivers will filter artificial signals from the natural confusion of background radio noises, it is hoped. Dr. Otto Struve, director of the observatory, and Dr. Frank D. Drake, radio astronomer, know that this is a long-time project that may require many years before positive results can be obtained. Thousands of stars may have to be investigated before the anticipated interstellar intelligence can be successfully intercepted and recorded. Even if the results are negative over a period of many years, we cannot despair and stop our efforts. There is always the immensity of time and distance to be considered and the immensity of bandwidth to be studied. If a planet is 500 light years away and has never transmitted before, we may listen in its direction for 499 years and never get a message, then receive it in the 500th year! And that is only *one* message from *one* planet. There may be millions of others hidden in time, space and direction.

Soon, in the writer's opinion, the world's radio observatories, geared to receive interstellar news, will not be on the earth at all but on the moon. Here the conditions for reception of transgalactic intelligence are almost ideal. The curse of radio astronomy today is the earth's atmosphere with its bedlam of every imaginable type of noise. In addition, there are the hundreds of man-made types of electric noise generators that constantly increase in intensity as time goes on.

A very large percentage of these noises will be absent on the side of the moon turned constantly away from the earth, since the entire body of the moon will be interposed between its far side and the earth. It is here that the great radio observatories will be located, many of them entirely automated and unmanned, permanently recording all intelligence for transmission to earth.

What about the earthlings' answer to the distant broadcasting "Planet X"? This problem, pregnant with many socio-political questions, has already been investigated by a number of scientists and philosophers. There seems to be no agreement so far as to the most advisable course. It probably had best be left to future and wiser generations.

—H.G.

* See also "Can We Radio the Planets?" by H. Gernsback, *Radio News*, February, 1927

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NEW stereo PICKUPS

Confused about the new crop of stereo cartridges and arms? Here's the first in a 3-part series that will give you the answers you have been looking for. Part I discusses ceramic units

By JULIAN D. HIRSCH

A NUMBER of new designs have appeared since our last survey of stereo cartridges (RADIO-ELECTRONICS, March, 1959), and many of the older ones have been refined and improved.

Certain definite trends in cartridge design can now be seen. Perhaps most noteworthy has been the advance of the moving-magnet pickup into the dominant position among magnetic cartridges. A few years ago the Shure Studio Dynetic introduced the moving-magnet design to the high-fidelity market. Today, half of the new stereo cartridges described in this series employ a moving magnet as their generating element.

The moving-magnet design is not inherently superior to any other. It does offer certain advantages in a stereo pickup. By proper design, the moving mass may be kept very low, yet modern magnetic materials make it possible to develop a relatively large output voltage from the minute stereo record groove modulation. The stylus-structure design of most moving magnet cartridges is such that they are quite rugged and yet easily replaced by the user.

But do not assume that other kinds of cartridges have been eclipsed by the moving-magnet types. Both the moving coil and variable-reluctance designs have their adherents, with outstanding performers in both camps.

Ceramic cartridges have continued to capture the lion's share of the mass market. A few ceramics have been aimed at the quality trade. These compete directly with magnetic cartridges, both in performance and price.

The integrated pickup design in which the cartridge and arm are designed as a unit (and must be used together) is becoming increasingly popular. This approach eliminates some of the consumer's freedom of choice in component selection. But it also eliminates many pitfalls involved in joining cartridges and arms of different makes (and usually results in a higher overall performance level for a given expenditure).

CBS Professional 55

This is a high-performance ceramic cartridge with relatively high stylus compliance and therefore able to track at low stylus forces.

It is housed in a transparent plastic body which affords an excellent view of its internal structure (each of its internal parts has its own distinctive color).

The two ceramic elements are coupled to the stylus by the lever system shown in Fig. 1. Both elements are normally deflected slightly by the armature lever tips. Lateral stylus motion moves one element tip backward (and allows the other to come forward) while vertical motion causes both elements to move in the same direction. The 45°

The Connoisseur CS-1 arm and pickup.

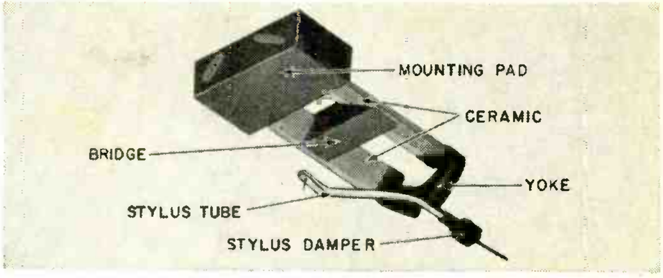
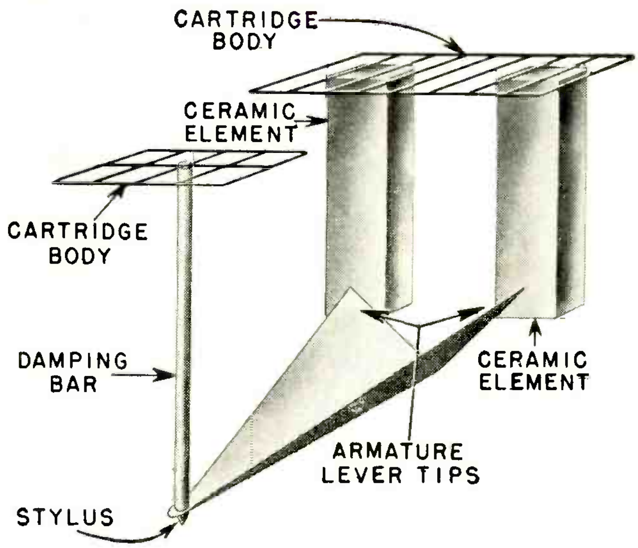


Fig. 1—Operating parts of the CBS Professional 55.

Fig. 2—Internal construction of the Electro-Voice 31MD7.



modulation of the stereo record groove is equivalent to a composite vertical and lateral signal, and each channel of the cartridge delivers an output voltage corresponding to the recorded amplitude of one of the channels of the stereo disc.

The design of the stylus lever arm provides high compliance (low mechanical impedance, desirable for low record wear) at the stylus point. It requires only one-fourth as much force at the stylus for a given element deflection as it would if the stylus drove the elements through a direct linkage.

The moving system of the CBS Professional 55 is heavily damped to reduce mechanical resonance effects. The ceramic elements are surrounded by a viscous material, and a bar of damping material extends from the tip of the stylus bar to the cartridge body.

The Professional 55 may be mounted in any standard arm with ½- or 7/16-inch mounting centers. It has three output terminals with a common ground.

A special feature of the 55 is the two sets of plug-in equalizing networks supplied with each cartridge. A ceramic cartridge normally delivers an output proportional to the *amplitude* of the record groove modulation. Although an amplitude-responding cartridge provides an *approximate* equalization for the RIAA recording characteristic, some additional equalization is still required. The equalizing networks (visible in the photograph at the bottom of the next page) plug into the preamplifier input. The leads from the tone arm, in turn, plug into the other end of each network (one per channel). When they are connected to the high-level input of a preamplifier, the output of the pickup system is accurately equalized for the RIAA characteristic and no further equalization is required from the preamplifier.

If it is desired to use a low-level (magnetic) input, the other pair of plug-in networks is used. In this case the cartridge output is converted to a velocity-responding basis, similar to the output of a magnetic cartridge, and the preamplifier provides the equalization.

The rated frequency response of the CBS 55 is 20 to 15,000 cycles ±3 db. The stylus is a 0.5-mil diamond, with lateral and vertical compliance of 3×10^{-6} cm/dyne. Depending on the arm in which it is installed, the tracking force is between 1.5 and 4 grams. The output—using the constant-velocity equalizers—is about 20 mv at 5-cm/sec stylus velocity, and with the RIAA network is 0.4 volt. The stylus assembly is replaceable by the user.

The CBS Professional 55 sells for $28.95 complete with two sets of plug-in equalizing networks in a fitted case.

Electro-Voice 31MD7

The Magneramic model 31MD7 is a ceramic stereo cartridge featuring a built-in printed-circuit equalizing network which converts its constant-amplitude response to constant velocity. It is intended to be connected directly to the magnetic input terminals of a preamplifier.

Fig. 2 shows the two ceramic elements and the manner in which they are coupled to the stylus. The stylus tube rests in a plastic yoke which is fastened to the ends of the two ceramic elements. Since the elements are angled at 90° (each one 45° from the vertical), each of the stereo channels in the record groove will cause only its corresponding element to be deflected and generate a voltage. Yoke compliance minimizes the deflection of the other element, thus maintaining channel separation.

The cartridge has standard ½- to 7/16-inch mounting centers and four output terminals. The terminals are in line, with the left and right channels on the outside and their grounds in the center.

The frequency response is rated at 20 to 15,000 cycles ±2 db. The output is 14 mv per channel at 5-cm/sec stylus velocity.

The stylus assembly is easily replaced by the user. The metal plate surrounding the stylus bar, which serves as a mounting for the bar, slides off the cartridge body, carrying the stylus with it. The stylus itself is a 0.7-mil diamond. The moving-system compliance is rated at 3.5×10^{-6} cm/dyne. The recommended tracking force is 2 to 4 grams in a transcription arm and 4 to 6 grams in record-changer arms.

The price of the Electro-Voice 31MD7 is $24.

Sonotone 8TA

The 8TA is an improved version of the original 8T stereo cartridge (September, 1958, page 39). Its appearance is nearly identical to the 8T, but a number of significant design changes have been made to improve its performance.

The chief change has been the replacement of the solid monel stylus shaft with a hollow aluminum tube one-third as heavy and 80% stiffer. The stylus jewels themselves have been reduced in size (and mass) to 40% of the original values. The 3-mil jewel on the turnover stylus bar is now mounted behind the 0.7-mil jewel instead of directly opposite it, to reduce further the effective mass of the moving system.

The original 8T had a relatively large open space around the nylon yoke that coupled the stylus bar to the ceramic elements. Dust could become trapped in this space and stick to the viscous damping grease within the cartridge. The resultant buildup of dust and lint could interfere with stylus motion. On the 8TA, a gold-plated metal cover protects the interior of the cartridge from dust buildup and keeps the stylus jewels from becoming clogged.

The reduction in stylus mass raises its resonant frequency from about 9,000 to 12,000 cycles. This resonance is well damped, resulting in an extension of

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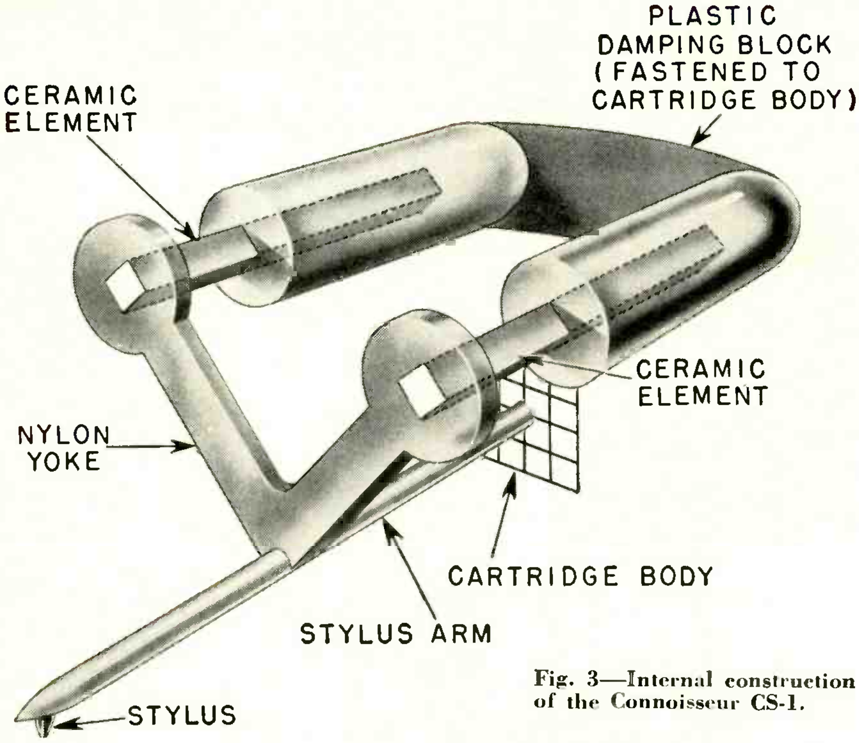

Fig. 3—Internal construction of the Connoisseur CS-1.

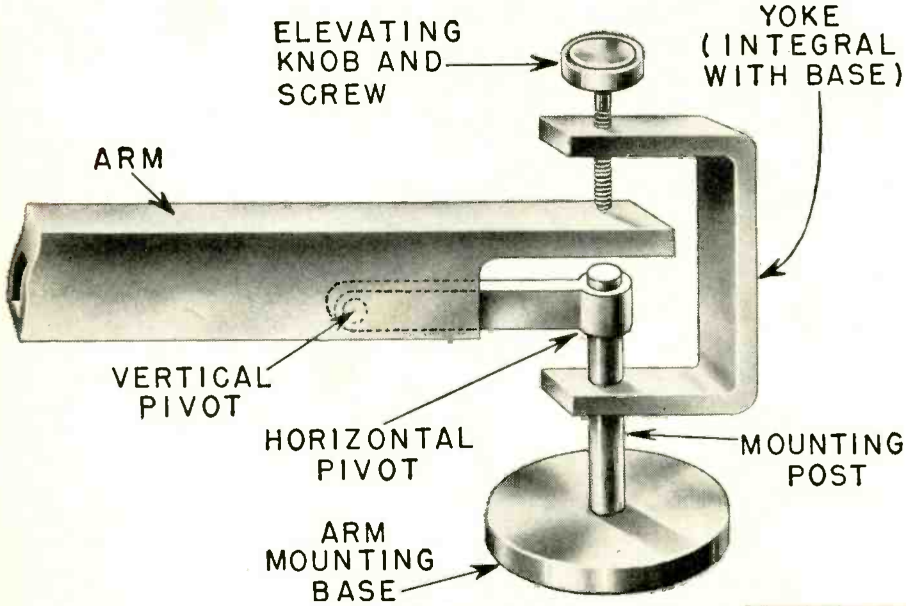

Fig. 4—Elevating screw allows the CS-1 to be raised and lowered without changing the lateral position of the stylus.

the upper frequency response of the 8TA to 15,000 cycles ±3 db. The upper limit of the original 8T was 12,000 cycles. The channel separation has also been improved in the range above 2,000 cycles. The compliance of the new stylus assembly is 3×10^{-6} cm/dyne, about 25% greater than that of the older unit.

The output of the Sonotone 8TA is about 0.3 volt per channel. It must be terminated in a resistance of at least 2 megohms for proper bass response, unless the recommended R-C equalizing network is used to convert its output to constant velocity. When so operated, its output is relatively high—about 35 mv.

The recommended tracking force is 3 to 5 grams in transcription arms and 4 to 6 grams in record changers.

The 8TA, like its predecessors, has a turnover stylus assembly containing both 3- and 0.7-mil jewels. Various combinations of sapphire and diamond styli are available. The stylus assembly is easily replaced without tools.

The Sonotone 8TA sells for $14.50 with two sapphires, or $19.50 with a 3-mil sapphire and a 0.7-mil diamond.

Connoisseur stereo pickup

The Connoisseur CS-1 is a unique integrated stereo pickup manufactured in England by Sugden and imported by Ercona Corp.

The cartridge is a ceramic type similar in principle to most ceramic cartridges we have described, but with somewhat more refined construction.

The two ceramic elements, making the usual 90° angle to each other, are very small and are immersed almost completely in a viscous damping material (Fig. 3). A Y-shaped yoke, which appears to be made of nylon, couples the ends of the elements to the stylus tube, which is firmly clamped in a slot in the end of the Y. The stylus assembly of the Connoisseur pickup does not appear to be replaceable by the user. The stylus arm is a short, light, hollow aluminum tube whose mass is obviously much less than that of any of the replaceable styli used on domestic ceramic cartridges. According to the manufacturer, it is 2 milligrams.

The CBS Professional 55 comes with two sets of equalizing networks.

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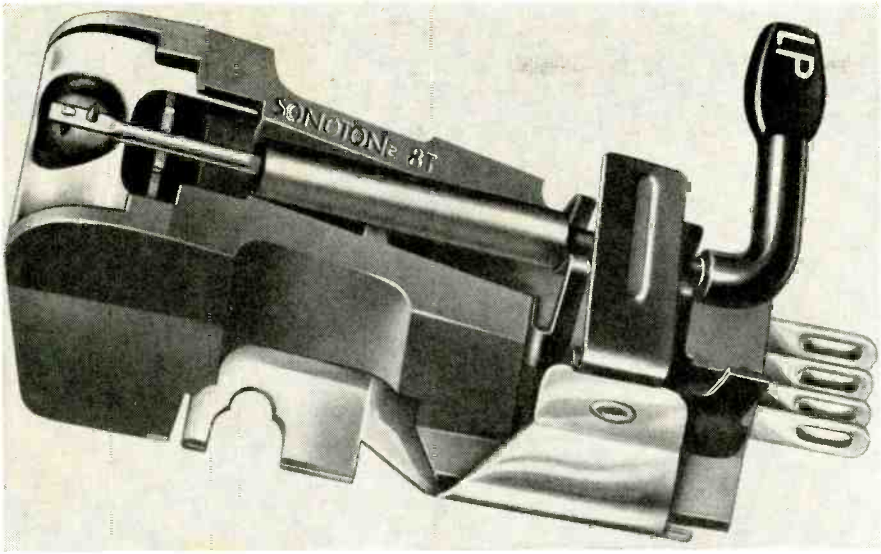
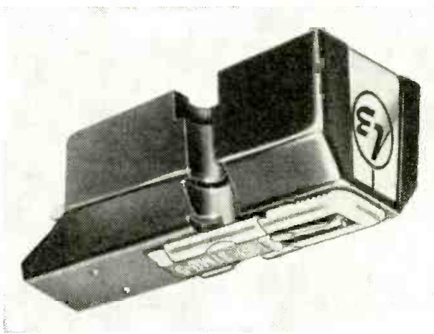


The Sonotone 8TA is identical in appearance to the 8T shown above.



Electro-Voice 31MD7.

The stylus jewel is a diamond with a 0.5-mil radius. The compliance of the stylus is 3.5×10^{-6} cm/dyne in both lateral and vertical planes. The frequency response is rated at 20 to 20,000 cycles ± 2 db.

The Connoisseur CS-1 pickup is designed to work into a resistive load of approximately 50,000 ohms such as the input circuit of most preamplifiers. When loaded in this manner, it is velocity-responsive, similar to a magnetic cartridge, but with a much higher output (about 40 mv at 5-cm/sec stylus velocity).

The cartridge can be used only in its companion arm, which forms a part of the CS-1 pickup. The arm has a unique method of raising or lowering it to the record surface, without danger of dropping or scraping the stylus against the record surface.

Fig. 4 illustrates the operation principle of the Connoisseur arm. In an actual arm, most of the operating portions are enclosed by the arm itself, which extends to the rear of the elevating knob to form a counterweight.

The yoke which holds the elevating knob and screw is fastened to the arm mounting post and does not move with the arm. The horizontal pivot is on the mounting post and the vertical pivot is about an inch forward of the mounting post. An internal projection extends rearward under the elevating screw. When the knob is turned clockwise, the rear of the arm is depressed, raising the cartridge from the record (Fig. 4). The arm may be positioned freely in the lateral plane, either to the magnetic arm rest or to any point of the record. Turning the knob counterclockwise lowers the pickup gently and smoothly to the record surface, after which another turn or two provides sufficient clearance between screw and the arm to allow for normally warped records.

The elevating mechanism has no effect on the lateral position of the arm, which may be raised at any point and lowered again into the same groove.

The maximum tracking error is less than 2°. The tracking force (fixed at the factory) is 3 or 4 grams. Although two shielded-wire pairs are brought out of the arm, the cartridge has only three terminals. Therefore, there is a common ground between the two channels at the cartridge. In certain installations, notably those with separate amplifiers rather than an integrated stereo amplifier, this type of grounding may cause hum problems. On the other hand, the Connoisseur cartridge is totally immune to induced hum, and its very high output minimizes the likelihood of hum problems in the playback system.

The price of the Connoisseur CS-1 is $59.50.

Parts II and III of this series will cover variable-reluctance, moving-coil and moving-magnet cartridges.

TO BE CONTINUED

Show stirs Controversy

THE biggest issue at the National Association of Music Merchants trade show (held July 10 to 14) was reverberation. Most of the top manufacturers seem to think it will be a big selling point for the fall–winter season. Philco and Zenith started the swing with their Reverbaphonic Sound and Sound Reverberation, respectively. Since then, Pilot, Fisher, Capehart, Magnavox, Hoffman and Sears Roebuck have indicated they will add the feature to at least part of their lines.

Basically, all reverberation systems take a portion of the input signal and feed it to a delay line (generally manufactured by Hammond Organ Co.). The delayed signal is then fed back into the music system to produce an echo effect (for a more detailed description, see RADIO-ELECTRONICS, August, 1960, page 43).

Not all manufacturers (or listeners) think that reverberation is "the thing". Stromberg-Carlson, for one, strongly opposes it. Its generally agreed, though, that reverberation is neither all good or all bad. For example, it can add a sense of "liveness" to recordings that have been made in a particularly "dead" room.

The expected controversy between open-reel and cartridge tape players did not arise. Almost all the tape players demonstrated were for open-reel tapes. RCA and Bell Sound were the only companies showing machines for the RCA tape cartridge. Bell Sound officials said they had many orders for the cartridge players—mostly from dentists. The machines play a pre-recorded white noise through headphones which deadens much of the pain felt by a patient during drilling.

Upswing of FM was reflected by the increase in tuners and radios shown. Since the FCC has not yet set the standards for single-FM-station stereo broadcasting, most of the new stereo tuners are the AM-FM type (one stereo channel is broadcast over an AM station, the other channel, over the FM station.) However, there is a jack for a multiplex adapter on most FM tuners.

An FM converter for auto radios was revealed by Granco. This soon-to-be-on-the-market unit converts the FM signal to a lower frequency AM signal that can be picked up by the car's existing AM radio.

More and more emphasis is being placed on the furniture angle. With fairly high prices (over $1,000) for the larger consoles and combinations, the public is no longer satisfied with "just another hi-fi cabinet." Westinghouse showed a line of experimental handcrafted stereo and TV cabinets that were not for sale (although it was admitted by company officials that retailer enthusiasm could prompt production of some of the models). END

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automatic DOORBELL intercom

This handy control circuit turns an intercom on when the doorbell rings and off 3 minutes later

By HENRY A. KAMPF

ANSWERING the door without having to rush to open it would be the answer to the busy housewife's prayer. The Automatic Doorbell Intercom makes it possible to talk to a salesman without even leaving the kitchen. When someone rings the doorbell, the intercom goes on, operates 3 minutes and then shuts itself off. This is more than enough time to find out who the caller is and what he wants.

By turning itself off when not in use, the intercom saves power. The control circuit can be added to existing intercoms or the transistor amplifier described can be used as the center of a new installation.

Switching circuit

The switching circuit is shown in Fig. 1. It does not require any changes in the existing doorbell, pushbutton and transformer setup. When a caller touches the pushbutton, the doorbell rings and relay RY1 is energized momentarily. RY2 (and the heater coil in RY3) is energized through RY3's contacts, which are normally closed. RY2 will stay energized until RY3's contacts open after a 3-minute delay. When this happens, the circuit goes back to its original state (after a short delay to allow RY3 to cool) to await the next caller.

The circuit to be controlled is connected across RY2's (the hold relay) coil. Switch S2 was added to allow the intercom to be turned on or off manually. It is not needed if only automatic operation is desired.

One speaker is located near the doorbell, the other is in the kitchen along with TALK–LISTEN switch S1. The amplifier and switching chassis may be located almost anywhere (the basement, near the fusebox, is a suggested location). S1 is a dpdt spring-return toggle switch which can connect either speaker as a microphone.

The heart of the switching chassis is a small thermal time-delay relay. It has a temperature-sensitive bi-metallic strip which operates like a thermostat. When heated, it bends because one side of it expands more than the other. The strip is enclosed in a glass envelope (about the same size as a 6SN7-GT tube) along with a heater coil. When a voltage is applied to this resistance-wire coil, it heats the bi-metallic strip. After a given amount of time (depending on relay design), in this case 3 minutes, the contacts open (or close, again depending on relay design).

Nearly any intercom amplifier is suitable as long as it uses transistors or battery type tubes (to cut warmup time to a minimum). A tube amplifier (shown in one of the photographs) and a transistor unit were used in the author's installation, with equal success.

Transistor amplifier

A good transistor amplifier is shown in Fig. 2. Three common-emitter stages are used. They give ample gain to drive the speaker with over ½ watt of power. A normal, conversational voice more than a foot from the microphone is readily understood at the other end of the intercom system. A low-noise transistor, the 2N105, is used at the input stage to reduce hiss. It is biased with a low collector voltage (and current) to help reduce noise.

The second stage or driver is more heavily biased. Collector dissipation is about 75 mw and it can easily supply the 25 mw of drive required for full power by the output stage. The second stage also has the volume control. As the resistance of this control, R4, is decreased, more and more negative-feedback current flows into V2's base from the collector, thereby reducing the gain of the circuit. The power amplifier is operated class-A with a zero-signal collector current of 150 ma. The power transistor (made by Sylvania) is either a 2N68 or 2N101, since they have identical characteristics. It requires a thermal connection to the chassis to help get rid of heat. However, the collector lead is internally connected to the body of the transistor and therefore the transistor must be electrically insulated from the chassis (Fig. 2). The mica washer can be obtained by tearing apart an old compression type mica padder capacitor. The shoulder insulating washer can be found on an old binding post.

R1, R3 and R5 determine the operating points of the transistors and each may have to be adjusted to the particular transistor. R5 should be adjusted first to give a collector current of 150 ma in V3. If V3's collector voltage is 12 ±2, it is close enough. R3 is adjusted until the collector voltage of V2 is 17 ±2. R1 is adjusted for a collector voltage at V1 of 1.5 ±0.5. Extreme care must be taken not to damage the transistors when soldering them into the circuit. Firmly grasp the lead being soldered with a pair of long-nose pliers. The heat of the soldering iron (and lead) is absorbed by the pliers before it can get to the transistor. The pliers can be taken away after the point has cooled. Take the same precaution with the diode, D. Keep the power transformer, T5, well away from T1 and 2, to minimize hum.

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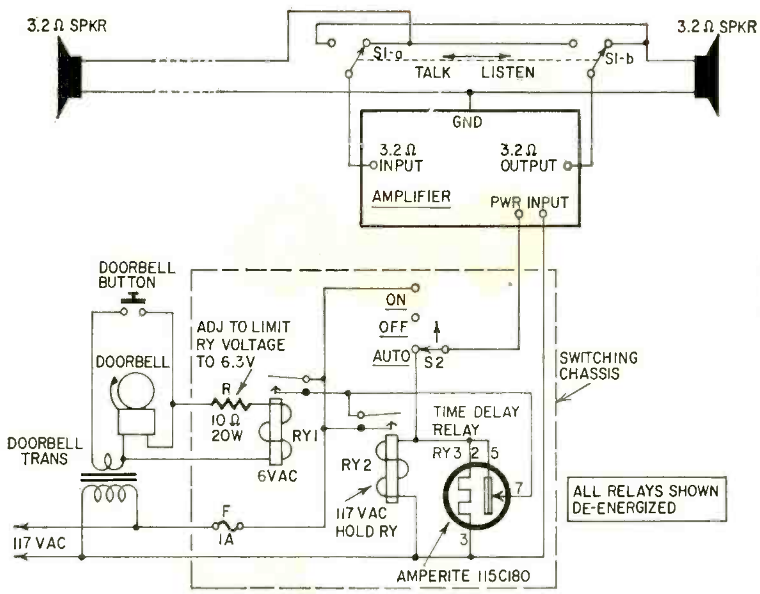
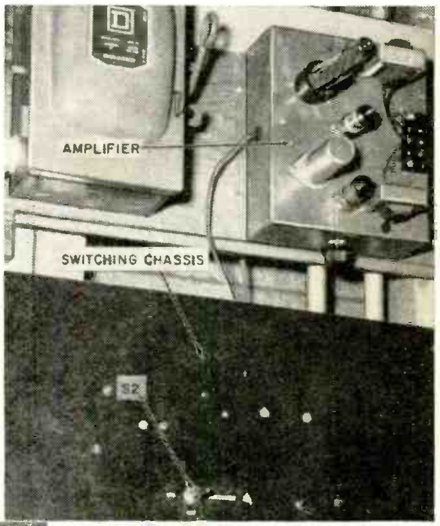
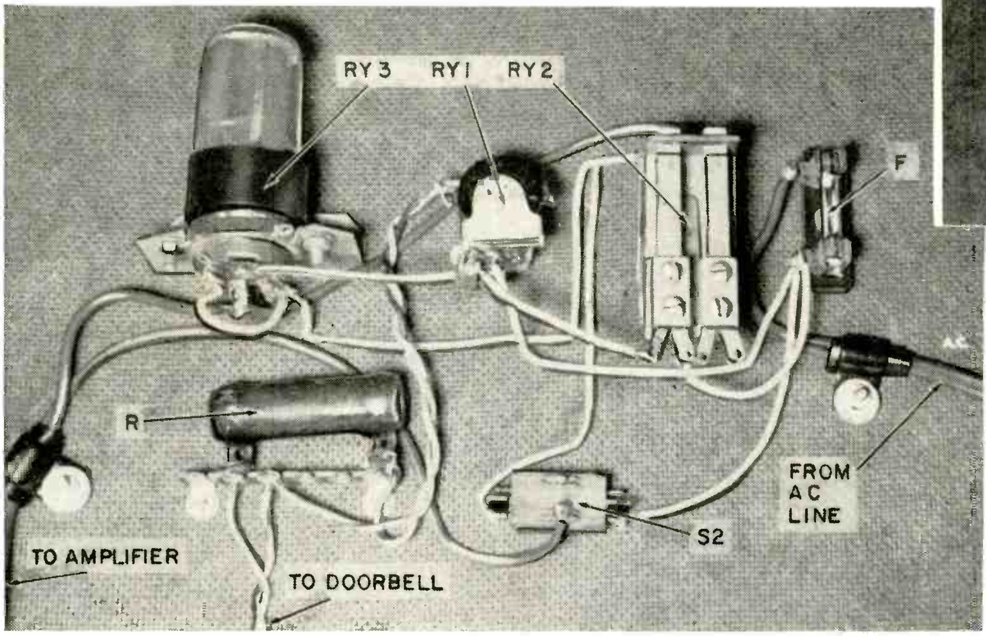


R—10 ohms, 20 watts
S1—dpdt, spring-return switch
S2—single-pole triple-throw switch
RY1—spst relay, 6-volt ac coil (Potter & Brumfield KA5AY or equivalent)
RY2—spst relay, 117-volt ac coil (Potter & Brumfield KA5AY or equivalent)
RY3—time-delay relay (Amperite 115C180 or equivalent)
F—1-amp fuse and holder
Octal socket for RY3
Chassis (or wall-mounted panel)
Speakers or intercom stations

Fig. 1—Circuit of the switching chassis. Talk–listen switch, S1, may be located on or off switching chassis.



Switching chassis (panel in lower part of photo) and amplifier mounted near house master switch (see above).



Rear view of switching chassis.

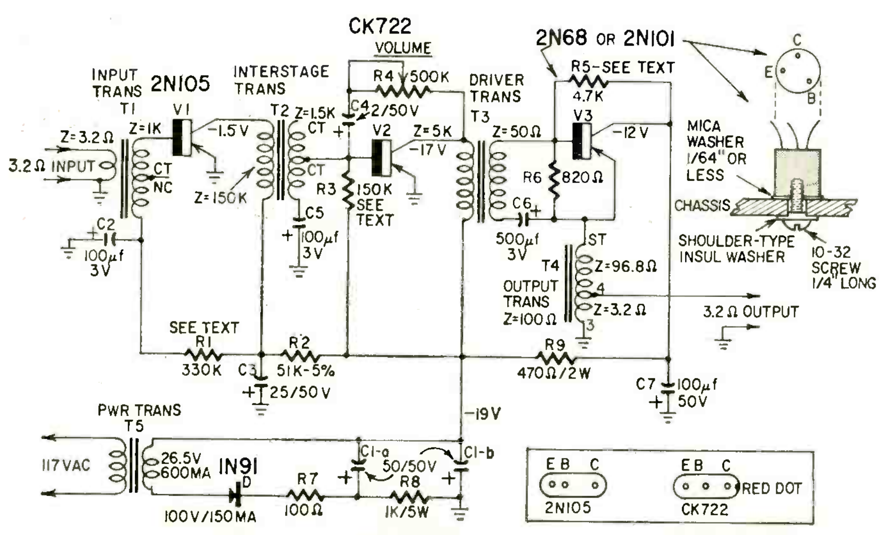


Fig. 2—Transistor intercom-amplifier schematic.

R1—330,000 ohms (see text)
R2—51,000 ohms, 5%
R3—150,000 ohms (see text)
R4—pot, 500,000 ohms, log taper
R5—4,700 ohms (see text)
R6—820 ohms
R7—100 ohms
R8—1,000 ohms, 5 watts
R9—470 ohms, 2 watts
All resistors ½ watt 10% unless noted
C1—50-50 μf, 50 volts (Mallory WP202.1 or equivalent)
C2, 5—100 μf, 3 volts
C3—25 μf, 50 volts
C4—2 μf, 50 volts
C6—500 μf, 3 volts
C7—100 μf, 50 volts
D—IN91 or equivalent
T1—input transformer; primary, 3.2 ohms; secondary, 1,000 ohms (Argonne AR138 or equivalent)
T2—interstage transformer; primary, 150,000 ohms; secondary, 1,500 ohms ct (Argonne AR126 or equivalent)
T3—driver transformer; primary, 5,000 ohms; secondary, 50 ohms (Stancor A3250 or equivalent)
T4—output transformer; primary 100 ohms; tap 3.2 ohms (Stancor A3838 or equivalent)
T5—power transformer, primary, 117 volts; secondary, 26.5 volts, 600 ma (Thordarson 21F27 or equivalent)
V1—2N105
V2—CK722
V3—2N68 or 2N101
Chassis
Miscellaneous hardware

END

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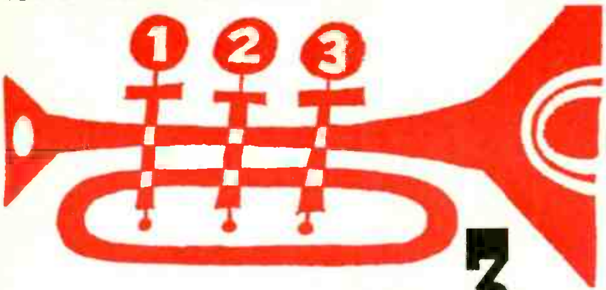


COMBINATION AMPLIFIER DOES 3 JOBS

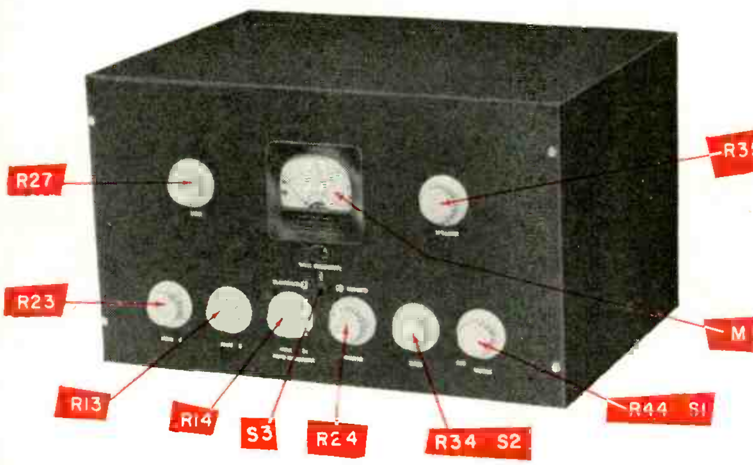
By JAMES E. DALLEY

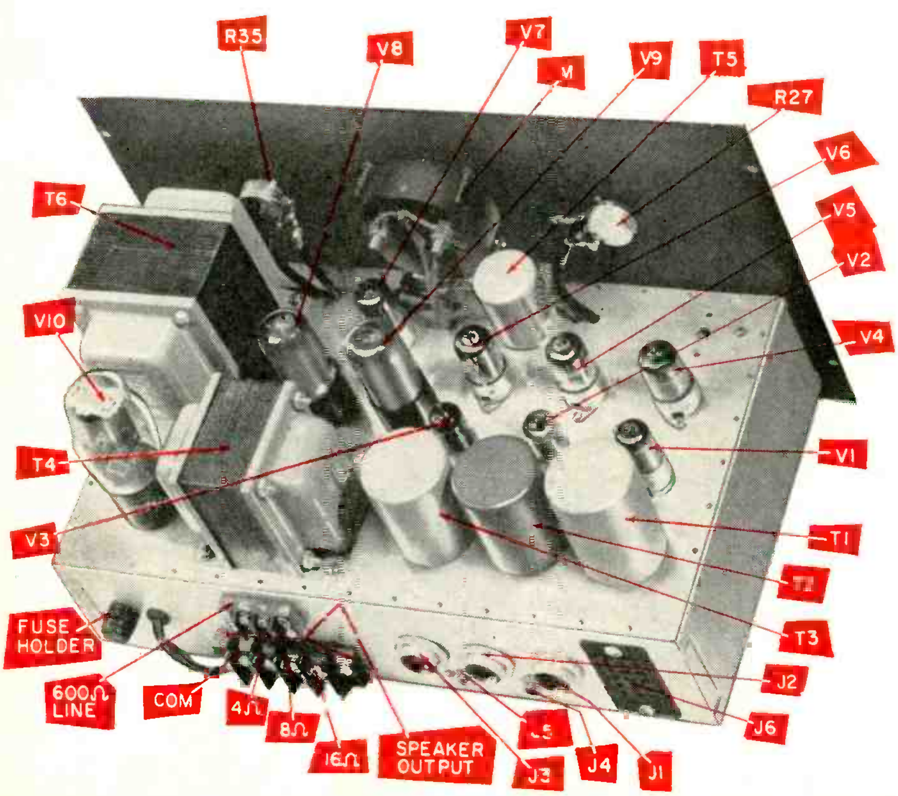
THE unit described here combines the functions of a small public-address amplifier, a remote line amplifier and a recording amplifier whose output level matches the bridge input of the Magnecorder PT6-JA tape recorder. It has three low-impedance microphone inputs, a phono input and a recorder input. The speaker output circuit has bass and treble attenuation controls and a bass-boost circuit.

Response curves are shown in Figs. 1–5. Fig. 1 shows the response from MIKE 1 input to the speaker output, with four settings of the tone controls. Curves A and B provide excellent response throughout the audio range and beyond on the high-frequency side. Fig. 2 shows the speaker output with the input to the phono circuit (J5). Curves A and B are even better here than in Fig. 1 because the signal does not have to go through an input transformer and there is one less coupling capacitor. Note that the response is better at both the low and extremely high frequencies. Fig. 3 shows the remote line output with input from each of the three sources. Here again the phono input (B) has the best bass response, but the recorder input (C) seems to have slightly better high-frequency response. Fig. 4 shows the recording output response with microphone and phono inputs. Fig. 5 shows speaker and line outputs with input to the recording jack (J4).

Input circuits

The three microphone circuits are





(Top) Front view of the amplifier showing the location of the controls. (Bottom) From the top, placement of all major components can be seen.

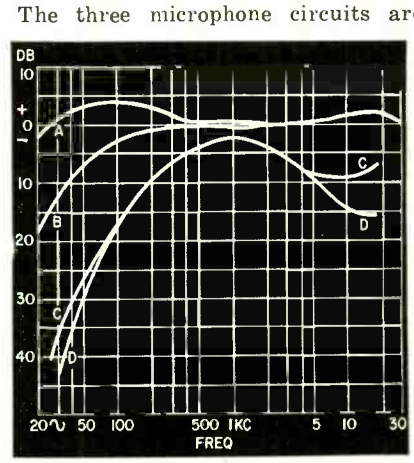


Fig. 1—Frequency response curves with signal input to J1. Output taken from the 16-ohm speaker terminals: Curve A shows response with bass and treble controls set at maximum with the bass boost circuit operating. Curve B is the same as curve A, except that the bass boost circuit is switched out. In curve C, tone controls are set at half scale, and in curve D, in minimum position.

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identical except for the RECORD-PLAYBACK switch (S3) in the MIKE 3 circuit. Each feeds into the primary of a Newcomb TR-91 plug-in type microphone transformer. These transformers can be connected for either 50 or 200 ohms input impedance. The response curves are based on the 200-ohm connection. The 470,000-ohm resistor across the secondary of the input transformer loads the secondary slightly, flattening the rise in response around 20 kc and reducing any tendency to oscillate. The cathode, screen and plate circuits are conventional for resistance-coupled pentodes. Individual volume controls are at the grids of the mixing circuit for the three microphones and the phono input. This provides complete isolation and keeps volume changes in one circuit from affecting any other circuit.

The phono input goes directly from J5 to the volume control in the grid of the mixer V5-b. It has sufficient gain to overdrive the speaker output circuit with a crystal pickup or with the G-E reluctance pickup and the G-E preamplifier that I use with this installation. A crystal pickup sounds best with the bass boost in. However, the G-E preamp has 18 db of bass at 30 cycles and the very low tones are greatly overemphasized and usually drive the amplifier to distortion if the bass boost is left in with the G-E cartridge and preamplifier. A G-E A1-901 record filter is used between the pickup cartridge and the preamplifier to provide proper playback curves for all types of recordings.

For playing tape recordings switch S3 is thrown to the PLAYBACK position. This takes the signal from the bridge connection of the tape recorder through J4 and through the voltage divider to V3's grid. The signal from the tape recorder is insufficient to drive the amplifier to full output when it is injected into the phono input and it drives the input circuits to distortion when fed directly into the microphone input, so an attenuation of approximately 18 db is inserted by the voltage divider. The amount of attenuation can easily be changed to match any recorder by varying the size of the 22,000-ohm resistor (R47) from the switch to ground. A larger value should be used if a higher input signal is needed. When S3 is in the PLAYBACK position, volume is controlled by the MIKE 3 volume control.

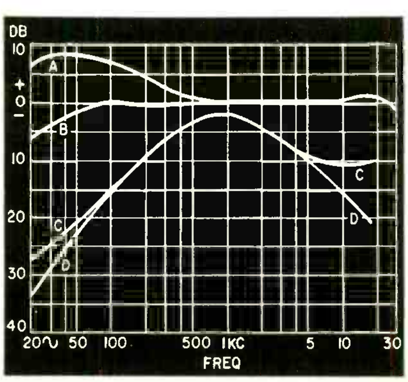

Fig. 2 — Same as Fig. 1, except signal is fed to the phono input (J5).

Mixing and output circuits

The mixing circuit consists of two 12AT7 double triodes (V4, V5). The grids feed from the individual input volume controls previously mentioned. The cathodes of each tube are paralleled and the common bias resistor is bypassed to ground. At first all four plates were paralleled, but I found that this caused a loading effect on any one triode and produced considerable distortion. The 10,000-ohm isolation resistors eliminated the distortion, but also reduced gain so that an additional stage (V6-a) for the speaker output circuit was needed.

Output to the tape recorder feeds through a frequency-correction network to S3, which must be thrown to the RECORD position, and out of J4. The recorder output curves of Fig. 3 were made with the recorder connected to J4.

The line output circuit feeds through the LINE volume control directly from the output of the mixer. V6-b acts as the line output tube. It uses a Triad A-55J line output transformer having output impedance of 600, 250 and 50 ohms. A Triplett 327-T decibel meter is connected directly across the 600-ohm line. This meter is actually calibrated for a 500-ohm line and, if accurate decibel readings are necessary, it should be replaced with a meter calibrated for a 600-ohm line. The line output is terminated in a pair of screw terminals and to two of the terminals of the output–input socket (J6—a Cinch-Jones S-315-AB socket). The three microphone inputs and the 8-ohm speaker output are also available at this socket. The plate circuit of the line output tube is shunt fed through a 15,000-ohm load resistor (R28) to prevent the direct current from passing through the primary of the small output transformer.

The speaker output circuit starts with V6-a which is fed from the mixers' output. Its plate circuit includes the tone control and compensation circuits.

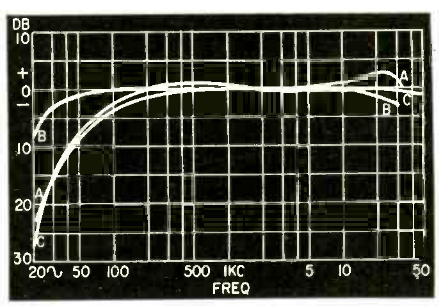

Fig. 3—Frequency response of the 600-ohm line output: curve A, input fed to J1; curve B, input fed to J5; curve C, line output with recorder input.

The plate load resistor consists of a 1,000-ohm resistor (R33) in series with a 15,000-ohm resistor (R32). A 0.5-μf capacitor (C16) is permanently connected to their junction and provides the bass-boost circuit. An 8-μf electrolytic (C31) is connected through S2 to the junction at all times except when the BASS control is turned to the extreme counterclockwise position, opening S2. Some bass boost is provided even when S2 is closed and the 8-μf capacitor is in the circuit. The BASS control places C23 in parallel with C24 in its maximum bass position (counterclockwise) and gradually reduces the effect of C23 in the circuit as the bass is reduced (R34 in its maximum resistance or clockwise position). The treble control is a simple attenuation control consisting of C22 in series with R44. This shunts the high frequencies to ground as R44 is reduced (clockwise position). The ON–OFF switch (S1) is on the treble control.

The phase inverter and driver consists of a 12AU7 double triode (V7). The cathodes are tied together and grounded through a 1,100-ohm biasing resistor (two parallel 2,200-ohm units). No bypass capacitor is necessary because signal currents in the two sections are equal and 180° out of phase, so they cancel in the cathode resistor. The grid of V7-a feeds from the speaker volume control and the grid of the phase inverter (V7-b) is fed by the signal developed across R38, which is connected to the junction of the grid resistors (R42 and R43) in the output stage. All three of these resistors are the same size (100,000 ohms) and provide a balancing effect on the drive to the

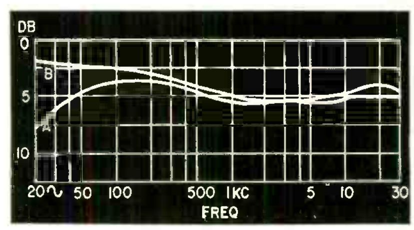

Fig. 4—Response of the recorder output: curve A, input to J1; curve B, input to J5.

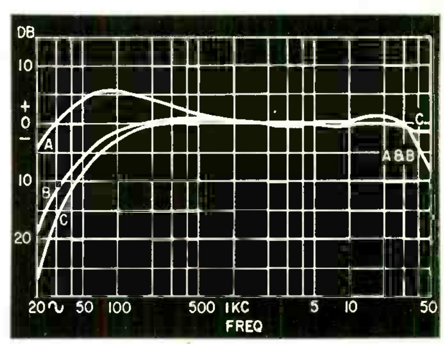

Fig. 5—Frequency response at the speaker and line output circuits with input to J4: curve A shows speaker output with bass boost; curve B shows speaker output without bass boost: curve C is for the 600-ohm line output.

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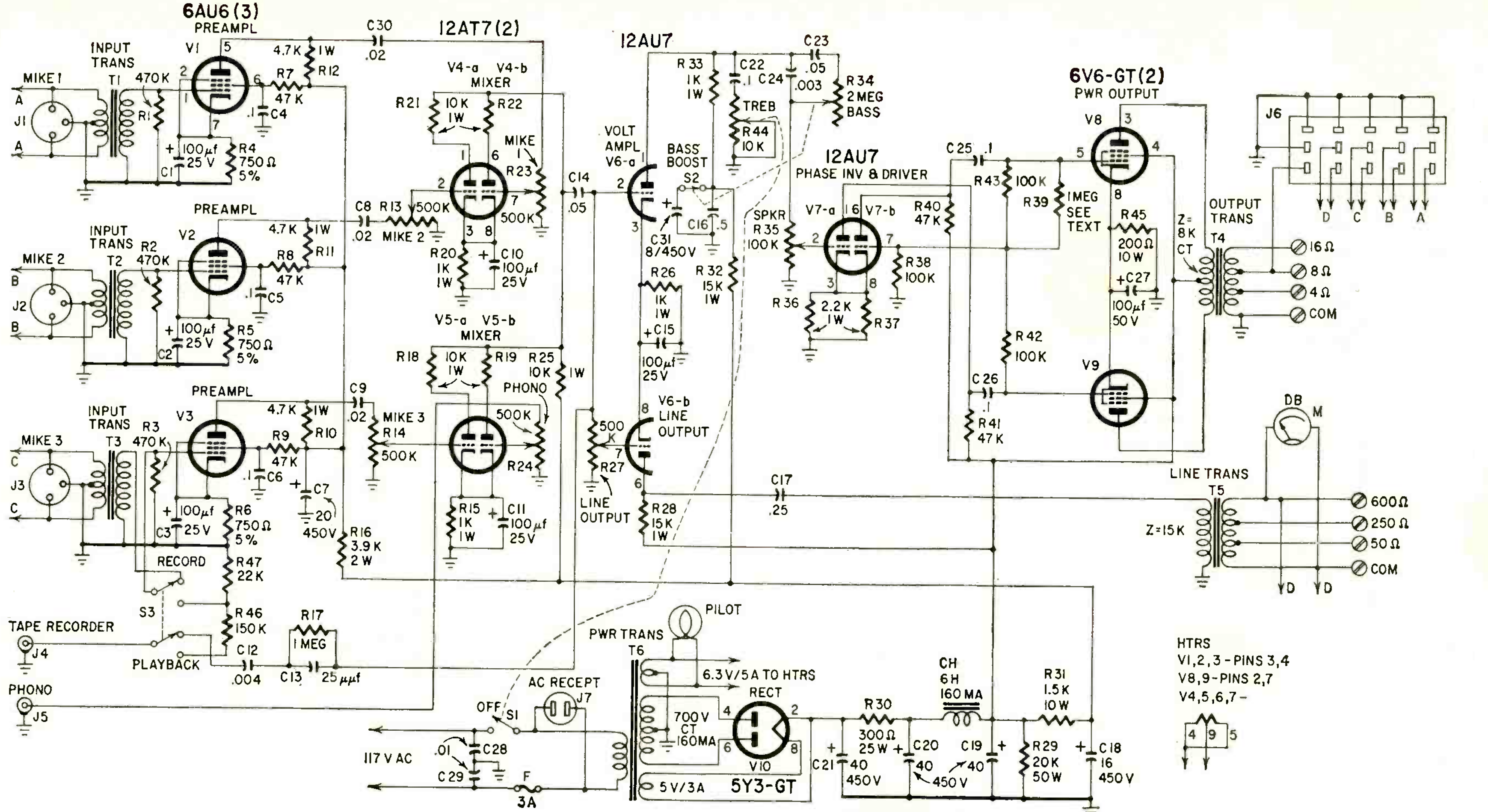

R1, 2, 3—470,000 ohms
R4, 5, 6—750 ohms, 5%
R7, 8, 9, 40, 41—47,000 ohms
R10, 11, 12—4,700 ohms, 1 watt
R13, 14, 23, 24, 27—pot, 500,000 ohms, audio taper
R15, 20, 26, 33—1,000 ohms, 1 watt
R16—3,900 ohms, 2 watts
R17, 39—1 megohm
R18, 19, 21, 22, 25—10,000 ohms, 1 watt
R28, 32—15,000 ohms, 1 watt
R29—20,000 ohms, 50 watts
R30—300 ohms, 25 watts
R31—1,500 ohms, 10 watts
R34—pot, 2 megohms, linear taper, with spst switch S2
R35—pot, 100,000 ohms, audio taper
R36, 37—2,200 ohms, 1 watt
R38, 42, 43—100,000 ohms
R44—pot, 10,000 ohms, linear taper, with spst switch S1
R45—200 ohms, 10 watts
R46—150,000 ohms
R47—22,000 ohms
All resistors ½-watt 10% unless noted
C1, 2, 3, 10, 11, 15—100 μf, 25 volts
C4, 5, 6, 22, 25, 26—0.1 μf
C7—20 μf, 450 volts
C8, 9—.02 μf
C12—.004 μf
C13—25 μμf
C14, 23—.05 μf
C16—0.5 μf
C17—0.25 μf
C18—16 μf, 450 volts, electrolytic
C19, 20, 21—40 μf, 450 volts, electrolytic
C24—.003 μf
C27—100 μf, 50 volts, electrolytic
C28, 29—.01 μf
C30—.02 μf
C31—8 μf, 450 volts, electrolytic
CH—filter choke, 6 henrys, 160 ma (Triad C-12X or equivalent)
F—fuse, 3 amps, 3AG
J1, 2, 3—3 contact microphone connectors (Amphenol 91-PC3F, or equivalent)
J4, 5—phono jack
J6—connector, female, 15 contacts (Cinch-Jones S-315-AB or equivalent)
J7—ac female receptacle
M—db meter (Triplett 327T or equivalent)
S1—spst on R44
S2—spst on R34
S3—dpdt slide
T1, 2, 3—microphone transformers: primary, 30–50 or 200–250 ohms; secondary, high-impedance grid winding (Newcomb TR-91 or equivalent)
T4—output transformer: primary, 8,000 ohms ct; secondary, 16/8/4 ohms, 15 watts (Triad S-31A or equivalent)
T5—line output transformer: primary, 15,000 ohms; secondary, 600/250/50 ohms (Triad A-55J or equivalent)
T6—power transformer: primary, 117 volts; secondary, 700 volts ct, 160 ma; 5 volts, 3 amps; 6.3 volts, 5 amps ct (Triad R-16A or equivalent)
V1, 2, 3—6AU6
V4, 5—12AT7
V6, 7—12AU7
V8, 9—6V6-GT
V10—5Y3-GT
Dial-lamp assembly with jewel and No. 47 bulb
Sockets, 9 pins, for input transformers (3)
Sockets, 7-pin miniature, with shields (3)
Sockets, 9-pin miniature (4)
Sockets, octal (3)
Fuse holder for 3AG 3-amp fuse
Terminal strip, 4 screw lugs
Terminal strip, 2 screw lugs
Chassis, 8 x 14 x 3 inches
Case, 15 x 9 x 11 inches
Miscellaneous hardware

Fig. 6—Circuit of the unusual 10-tube unit.

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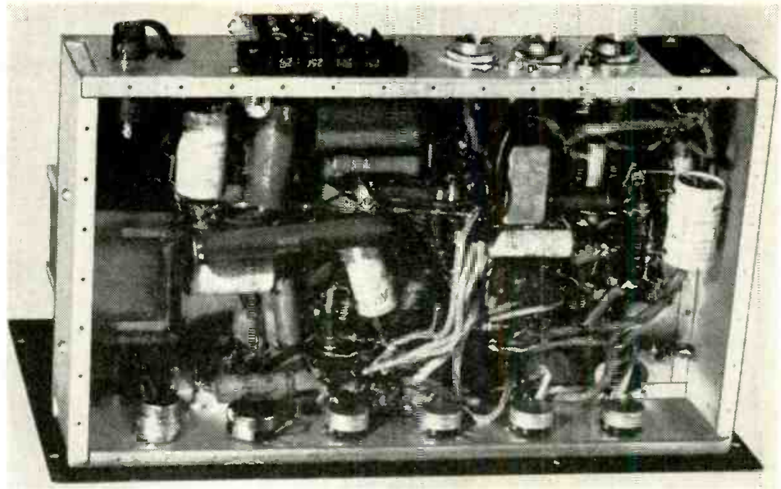
phase-inverter circuit. R42 and R43 must be properly balanced to provide the correct drive to the second section of the phase inverter so that the grids of the output stage will be driven equally. This was done by feeding a signal in ahead of the phase-inverter stage and measuring the drive at the grids of the 6V6's. The values of R42 and R43 are then adjusted slightly until a perfect balance is obtained. A 1-megohm resistor (R39) shunted across R43 provided the proper resistance in this case, but may not be the proper value for another set of parts.

The output cathodes are bypassed because there is a variation of plate current in the push-pull stage when the signal changes in intensity. The output stage is operated class AB1 with 285 volts on the plates and 19 volts bias. The output transformer used is a Triad S-31A. It provides the proper primary impedance of 8,000 ohms and output impedance of 4, 8 and 16 ohms. This circuit is supposed to provide 15 watts of output power; however, there is noticeable distortion at 15 watts and tests indicate that 12 watts is about the maximum undistorted power. An inverse feedback circuit was originally used but, as greater undistorted power was obtained without it, it was removed.



Underchassis view of combination amplifier.

Power supply

The power supply uses a Triad R-16A power transformer and a Triad C-12X filter choke, rated at 160 ma. The measured current at no signal input is 150 ma, so these ratings should not be reduced. R30 is primarily a voltage-dropping resistor to reduce the plate voltage of the output tubes to about 285 (plate to cathode). The three filter capacitors (C19, C20 and C21) had to be doubled to reduce the hum when the bass boost is used. The hum is just noticeable with the speaker volume turned full and the input volume controls turned down. J7 is a power receptacle for the phono preamp. It is connected after the fuse and line switch to provide protection and to eliminate the necessity of separate switching for the preamplifier. It was added after the photographs were taken and therefore does not show up.

The amplifier was built on a 8 x 14 x 3-inch chassis. The cabinet is 15 x 9 x 11 inches. A slightly larger chassis and cabinet are recommended if space permits, because of crowding under the chassis and the heat dissipation problem.

All ground connections were made to a common bus of No. 12 copper wire grounded at both ends. All signal leads of any length were shielded in circuits up to the phase inverter. The shields should be kept on the microphone preamplifier tubes, but it makes little difference whether they are on or off the other tubes.

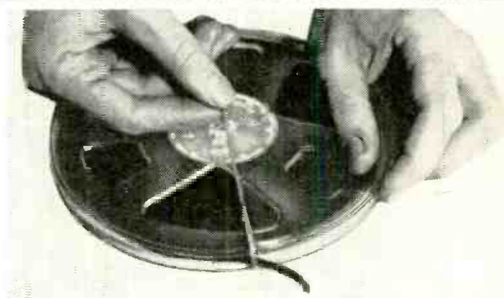
It seems presumptuous to call an amplifier using such common tubes and circuits high fidelity, but it closely approaches the performance of a strictly hi-fi unit using the same turntable and speaker. END

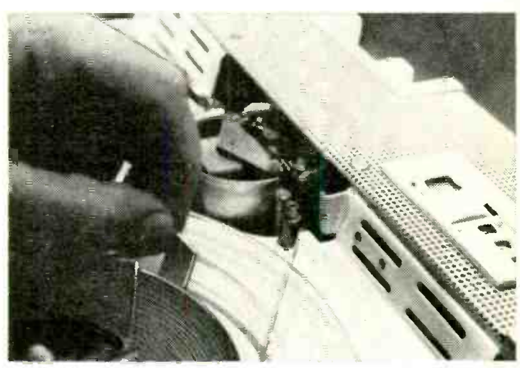
Four Tape Tips

TAPE recording can make the amateur or professional sound technician tear his hair if the tape tangles or snaps at the wrong time, as it usually does. To prevent this, never put too much tape on the reel. Use 600 feet of tape on 7-inch reels, and you'll seldom be troubled with tangling or tape breakage. Such trouble is invariably encountered at the end of the tape when it is being rapidly rewound. The extra flange width keeps the tape from climbing out of the reel to backlash and break.

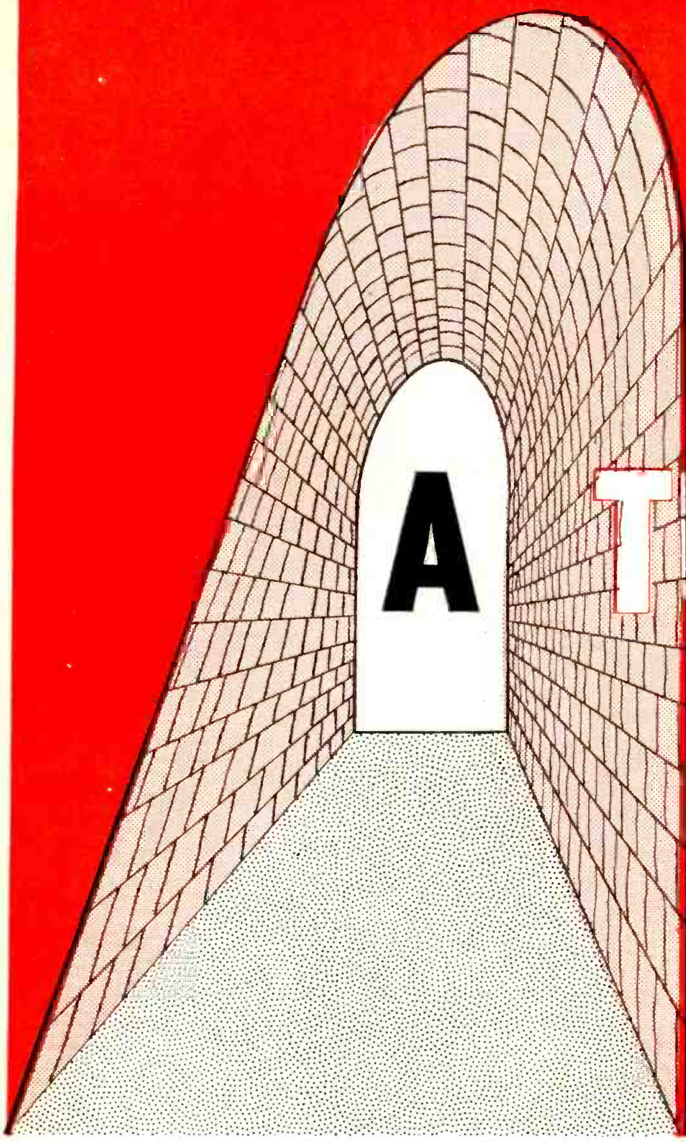
To mark a place on a reel of tape when you're working in a darkened corner, drop a slip of paper, match stub or toothpick into the reel as you start recording. When the session is finished and you want a playback, rewind the tape until your marker falls out and you're ready for business without a hitch.

Feedback and poor sound reproduction are usually problems when using nondirectional crystal mikes. A soft, thick cloth—even several layers of a handkerchief—wrapped around such a mike will often help when trouble of this kind is encountered. It's a good thing to remember when you have to record "brassy" music at close range.





There's probably nothing more annoying to the tape-recording enthusiast than to have recording tape spill when a reel is being handled. I keep this from happening by slipping a rubber band over the reel of tape as shown in the photograph. Even if the reel is accidentally dropped, the tape doesn't usually spill off. For even greater safety, notch the rim for the rubber band.—*Glen F. Stillwell and John A. Comstock*



A TUNNEL DIODE Oscillator

By
WILLIAM GROSSMAN*
and
MARVIN FRIEDMAN*

THE tunnel diode promises to be the most important achievement of the semiconductor industry since the transistor was invented. Circuits using tunnel diodes are already showing themselves superior to those using transistors and vacuum tubes, in several applications.

Let us connect a conventional p-n junction diode (such as the 1N34) in the circuit of Fig. 1. The center-tapped potentiometer allows us to either forward- or reverse-bias the diode. If we vary the potentiometer setting and plot the change of current as the voltage is varied, we get the typical p-n junction-diode curve (Fig. 2).

The curve shows that the diode has a low internal resistance when forward-biased (region A to B in Fig. 2) and a high resistance when back-biased. This is the area from A to D. Increasing either the forward or back bias of the diode increases the current (though the increase is very small in the reverse direction). We can say that the diode has a positive resistance when either forward- or back-biased.

Tunnel-diode curve

Now suppose we insert an Esaki tunnel diode (General Electric Co. No. ZJ-56A) in the same circuit and plot the current as the voltage is varied. The curve is shown in Fig. 3. The current change is vastly different from that of the 1N34. As forward bias is increased, the current rises rather quickly to a peak (point B). As forward bias is further increased the current decreases abruptly to point C, then starts rising again. The current through the tunnel diode increases with an increase in voltage in the region from A to B. This means that it has a positive resistance in this range. From B to C in Fig. 3, there is a *decrease* in current for an *increase* in voltage, or a negative resistance. We can say that this tunnel diode has a negative resistance characteristic when it is forward-biased at any voltage between B and C.

If we draw a line tangent to the curve at point X in Fig. 4, we can see that the tangent or slope (θ) of the curve is negative. (A negative curve, in mathematics, is one whose vertical value, or distance from the base line, *decreases* as its horizontal distance to the right from the origin *increases*. This is analogous to the electrical decrease in current with increase in voltage.) The value of the tangent is the current divided by the voltage at the tangent point. This equals the diode's negative resistance.

Bias

We want to bias the tunnel diode in the negative-resistance portion of its characteristic (Fig. 4, point X). When so biased it can oscillate or amplify.

A typical tunnel diode has a negative resistance of approximately −100 ohms when biased in its negative resistance region. Approximately 125 millivolts are required to bias the diode. The cur-

* B & K Manufacturing Co.

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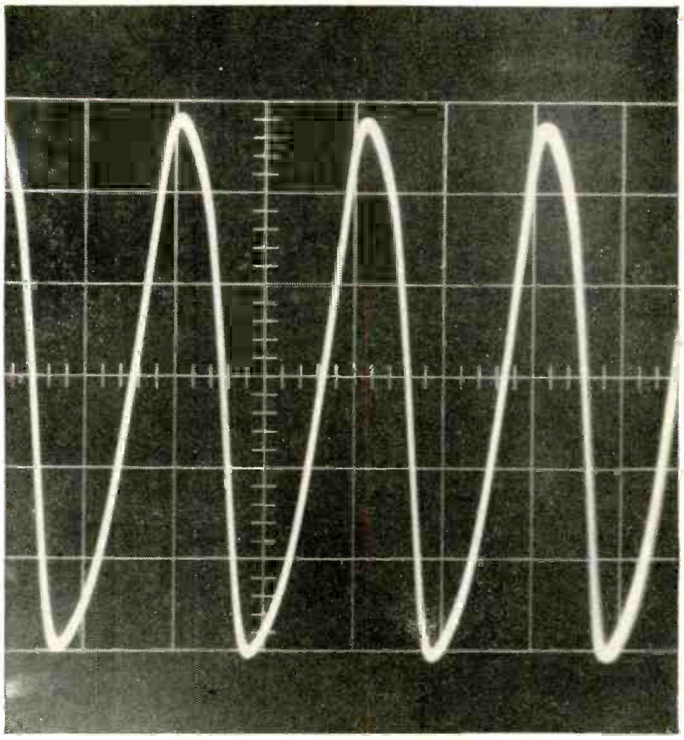

Photograph of oscilloscope tracing (using 5,000-cycle coil). Scope is connected across tuned circuit.

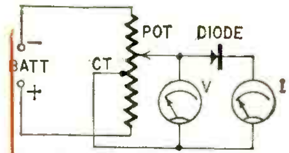

Fig. 1—Setup for plotting diode current as a function of voltage.

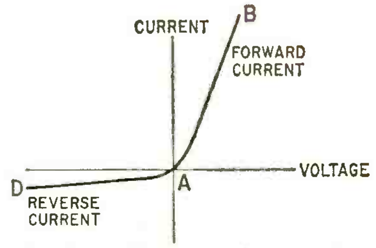

Fig. 2—Current-voltage characteristic of a typical p-n junction diode.

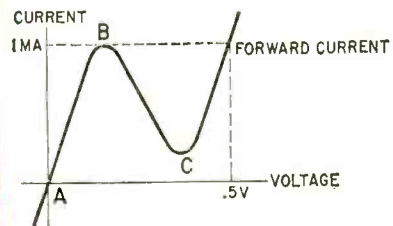

Fig. 3—Current-voltage characteristic of Esaki tunnel diode (GE No. ZJ-56A).

Oscillator, audio to rf ranges

Active element—a tunnel diode

Power source—penlight cell

Values given for four frequencies, others may be built as desired.

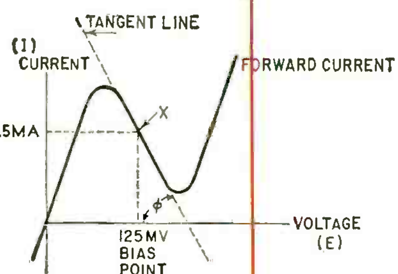

Fig. 4—Slope of characteristic around point X indicates negative resistance.

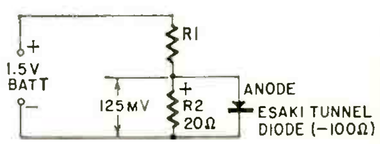

Fig. 5—Circuit for biasing tunnel diode from low source resistance.

rent drawn by the tunnel diode (when biased at this point) is approximately 0.5 ma. If our source of voltage is a 1.5-volt battery, we require a series resistor of about 3,000 ohms. Since our diode has a negative resistance of 100 ohms, the sum of the series resistor and diode's negative resistance is 2,900 ohms. Thus the diode's negative resistance has been cancelled by the series dropping resistor. To overcome this difficulty, the biasing voltage is developed across a resistance source less than the *absolute* value of the diode's negative resistance. The diode power supply then is as shown in Fig. 5. When this circuit is used, the diode has a net negative resistance of 80 ohms.

If an external circuit is connected to the diode and the resistive losses in the circuit are less than 80 ohms, the circuit can oscillate because the external losses are overcome. If an external circuit has losses equal to the negative resistance, the circuit is stable and can amplify.

By adjusting circuit losses, it is possible to use the same diode for oscillation and amplification at different frequencies. This action is like that of vacuum tubes or transistors in reflex circuits, now becoming common in experimenters' 1- or 2-transistor "shirt-pocket" radios.

Transistors and vacuum tubes depend on the control of charge carriers (electrons or holes) by a third element (a grid or base). This process takes finite time and is inherently noisy. These factors limit the frequency at which conventional devices can operate. The tunnel diode depends on a unique "quantum-mechanical" tunneling of charge carriers through the diode junction. This effect apparently takes place at close to the speed of light. Thus the tunnel diode's theoretical upper frequency limit is extremely high.

Resonant circuits

Now that some of the mystery surrounding the tunnel diode has been clarified, we will attempt to create a circuit that will take advantage of its negative resistance.

Fig. 6 shows a parallel-resonant circuit consisting of an inductance L and capacitor C.

If the capacitor is placed across the battery (and allowed to charge) and then reconnected to L, it will discharge through the inductance. Current flowing in L will cause a magnetic field to be built up around the coil until the capacitor has discharged. The field will then collapse (since the magnetic field can be maintained only while current is flowing). The collapsing field will induce a voltage in L which will cause current to flow back into C (recharging it). This process would repeat itself again and again if there were no losses in the circuit) at a rate called the resonant frequency. In practice, however, no capacitors or coils are loss-free. These losses appear in the circuit in the form of resistance and consume power.

To make this charge and discharge

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process continuous, power must be supplied to the circuit in amounts equal to the power consumed by R (the loss resistance). When this is done, the circuit oscillates. In practical vacuum-tube oscillators, enough of the output is fed back into the input circuit to overcome the resistive losses of the resonant circuit. This can be expressed by stating that the energy fed back overcomes the positive resistive losses. Thus the fedback energy can be called $-R$.

Practical oscillator

The tunnel diode has a negative resistance, or $-R$, characteristic. If the

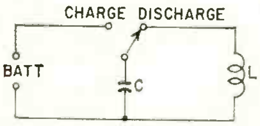


Fig. 6—A basic L-C circuit.

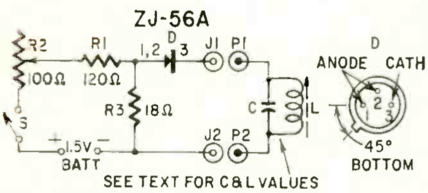
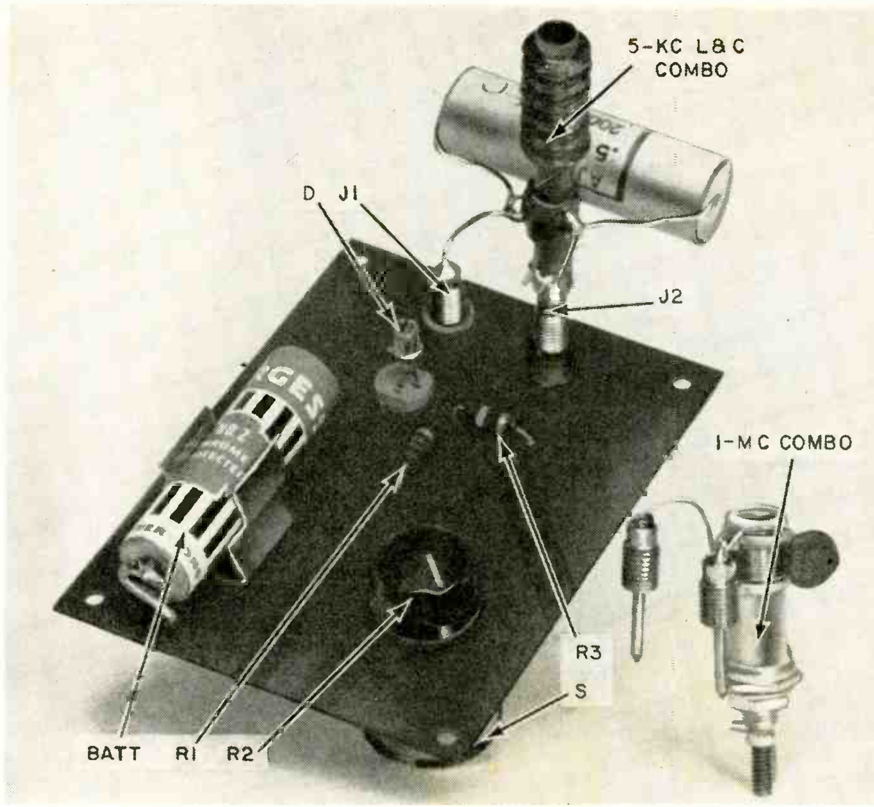


Fig. 7—Schematic of tunnel-diode oscillator. See text for values of L and C.



The tunnel-diode oscillator. The L-C combinations are attached to pin jacks for easy band changing.

R1—120 ohms
R2—pot, 100 ohms, linear taper
R3—18 ohms
All resistors ½ watt
C—see text
S—spst switch on R2
D—1-ma-peak tunnel diode (General Electric ZJ-56A or equivalent)
Batt—1.5-volt penlight cell
J1, 2—tip jacks
P1, 2—tip plugs
Transistor socket
Fuse clip for battery
Knob and phenolic board

negative resistance is greater than the positive resistance of the circuit, we have a diode oscillator. Fig. 7 shows the circuit of such an oscillator.

The battery supplies the necessary bias voltage to set the operating conditions of the diode. R1, 2 and 3 are equivalent to R1 and 2 of Fig. 5. The diode is connected across the resonant circuit. Since the negative resistance of the diode is greater than the sum of R3 and the losses of the tuned circuit, the circuit will oscillate.

The table shows values of L and C that will enable the circuit to oscillate over a wide range of frequencies.

Frequency	L	C
400 cycles	1 h	0.15 μf
5 kc	10 mh*	0.1 μf
1 mc	40 μh*	470 $\mu\mu$f
10 mc	1 μh*	200 $\mu\mu$f

* Reading from the top down, J. W. Miller Nos. 6314, 4408 and 4403

If C is a variable capacitor, it is possible to tune the oscillator to various frequencies. This circuit will oscillate at a very high frequency whose limit is dependent on the value of L and C. The diode used, No. ZJ-56A, has the positive element connected to pins 1 and 2 and the negative element is pin 3. Two leads are used for the anode to minimize lead inductance. If this inductance is too large, it restricts the upper frequency at which the diode will oscillate.

Adjustments

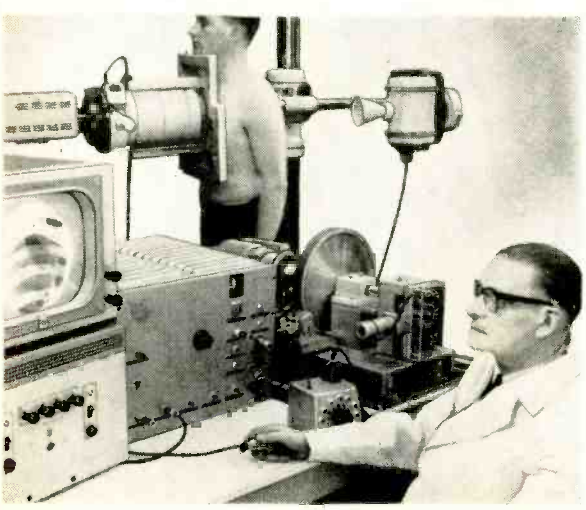
Adjusting R2 is all that is required to establish proper bias for the diode. The oscillation can be detected by connecting an oscilloscope across the tuned circuit. If a scope is not available, tune a receiver to the approximate frequency and adjust R2 while searching for the signal.

Construction

The oscillator is constructed on a piece of phenolic board. A transistor socket is used for the diode (in case the builder wishes to use the same diode for other applications). Power is supplied by a single penlight cell mounted in a fuse clip. An on—off switch (mounted on the 100-ohm pot) is used to prolong battery life (which should be in excess of 50 hours).

The tuned circuit (a capacitor-coil combination selected from the above table) is plugged into the two pin jacks. This arrangement allows quick frequency shifting when desired.

The frequency stability of the oscillator is excellent and is limited primarily by the stability of the coil and capacitor. END



TV Fluoroscope combines doctor's fluoroscope with closed-circuit TV system. System reduces radiation exposure, increases clarity and detail. The TV picture can be recorded for reference. Dr. Russell H. Morgan of John Hopkins University described the arrangement at an American College of Radiology lecture.

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RADIO WAVES & LIFE

There is strong evidence that life (human and otherwise) may be able to detect (or be affected by) radio waves.

By TOM JASKI

IN a recent editorial (August, 1959), Hugo Gernsback called for a serious reappraisal of the effects of radio waves on human and animal physiology. In view of the almost casual use of high-power radar and industrial rf heating equipment, this is certainly a timely word of warning.

It is not surprising then that the Air Force is already keenly aware of these problems, and has a number of projects under way to discover the exact effects of high-intensity radar pulses and microwaves on human and animal tissue. These projects are being carried out at our major universities, each specializing in one particular frequency. For example, the project at the University of California, under the direction of Prof. Charles Süsskind, is primarily investigating the effects of 3-cm radar energy. Test subjects are mice, ants, and yeast cells.

Thermal effects

Of great importance, and therefore under intensive investigation, are the thermal effects of such waves, and these have been measured rather precisely under a variety of conditions.

Using mice as subjects, it was found that near-lethal doses of radiation do not seem to cause any pathological changes in them, and that the lethal effect is primarily an overtaxing of the mice's temperature-balancing system. It was found that the major heating effect took place immediately under the skin, but of course heat generated there is rapidly distributed through the body. The temperature of the mice was monitored continuously. The photograph shows zoologist Susan Prausnitz monitoring the temperature of a mouse suspended in the wire cage right in front of the waveguide just visible on the left. The mouse is slowly rotated to insure even radiation over the entire body. Death occurred in 50% of the mice when a critical temperature of 44.1°C was reached.

Other interesting findings include the fact that radar waves appear to have no significant effect on the fertility of the male mice. The effects of radar waves on the longevity of the mice are currently being investigated.

Zoologist checks the temperature of a mouse (circled object suspended in front of waveguide).

An intensive series of experiments was carried out on cellular organisms, such as yeast cells, but, other than showing thermal effects, the experiments were inconclusive. Similar experiments with insects such as ants delivered relatively minor data. But one interesting item which emerged was that the ants, normally moving every which way, in a Petri dish, *will all line up in a 3-cm field, aligning their antennas parallel to the field*, apparently to minimize the effects.

The project is continuing, and more research on mice, ants and other animals is contemplated. Psychological effects will be looked into. One promising item in the ant experiments was that the ants which were exposed to 3-cm waves apparently lost the ability, at least temporarily, to communicate the source of food to their fellows, as ants usually do. It may be significant that the large ants used have antennas which measure very nearly one-fourth the wavelength of the 3-cm radiation.

Incidentally, mice are so frequently used for this kind of experiment because they are easily handled, easily obtained and relatively inexpensive, while their physiology and metabolism bear a useful resemblance to human counterparts in some ways. The life span of a mouse is limited, permitting experimenters to evaluate genetic effects over several generations.

Meanwhile other service branches are carrying out research programs concerned with the effects of radio waves on animal life, not necessarily limited to radar frequencies. A public announcement by scientists at the National Institute for Neurological Diseases concerning the lethal effects of 388-mc radio waves on monkeys also shows there is great interest in other frequencies and effects besides thermal.

Some early reports

As long ago as 1930, Nrunori claims

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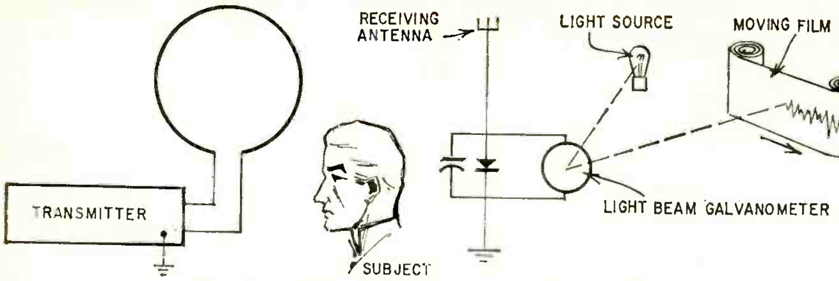

Fig. 1—Cazzamalli used this simple set-up to detect "radiation" from human subjects.

to have seen evidence that the human organism "radiates" and "reacts to" radio waves of 2.33 meters and its harmonics—in other words: 129, 258, 387 and 596 mc.

This brings to mind the work of a man who started publishing articles on this kind of subject more than 35 years ago. An Italian university professor named Cazzamalli placed human subjects in a shielded room, subjected them to high-frequency radio waves, and claimed to be able to record a "beat" which he received on a simple untuned receiver consisting of a galena crystal, a small capacitor, antenna and sensitive galvanometer. Cazzamalli's equipment, as well as it can be determined from his early articles, is shown in Fig. 1. The one item which he never mentions, perhaps because he could not accurately determine it, is the power of his transmitter. He published oscillograms purportedly showing variations of the "beats" when his subjects were emotionally aroused or engaged in creative efforts. Later experiments delivered much more startling results: he found that some of his subjects would hallucinate under the influence of high-frequency radio waves, which by then ranged all the way up to 300 mc.

The Cazzamalli experiments were carefully duplicated with modern equipment, of much greater sensitivity than his. His "oscillatori telegrafica" (presumably a transmitter as used for wireless telegraphy) was replaced with a very modest low-power oscillator. The reason for this was twofold. In the first place, university authorities take a very dim view of experiments on human beings, even if these subjects are the scientists themselves, volunteering for the part. Second, a previous experiment had indicated in a rather startling way that power was not required to evoke effects in the human nervous system. In fact, there seemed to be some sort of resonant frequency applicable to each individual human.

Effects on humans

That experiment was suggested by the behavior of the monkeys we cited. These animals went through a sequence of behavior which would indicate that something besides thermal effects was operating. To discover if this "something" was subjectively noticeable by an individual, a weak oscillator was swept through the band from 300 to 600 mc with the request that the subject indicate any points at which he might notice anything unusual. The subjects were not allowed to see the dial. At a particular frequency, varying between 380 and 500 mc for different subjects, they repeatedly indicated a point with almost unbelievable accuracy (as many as 14 out of 15 times).

Subsequent experiments with the same subjects showed that at the "individual" frequency, strange things were felt. Asked to describe the experience, all subjects agreed there was a definite "pulsing" in the brain, ringing in the ears and a desire to put their teeth into the nearest experimenter. The oscillator in this case was putting out only milliwatts of power, and was placed several feet from the subject.

Optical and growth effects

It was not the first time that such phenomena had been observed. Van Everdingen, a Dutch scientist, had discovered many years ago that radiation would affect the heartbeat of chicken embryos, when he was experimenting with the effects of high-frequency radiation on growth (specifically working toward any effect it might have on malignant growths). Van Everdingen used 1,875 mc and 3,000 mc and discovered that this kind of radiation would change the optical properties of a glycogen solution. Glycogen is a substance which occurs very abundantly in chicken embryos, particularly at an early stage of development. It is also the substance which provides our muscles with energy! Van Everdingen found that this change of optical polarization had some connection with tumor growth. He proceeded to re-rotate the polarization in extracts obtained from tumor-producing mice. When this optically "pure" substance was injected into mice with malignant tumors, *and these mice were kept on a diet free of animal fats, the tumors would cease to grow.* Only radiation at uhf or shf would produce these effects in the substances he used.

But Van Everdingen was not the only one who discovered important facts about radiation on living tissues. Years before, a Frenchman named Lakhovsky claimed to have removed tumors from patients with high-frequency radiation treatments, and his book, *The Secret of Life*, has a number of attestations in it from grateful patients who were cured. Lakhovsky stated that healthy plant growth is materially aided by placing a copper ring about 8 inches in diameter and supported on an insulating wooden stick (Fig. 2) around the plant. So-called tumerous growths on plants disappeared within such a ring. Lakhovsky's experiment with plants has been duplicated successfully. But then we should also note that the same kind of thing has been done by a group of devout citizens using group prayer!

But the people who have published the most data on the subject of uhf radiation effects on animals and human subjects are the Russians. In *Biofisica*, the Russian biophysics journal, a scientist named Livshits published two survey articles on the work that had been done in this field by 1958 and 1959. They are too extensive to repeat in great detail here, but some of the more impressive highlights will be reported.

Many experiments were carried out on animals with conditioned reflexes, and one by Glezer showed that a weak uhf field would inhibit the conditioned reflex, indicating that some inhibition of the cortex was taking place.

As in Van Everdingen's experiment with chicken eggs, Pardzhanidze showed that the EEG's of rabbits were drastically changed when the animals were subjected to a uhf field. Bludova, Kurilova and Tikhonova showed that the field produced an increase of sensitivity in the retina, and simultaneously reduced the area of color sensitivity. It is interesting to speculate how this would correlate with the Land effects. (Land, of Polaroid camera fame, has shown recently that our concepts of three-color vision may well be false, and that color vision seems to depend primarily on the presence of two images stimulated by two different frequencies of light!)

Turlygin similarly showed that the sensitivity of the eyes of dark-adapted subjects at marginal levels was increased as much as 100% by the presence of a uhf field.

Nerve effects

Of importance in the light of Lakhovsky's claims is the experiment by

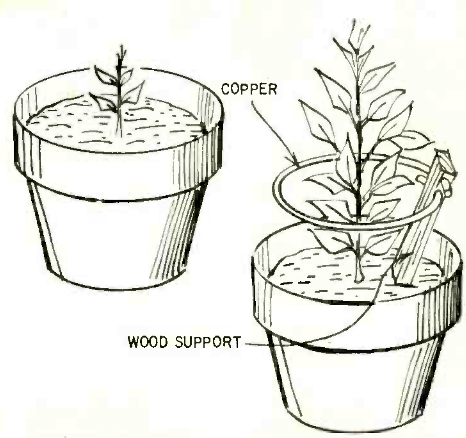

Fig. 2—A copper ring, eight inches in diameter, seems to improve plant growth (after photograph in *Secret of Life* by Lakhovsky).

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Grigoreva, who showed that short exposures to uhf would expedite the regrowth of severed nerve tissue, while prolonged exposure would suppress the regrowth.

A fact discovered many years ago is that a uhf field will have an analgesic (pain-reducing) effect on nerves, and radiation therapy of patients with painful diseases such as arthritis is fairly common practice here and abroad. If the field gets very intense, the situation reverses, and the effects on the nerves can be extremely painful, as Lebedinskii reports.

Numerous experiments are cited which deal with the simultaneous effects of various kinds of drugs, stimulants and toxins, and uhf fields. Many of these deal with very specific reactions and conditions, and any generalization would be rather meaningless. One particularly was of interest because of its relation to the experiments of the late Pavlov, the father of the conditioned reflex. This experiment shows that the field increases the secretion of histamine in the stomach, and in related experiments that the secretion of digestive juice which was artificially stimulated by such drugs as atropine is materially reduced by the field.

Closer to home, we find that Hugh Fleming at Oregon State College carried out experiments on the effects of high-frequency fields on microorganisms. Fleming used radiation at frequencies varying from 10 meters to 90 cm (30 to 270 mc). One result was that the rate of growth of cells will increase to a certain power level, and then will sharply decrease. Time of exposure and conductivity of the medium are important variables (as was also discovered by Van Everdingen, who also found the *viscosity* of the medium to be most important).

Summing it up

Now what does all this mean in terms of Mr. Gernsback's warning statement?

If you consider the few items we have been able to quote (more detail can be found in the articles cited in the bibliography), it is obvious that we are in some way susceptible to radio waves, and that our susceptibility is not necessarily limited to a particular frequency. Nor are large amounts of power required to produce some of the effects within us.

But precisely what these effects are, we understand not at all. Van Everdingen points out the possibility of molecular resonance, affecting the chemical bonds in our very substance. The egg experiments certainly indicate some sort of interference with the cortex (our "gray matter") which may affect both our thinking and our control over the "baser" drives (generally considered to be generated in the lower sections of the brain, but normally controlled or inhibited by the cortex).

Our physiological functions, such as our digestion, our ability to see and recover from damage when nerves are involved may well be drastically affected if we are subjected to a high enough power level. Tumors may be inhibited by the proper kind of radio waves yet, in other cases, particularly when coupled with the "wrong" kind of diet, radiation may also promote the growth of tumors. (This too was demonstrated by Van Everdingen in Holland.)

We do not yet know if our longevity will be affected. Certainly we should consider the possibility that there may be some relationship between the increase of cancer and the amount of radiation we indiscriminately spew into the atmosphere. Or even that there may be some connection between that radiation and our sharply increasing crime rates. We simply do not know enough about the effects, but what little we do know would tend to make Mr. Gernsback's warning all the more urgent. For while there is nothing lethal about the doses of radio-frequency energy we absorb daily, neither is there anything lethal in the steady drip of water on a man's forehead—but it was effectively used by medieval torturers to drive him completely out of his mind. Perhaps we have a responsibility to mankind, before we fill in all the gaps in the radio spectrum, to discover once and for all if we are affecting human life on this planet. And if so, in what manner, as we finally had to do for another surprise out of Pandora's box, man-made radioactivity. END

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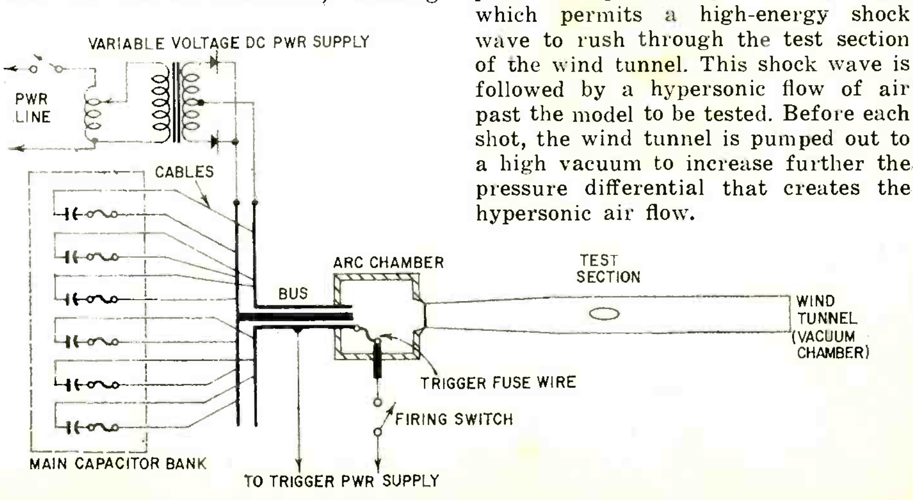
5,000,000-AMPERE ARC

A capacitor bank of 390,000 μμf—2,000 capacitors of almost 200 μf, 6,000 volts each!—is being built for a Boeing Aircraft wind tunnel in Seattle by G-E. The capacitors contain 200 acres of aluminum foil and will fill a room 35 x 35 x 25 feet. In this huge bank will be stored 7,000,000 joules of electricity. It can be discharged in a few milliseconds, creating the highest-current arc ever known, 5,000,000 amperes.

Because there is no device capable of switching and carrying such a current, a piece of steel piano wire will be vaporized near the arc electrodes, releasing metal ions. These ions will close the circuit between the electrodes, allowing the capacitors to dump their enormous current. The speed of discharge must be very high. Since every bit of inductance in the current path slows up the speed of discharge, special engineering is being employed to keep the inductive reactance very low and to carry the huge current.

The enormous energy loosed by the great arc heats the air in the arc chamber to 18,000°F, creating air pressure near 30,000 pounds a square inch. This pressure ruptures a plastic diaphragm which permits a high-energy shock wave to rush through the test section of the wind tunnel. This shock wave is followed by a hypersonic flow of air past the model to be tested. Before each shot, the wind tunnel is pumped out to a high vacuum to increase further the pressure differential that creates the hypersonic air flow.



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EQUIPMENT CAN BE EASY TO SERVICE

Cover Feature

Intimate look at a big airport radar system shows how careful construction eases repair work

RADAR meant to operate 20 years without obsolescence means—by today's standards—very complex electronics. But this radar will be easy to service because the problem was considered when the equipment was designed.

The Texas Instruments ASR-4 airport surveillance radar now being installed at major airports throughout the country will be on the air continuously for 20 years, according to present Federal Aviation Agency (FAA) plans. It distinguishes between moving aircraft and fixed ground targets, displays only moving targets or a combination of moving and fixed targets, electronically adds data on navigational hazards and aids, measures distances between moving aircraft, operates with either linear or circular polarization, and has provisions for future inputs from air traffic control computers and for alpha-numberic code tags for individual aircraft. It is a "completely dualized" system, except for the antenna, so it is actually two identical radars with one on standby or being serviced while the other carries the load. It has advanced features for screening out interference from other radars—very important because of the increasing density of radiating equipment in the US today—and has moved the first "blind" speed (the speed at which a moving aircraft disappears from the scope) from 120 knots to a more tolerable 1,200 knots.

Obviously a radar that can do so much must be a highly sophisticated system. It is true that the ASR-4 is an advanced airport surveillance radar and is quite complex, yet it contains familiar components such as resistors, capacitors, vacuum tubes. These components are arranged to form special circuits which are not hard in themselves to understand. Because of its logical circuit arrangement and the many extra features to aid in troubleshooting, it is a relatively easy piece of equipment to understand and maintain. Layout of the equipment at the three sites (transmitter, equipment room and the instrument flight rules room) are shown in Fig. 1.

Built-in reliability

Twenty-year life on a piece of electronic gear is a pretty big order. On equipment the size of the ASR-4 (1,900 vacuum tubes), the problem becomes complex indeed. To get such a life expectancy requires special techniques, such as derated components, conservative design and thorough evaluation tests. Resistors and capacitors, which make up the bulk of the parts list, are a good example of the derated components. Composition resistors do not exceed 50% of their rated dissipation, and 5% tolerance or less is specified for over 90% of the resistors used. Capacitors are derated to 70% of their voltage rating and even less voltage is allowed where temperature or humidity has an adverse effect. Except in very special cases, no electrolytic capacitors are used in the system.

Conservatively designed circuits operate reliably with "off-the-shelf" components as long as their performance falls within the manufacturers' stated parameters. Using components with typical loose tolerances means changes in circuit operation, but the ASR-4 includes maintenance adjustments that correct for these variations. Each circuit is checked in both individual unit

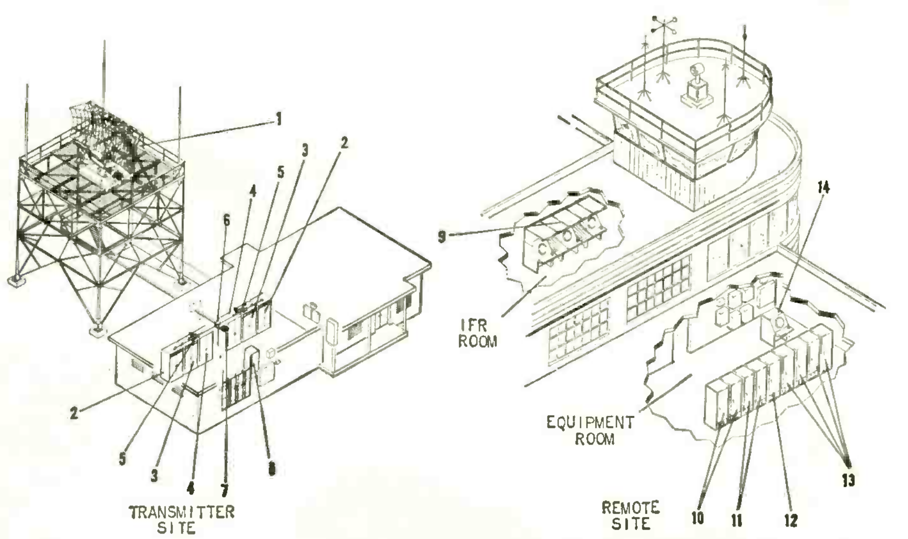

Fig. 1—Principal sections of radar system, showing their locations.

Legend:
1—Antenna Assembly
2—Transmitter Assembly
3—Performance Monitor Assembly
4—Receiver Assembly
5—Miscellaneous Transmitter Building Waveguide Components
6—Waveguide Switch
7—Dummy Load
8—Transmitter Building Control Assembly
9—Console Assemblies
10—Video Mapping Assembly
11—Common Equipment Assembly
12—Equipment Control Assembly
13—Console Equipment Assemblies
14—Maintenance Console Assembly

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tests and in a complete system test to assure proper operation.

Check and test features

A radar the size of the ASR-4 can keep several top technicians busy continuously making precise measurements to make sure it is operating as it should. But this unit eases the technicians' job by automatically making tedious and time-consuming measurements such as transmitter power output, voltage–standing-wave ratio (from transmitter to antenna), relative tuning of the local oscillator with respect to the transmitter frequency, and the system noise figure. These and other quantities are indicated continuously on panel meters. The performance monitor makes these measurements. It also checks receiver crystals without removing them from their holders.

Another valuable unit in the transmitter is the fault panel with fault indicating lights. Certain abnormal conditions such as voltage and current variations in the pulse modulator, harmful to expensive components, will cause a 5-second interruption in the modulator and modulator driver high-voltage supply. Afterward the system recycles and continues to operate unless the fault occurs again. If the system recycles three times and the fault is not cleared, it locks out and appropriate indicator lights on the panel light to tell the technician where the fault occurred and what kind of fault it was. More serious faults will cause the equipment to shut down the first time.

All of the cabinets at either site contain panel meters with switches so that voltage and current for any power supply in the cabinet can be measured without extra test equipment. Each power supply is fused with indicating type fuseholders that remain lit until the fuse is replaced or the power shut off.

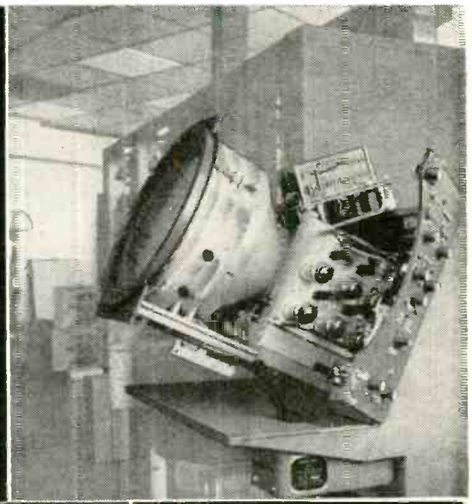
Built-in oscilloscopes and auxiliary test equipment are furnished with each system. Test points (complete with waveforms) are placed in circuits throughout the system to allow systematic troubleshooting that pinpoints the trouble to a very few stages. Additional circuit tracing is made easier by component references on the panels.

Probably the most important single aid to troubleshooting is the PPI (*P*lan *P*osition *I*ndicator) display. Like a television set, the PPI scope almost spells out the type of trouble. By having a maintenance console in the equipment room and a monitor PPI at the transmitter site, the technician can see the trouble indications for himself. Also, the PPI lets the technician view the results of any maintenance adjustments directly.

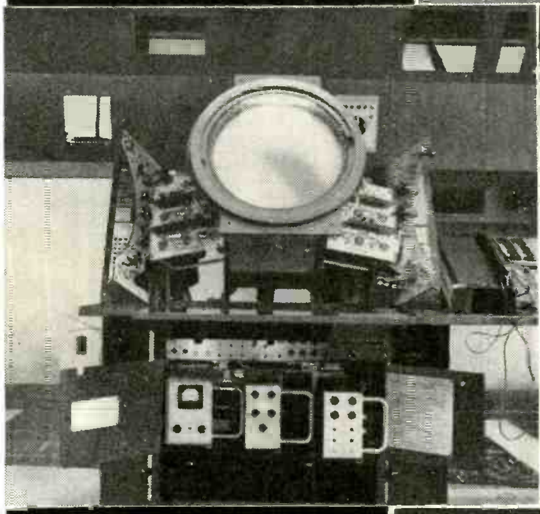
Accessibility

The ASR-4 represents a significant advancement in component accessibility. Technicians who have had to reach awkward places in an operating piece of equipment to make adjustments will readily appreciate these extra features. All cabinets contain front and rear interior lights which can be switched on to see in all corners. Hinged panels and panels mounted on sliding tracks make a simple matter of reaching components in the remote equipment, while roomy fixed panels allow plenty of elbow room at the transmitter. Indicator consoles are an excellent example of accessibility. The CRT housing and attached panels telescope out on sliding tracks and lock in position. The attached panels swing out, exposing all the components. The panels at the bottom of the console roll out on overhead tracks and can be lifted by extension cables to a comfortable working level for additional checks. In addition, a test junction box allows voltage measurements and waveform checks on these units. Maintenance adjustments or circuit checks can be made while the console is operating in this position.

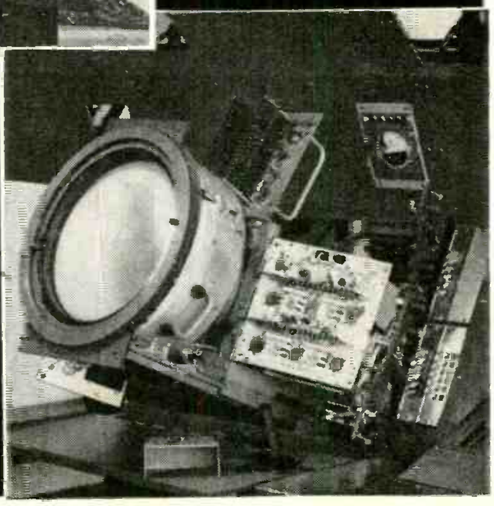
The special features of the ASR-4 make it the most advanced airport surveillance radar in use today. Advanced circuits for better performance, built-in check and test features, dual channel operation, easy-to-get-at components and built-in reliability add up to a system that will find years of useful service. With faster air traffic and more aircraft, this radar will increase the safety of air line travel and facilitate the air traffic control around congested airports. END



(Right) Side panels swung back, top chassis turned over and locked on its own rack.



(Left) How the equipment below the tube is rolled out.



(Right) Close-up showing all chassis turned over for easy servicing.

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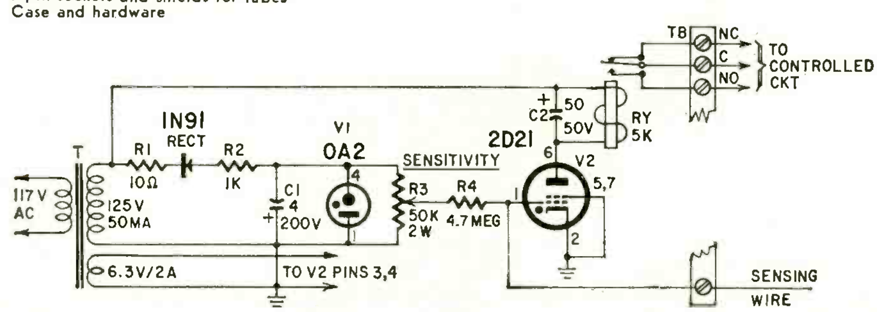
PROXIMITY RELAY

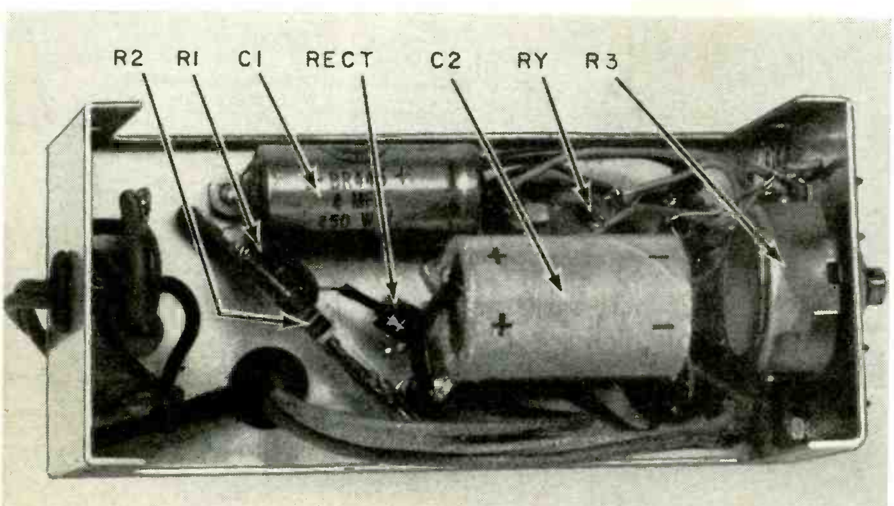
Build a proximity relay with a minimum of parts and eliminate most of the troubles that often accompany a finicky oscillator

R1—10 ohms
R2—1,000 ohms
R3—pot, 50,000 ohms, linear taper, 2 watts (Ohmite CLU5031 or equivalent)
R4—4.7 megohms
All resistors ½-watt 10% unless noted
C1—4 μf, 200 volts or higher, electrolytic
C2—50 μf, 50 volts, electrolytic
T—primary, 117 volts; secondary 125 volts at 50 ma and 6.3 volts at 2 amps (Stancor PA8421 or equivalent)
RY—5,000-ohm relay, spdt contacts (Potter & Brumfield RS5D or equivalent)
RECT—1N91
V1—OA2
V2—2D21
TB—terminal board, 4 terminals
7-pin sockets and shields for tubes
Case and hardware

By LEONARD J. D'AIRO *



Schematic of proximity relay. Spst on–off switch may be added.



Underchassis view of the instrument.

THIS novel relay circuit has uses ranging from a burglar alarm to an actuator for animated window displays.

A 2D21 gas tetrode is used to operate the relay and an 0A2 is used for voltage regulation. A miniature power transformer delivering 125 volts at 50 ma and 6.3 volts at 2 amperes powers the unit. Peak power consumption is 5½ watts, while standby power consumption is only 4½ watts (about half the power drain of a night light!). This makes the unit suitable for long periods of operation.

Operation

The high-voltage output of the transformer is rectified and regulated to provide a dc bias for the control grid of the 2D21. The level of the bias is adjusted by pot R3. The plate of the 2D21 is connected direct to the unrectified high voltage through the relay. This places 60-cycle ac on the plate.

As soon as an ac voltage (whose peak is at least equal to the applied bias) is applied to the control grid, the gas within the tube ionizes, current flows in the plate circuit and the relay closes. The 2D21 conducts only as long as the ac voltage is applied to the grid and will cut off once the voltage is removed.

Since ac is applied to the plate, the gas within the tube is ionized only over a small portion of the positive half of

*Author: *Servicing Transistor Radios*, Gernsback Library, New York, N. Y.

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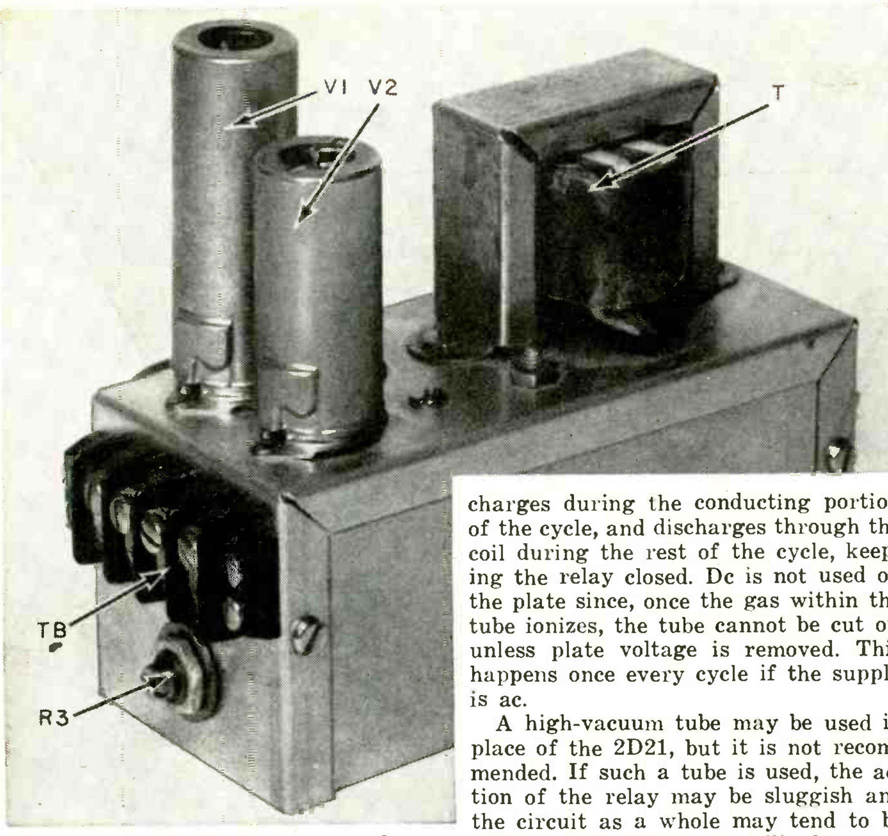


Top view. Relay contacts and grid of 2D21 connected to terminal board.

the ac cycle. Therefore the relay will tend to close during this portion only and open for the remainder of the cycle. This causes the relay to hum or chatter. A 50-μf capacitor across the relay eliminates this chatter. The capacitor charges during the conducting portion of the cycle, and discharges through the coil during the rest of the cycle, keeping the relay closed. Dc is not used on the plate since, once the gas within the tube ionizes, the tube cannot be cut off unless plate voltage is removed. This happens once every cycle if the supply is ac.

A high-vacuum tube may be used in place of the 2D21, but it is not recommended. If such a tube is used, the action of the relay may be sluggish and the circuit as a whole may tend to be erratic. The sensitivity will also vary with temperature and humidity.

Construction

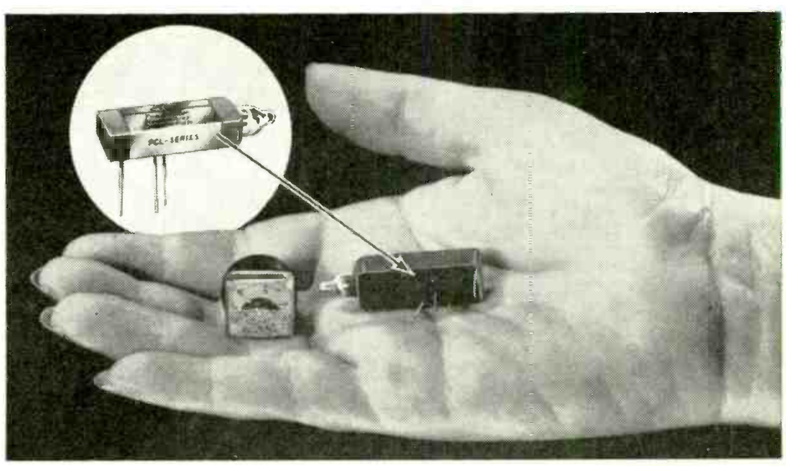
The relay circuit was built into a Minibox. The power transformer and tubes are mounted on top while all other components are mounted within. The bias adjust pot (SENSITIVITY) is mounted below the terminal block to which the relay contacts and 2D21 grid are connected. Circuit layout is not too important (or critical), but take care to shield the grid circuit from any ac field within the box. Do not use the unused pins on the sockets as tie points. Both tubes have extra internal connections not shown in the schematic.

Adjustment

To operate the relay, first turn the pot to its maximum clockwise position (maximum bias). Connect a 2-foot length of wire to the control-grid terminal of the block, and turn on the unit. After the 2D21 has warmed up, rotate the pot in a counterclockwise direction until you hear the relay click. Then advance the pot until the relay clicks again. Bring your hand near the wire and see if the relay clicks when your hand is about 3 inches away. If not, rotate the control counterclockwise until it does. The relay should click on and off as your hand is moved nearer to and farther from the wire. The circuit is now set to its maximum sensitivity for that length of wire and is ready for operation.

The pot provides an ac-pickup sensitivity range between 100 millivolts and 100 volts, depending upon the ac field surrounding the circuit. The maximum length of wire that should be used is about 5 feet, although this length can be increased to 25 feet if shielded wire is used (5 feet of which can be exposed). The wire can be connected to any metal object, such as a chair, table, etc. as long as it is not grounded or too close to any ac carrying leads. As soon as a person or animal approaches the object or wire, the relay operates. END

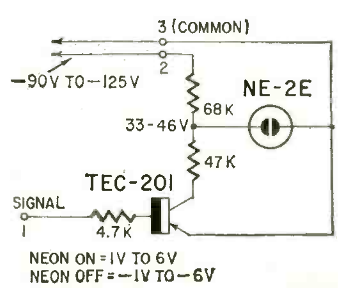
Miniature INDICATOR



PROGRESS toward using less panel space for indicators is shown by the two miniaturized units in the girl's hand. Because miniaturization has come so far in the past few years, the amount of panel space the indicator takes up, whether it is a meter or a pilot light, is often the limiting factor in reducing the size of electronic gear.

This little panel meter is made by Alco Electronics of Lawrence, Mass. Just ⅝ inch square, it is mounted by drilling a ½-inch hole in a panel and tightening the threaded ring on the rear of its case. The meters are available in the usual variety of dc voltage and milliampere ranges. The one shown here goes to full scale on 1 ma.

The other unit is a complete transistor-driven neon-lamp indicator circuit including three resistors, a transistor and the neon bulb (see diagram). Just three leads come out of the encapsulated body of the PCL (*P*rinted *C*ircuit *L*amp). They connect to ground, B-voltage and a signal point. PCL's are made by Transistor Electronics of Minneapolis in 14 stock models to indicate a change in polarity at any desired low dc point in a circuit. In a typical PCL circuit, a change in polarity from anywhere between −1 to −6 volts to anywhere between 1 to 6 volts will turn the neon light on. Reverse signal polarity extinguishes the lamp. END



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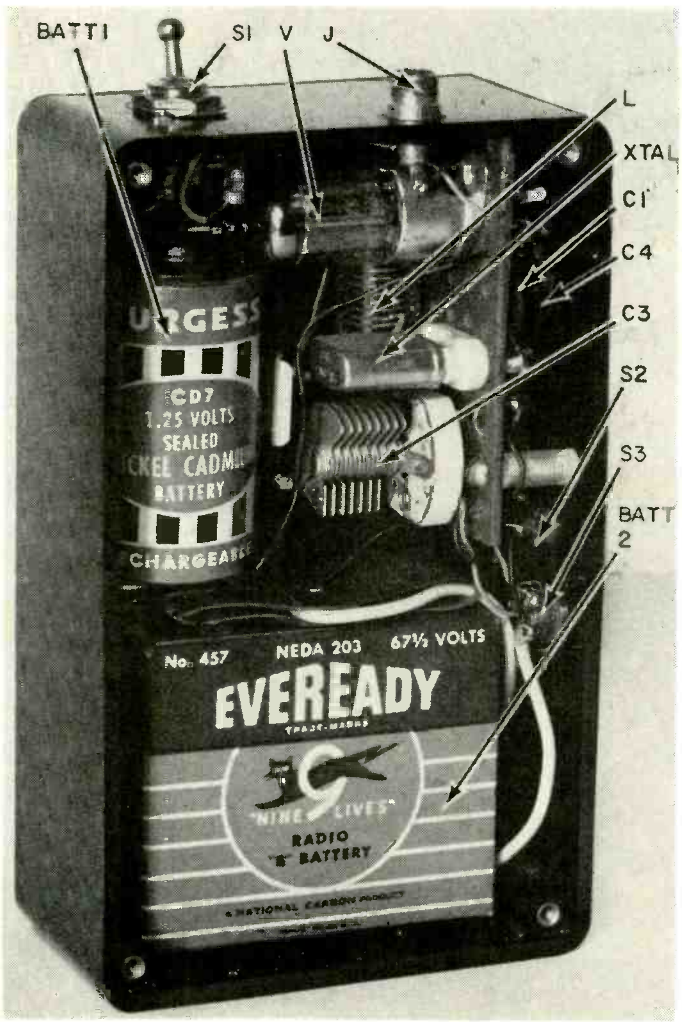
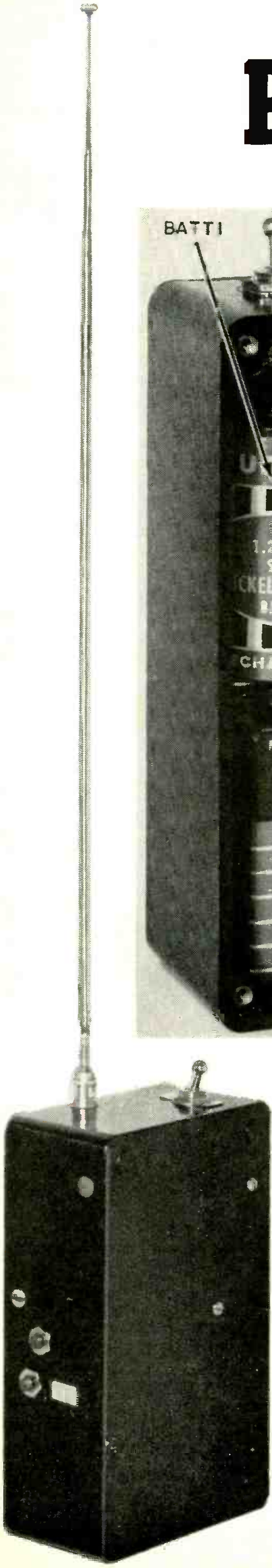
PORTABLE R/C

One-tube transmitter



Interior view of transmitter. Notice unit is constructed on perforated panel.



Upper button (S2) is for CW signal, lower button (S3) for AM signal.

By I. QUEEN
EDITORIAL ASSOCIATE

PART 19, Vol. VI of the FCC rules and regulations (August, 1959) defines and prescribes class-C radio operation. It authorizes transmission for the "control of remote objects or devices by radio, and the remote actuation of devices which are used solely as a means of attracting attention." No intelligence of any kind may be transmitted.

Class-C offers a wonderful chance for youngsters (and oldsters) to learn radio operation. At the same time it is a means of doing useful work, turning on appliances, opening garage doors, etc. from a distance. Youngsters from 12 years up are permitted to use this band. All you have to do is fill out an FCC Form 505 and wait for your license. No technical skill or knowledge is required.

The schematic shows that the transmitter uses a single 3A5 tube. A tube puts out more power than can be obtained practically from a transistor at this time.

The A-battery consists of only one size-D cell. Furthermore, it is a *rechargeable* type that provides about 11 hours' continuous use, after which it may be recharged. Obviously, battery

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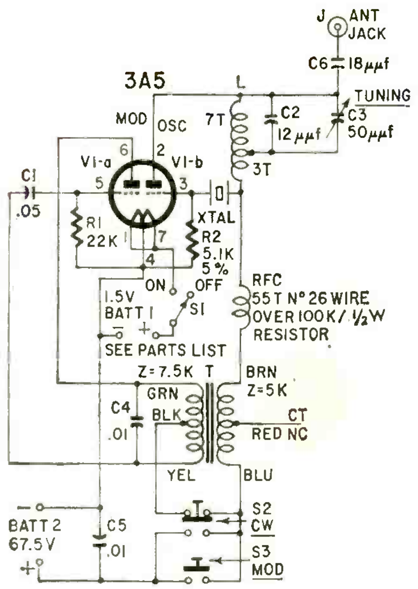

Schematic of R-C transmitter.

R1—22,000 ohms
R2—5,100 ohms
Both 10%, ½ watt
C1—0.05 μf, disc ceramic
C2—12 μμf, ceramic
C3—variable, 50 μμf
C4, 5—0.01 μf, disc ceramic
C6—18 μμf, disc ceramic
All capacitors 200 volts or higher
L—10 turns air-wound, ½-inch diameter, spaced 16 turns to the inch, tapped at 3 turns (Barker & Williamson Miniductor 3003 or equivalent)
RFC—55 turns No. 26 enameled wire on 100,000-ohm ½-watt resistor
T—primary, 7,500 ohms, ct; secondary, 5,000 ohms (Argonne AR154 or equivalent)
V1—3A5
S1—spst toggle
S2—spdt spring-return pushbutton
S3—spst spring-return pushbutton, normally open
BATT1—rechargeable size-D cell (Burgess CD7 or equivalent)
BATT2—67½-volt B-battery (Eveready 457 or equivalent)
XTAL—third-overtone crystal for radio-control band (in this case, 26.995 mc)
J—phono jack
Telescoping antenna with phono plug soldered to bottom
Perforated panel to use as chassis
Socket for crystal, 7-pin miniature tube socket
Bakelite case, 6¼ x 3¾ x 2 inches (Lafayette MS-216 and cover MS-217 or equivalent)
Battery connectors and hardware
FCC Form 505 (Class-C license)

TRANSMITTER

controls models. No license examination required

power is *not* a problem here.

Circuitry

V1-b is the oscillator triode. It is tuned to the third overtone of the crystal (in this case, 26.995 mc), selected for the class-C Citizens band. A fixed capacitor, C2, shunts the tuning capacitor, C3, to reduce its tuning range.

V1-a is an audio oscillator and modulator. Its signal amplitude-modulates the rf from V1-b. When push-button S2 is depressed, the set emits a CW (unmodulated) signal. Under this condition, the B-drain is 5 ma. When pushbutton S3 is depressed, an AM signal is generated and the drain rises to about 7.5 ma. C4 determines tone frequency. Increasing its value lowers the frequency.

L is a 10-turn air-wound coil ½ inch in diameter (spaced 16 turns to the inch), tapped at three turns. It may be a section cut from a Barker & Williamson Miniductor coil 3003. RFC is made of No. 26 enameled wire wound over a 100,000-ohm ½-watt resistor. Use 55 turns.

It is easy to adjust the transmitter. Insert the proper crystal and tune C3 for maximum output. An S-meter on a short-wave receiver or field-strength meter helps tune for maximum.

With a power input of about 300 milliwatts, the transmitter is far below the legal maximum of 5 watts. On the other hand, it is far above the flea-power rigs described from time to time. On actual test, the tone has been heard clearly at least six city blocks away. On flat terrain with no obstructions, the range is greater.

If higher power is desired, omit the tone modulation and connect the triodes in parallel. Omit T, S3, C1, C4 and R1. Reduce R2 to 2,700 ohms. END

- Battery-operated R/C transmitter.
- Crystal controlled (any class-C frequency usable).
- One tube—3A5.
- Output modulated or unmodulated rf.
- Power input about 300 mw.

Unit was tested and found to work as specified by author. Maximum range about ½ mile, line of sight. Frequency steady.

BENCH TESTED

trouble shooting with the FCC

THE latest release from the FCC Field Engineering and Monitoring Bureau reveals a variety of interesting cases.

The Santa Ana (Calif.) monitoring station, using direction-finding equipment from the Los Angeles district office, tracked down mysterious conversations heard by Long Beach listeners. The owner of the house where the broadcasts originated denied having a transmitter, but admitted owning a phono oscillator.

His oscillator was found to be radiating on several AM broadcast frequencies and had harmonics all the way up to 30 mc. A concealed microphone was found in the living room. The man later admitted that he had planted the mike so that he could listen in on his wife's conversations.

A TV viewer in Rochester, N. Y., was so positive that a local ham was the source of his interference that he drew up a petition and appealed to his Congressman to do something about it. The Rochester Television Interference Committee, composed of amateur radio operators, cooperated with the FCC's Buffalo field office by checking the ham's equipment. They said it was not at fault. The interference continued and so did the search. After some 100 hours were spent looking for the irate viewer's trouble source, it was finally located—it was the butter conditioner in the door of the refrigerator in the complainant's own kitchen that was sending out the offending signals.

The Los Angeles (Calif.) district office received complaints that an unidentified Citizens-band station had been on the air for more than 3 hours. A car was sent out to locate the station. As the search narrowed, an FCC engineer heard a fragment of conversation in which someone was telling someone else that his account with a certain piano company was overdue.

The piano company office was visited and a very flustered woman explained that she did not know how to turn off a Citizens band radio. A short briefing solved that one.

A complaint by a Navy installation in Maryland led to the discovery that a transmitter in the British West Indies had been left on and unattended for a considerable time.

An airline at Chicago (Ill.) reported that a strong local signal was interfering with air-to-ground communications. The signal was traced to a piano factory in Michigan that had a defective rf heater. Besides drying glue, the heater was putting out a signal that could be heard hundreds of miles away from the factory. END

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CB transceiver circuitry

A noise-immune squelch circuit is one of the new CB transceiver features discussed in this article

The Apelco AR-9. Push-to-talk switch is on microphone.

Radson RT-75 transceivers.

By ROBERT F. SCOTT
TECHNICAL EDITOR

THE number of Citizens-band licensees is growing by leaps and bounds and the manufacturers of class-D transceivers are hard pressed to meet the demand for equipment and accessories. New manufacturers are entering the field and old ones are constantly improving their old models (and adding new ones). Circuit analyses and complete schematics of the International CTZ-5A Citizens Bander, RCA's Porto-Phone and the Multi-Elmac Citi-fone appeared in the September and December, 1959, issues along with abstracts of interesting circuits in the Vocaline ED-27 and Globe CB-100. This month we have some dope on the Apelco AR-9 along with interesting circuits from the Radson RT-70 and RT-71 and the Vocaline ED-27.

Circuit of the AR-9

The AR-9, a product of Applied Electronics Co. (213 E. Grand Ave., San Francisco, Calif.), is a five-channel transceiver available for 117 volts ac, and 12- and 32-volt dc operation. The 12-volt supply is shown as part of Fig. 1. A dynamotor is used on 32 volts dc and a conventional full-wave supply (with a 12X4 rectifier) is used on ac.

The receiver circuits are conventional with a 12AU6 rf amplifier, 6U8 mixer and crystal oscillator, 12BA6 455-kc if amplifier, 12CR6 detector, avc and first af amplifier, 6AQ5 audio output (and transmitter modulator) and a 12AL5 series-type noise limiter and squelch.

The noise limiter and squelch circuits are similar to those in the Globe CB-100 covered in detail in the December, 1959, issue. The audio from the cathode of

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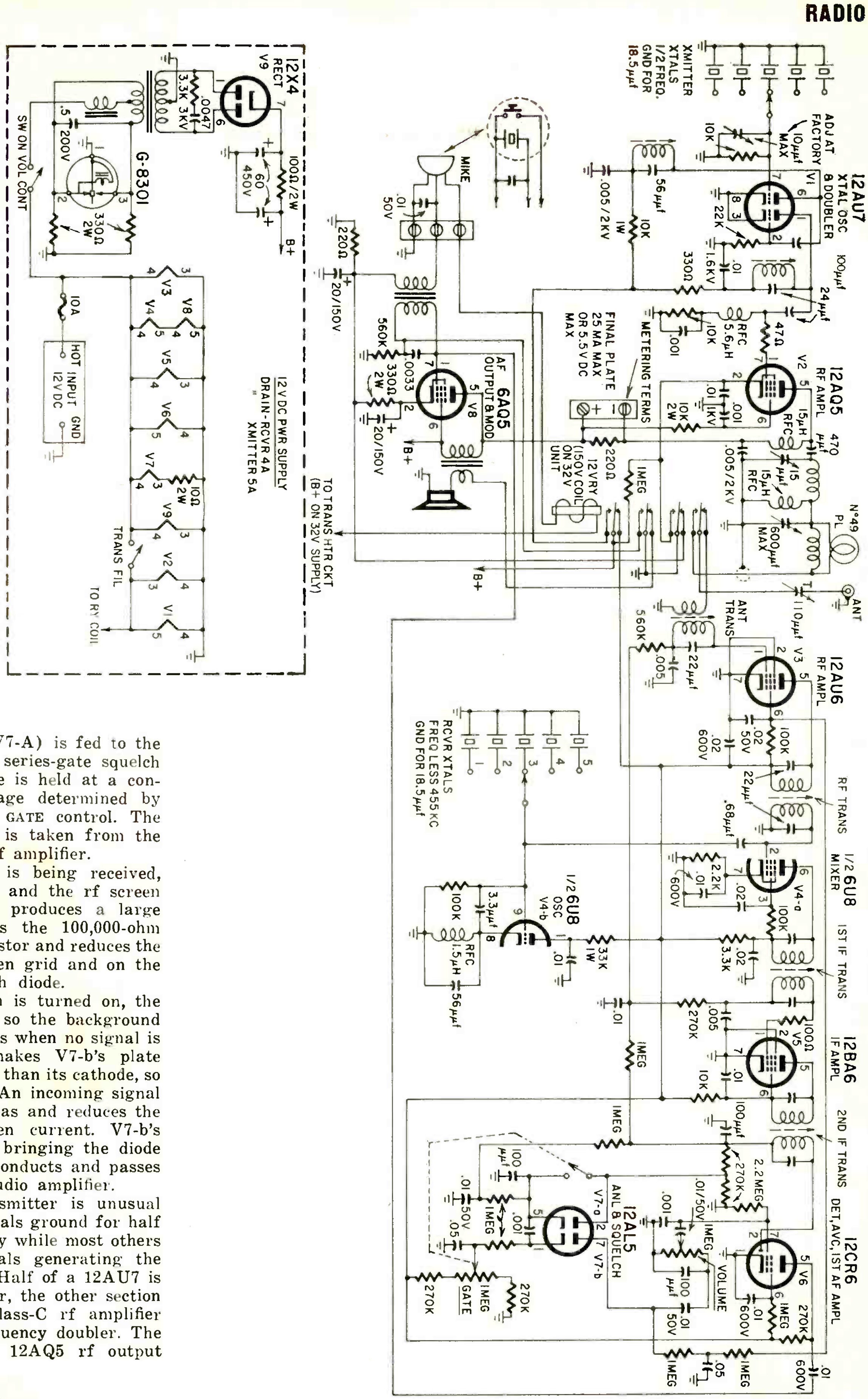

the noise limiter (V7-A) is fed to the cathode of V7-b, a series-gate squelch tube. V7-b's cathode is held at a constant positive voltage determined by the setting of the GATE control. The dc on V7-b's plate is taken from the screen grid of the rf amplifier.

When no signal is being received, the avc bias is low and the rf screen current high. This produces a large voltage drop across the 100,000-ohm screen-dropping resistor and reduces the voltage on the screen grid and on the plate of the squelch diode.

When the squelch is turned on, the GATE control is set so the background noise just disappears when no signal is coming in. This makes V7-b's plate slightly less positive than its cathode, so the tube is cut off. An incoming signal increases the avc bias and reduces the rf amplifier's screen current. V7-b's plate voltage rises, bringing the diode out of cutoff so it conducts and passes the signal to the audio amplifier.

The AR-9's transmitter is unusual in that it uses crystals ground for half the output frequency while most others use overtone crystals generating the channel frequency. Half of a 12AU7 is the crystal oscillator, the other section is an overbiased class-C rf amplifier operating as a frequency doubler. The doubler drives the 12AQ5 rf output stage.

Radson transceivers

These radiotelephone sets, made by Radson Engineering Corp. (Macon, Ill.), are available in four models. The

Fig. 1—Schematic of Apelco AR-9 transceiver with 12-volt power supply.

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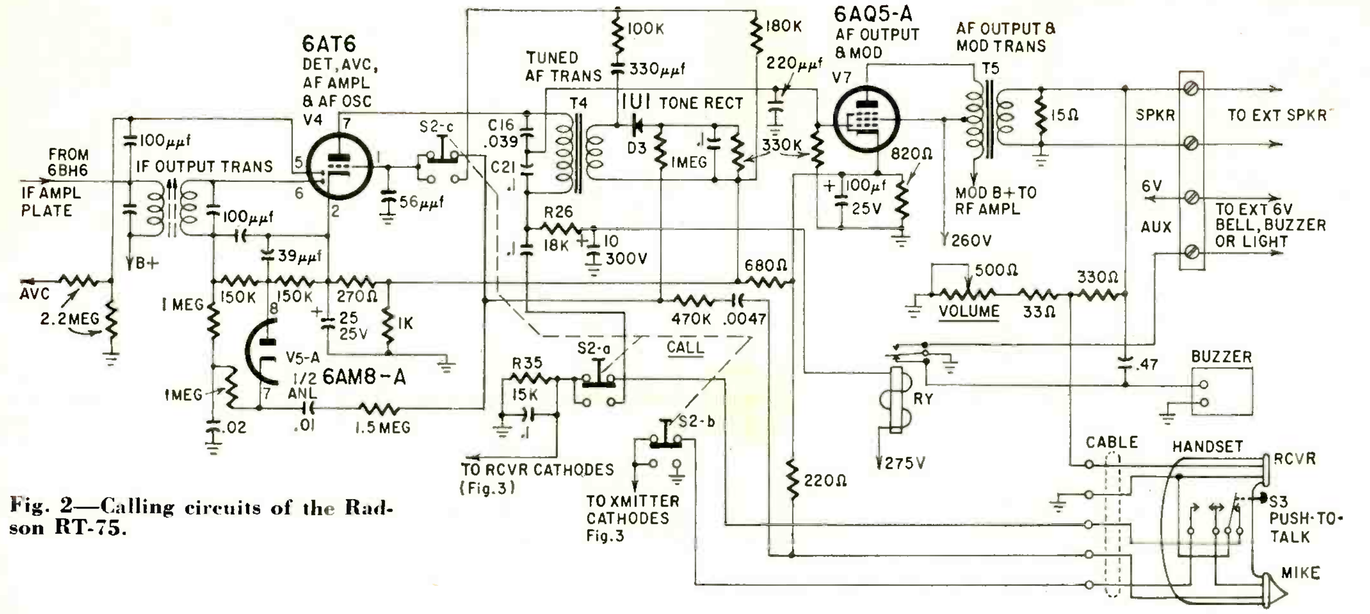

Fig. 2—Calling circuits of the Radson RT-75.

RT-70 (single channel) and RT-70A (two channels) units are made for base-station service with 117-volt ac supplies. The RT-75 (single channel) and RT-75A (two channels) are designed for mobile and marine installations powered by 6- or 12-volt batteries. The receiver of these units is a crystal-controlled superhet with two stages of 1.65-mc if and an automatic noise limiter. The transmitter is crystal-controlled with 5 watts input to the final amplifier. Unlike most Citizens-band transceivers which have built-in speakers, the Radson units have *handsets* with built-in push-to-talk buttons.

Another unusual feature of these instruments is the calling system that allows one station to signal another when communication is desired. Pressing the CALL button at one station sounds an alarm at the other. In the average Citizens-band transceiver—as well as many used in other services—the squelch is opened by any station on the frequency. Thus, an operator, busy with other tasks, is often interrupted by calls not intended for him. In a network of Radson units, signals from other transceivers will be picked up but will not disturb the operator a few feet away because of the low audio output from the handset. On the other hand, a station in the net alerts others in the same net by pressing his CALL button. The transmitter sends out a tone-modulated signal that triggers signal buzzers in other similar transceivers.

Signaling Circuits

Fig. 2 shows the audio and signaling circuits in the RT-70 and RT-75. The CALL switch (S2) is a three-pole double-throw pushbutton mounted on the control panel. The diagram shows it in the normal (receiving) position.

When S2 is pressed, section S2-c connects V4's grid to the secondary of T4 and converts this stage to an audio oscillator tuned to around 2,300 cycles by C16 and C21. The signaling tone is fed through C16 to the grid of the 6AQ5 af output and modulator. S2-a of the CALL switch inserts R35 in series with the cathodes of the receiver's rf amplifier, converter and first if amplifier to disable these circuits. Simultaneously, the transmitter's rf section is turned on by grounding the cathodes through S2-b. The rf output is modulated by the audio tone developed across T5—half of which acts as the secondary of a modulation transformer.

In the receiver, the signal from the if amplifier is fed to the detector and avc diodes of V4. The detector's output feeds through the series type noise limiter V5-a and section S2-c of the CALL switch to V4's grid. V4's plate load consists of R26 and the primary of T4 in series. T4's primary is tuned to 2,300 cycles and appears as a very high impedance at this frequency. The coil of the alarm relay is in series with V4's plate supply. Normal plate current keeps the relay energized so the buzzer and auxiliary alarm are inoperative.

If the incoming signal is modulated by the calling tone, a high-voltage 2,300-cycle signal develops across T4's primary and secondary. The secondary voltage is rectified by D3 and applied as a negative bias to V4's grid. This reduces the plate current so the relay releases. This switches 6 volts to the auxiliary alarm circuit and connects the buzzer—a modified miniature PM speaker—across the secondary of output transformer T5. The buzzer is fed by the 2,300-cycle tone tapped off T4's primary and amplified by V7, the af output and modulator tube.

At most frequencies in the voice range, T4's tuned circuit has negligible impedance so V4's plate load is R26 alone and C21 is the coupling capacitor to V7's grid. V7's output is fed to the receiver in the handset through a resistive network across T5's secondary.

When transmitting, the transceiver's circuits are switched by S3 in the handset. This grounds the mike and transmitter cathodes and removes the short from across R35 to disable the receiver.

Most receivers use a pentode rf amplifier, a separate crystal oscillator and the send–receive relay switches the antenna between the transmitter output and the input to the receiver. The corresponding circuits in the Radson units

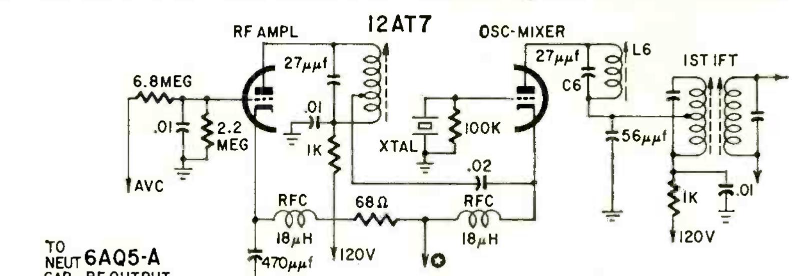

Fig. 3—Input and output stages of the Radson transceiver.

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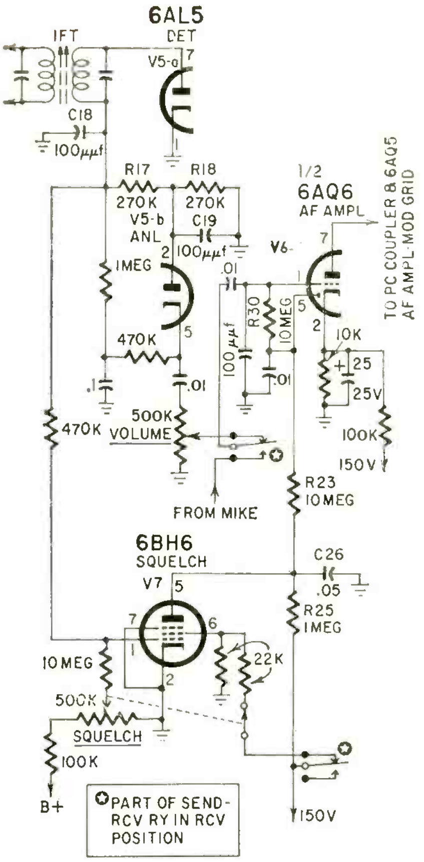


Fig. 4 — Noise-immune squelch circuit of the Vocaline ED-27.

are quite different (Fig. 3). The rf amplifier is a grounded-grid type with the cathode capacitance-coupled directly to the transmitter's output tank circuit. The oscillator is a triode type with the plate load consisting of a 27-mc tuned circuit C6–L6 and the primary of the first if transformer. The rf signal is fed to the cathode.

Noise-immune squelch

Most squelch circuits in AM receivers are opened by electrical noise impulses produced by lightning, neon signs, automotive ignition systems and other non-radio devices. During thunderstorms or in noisy locations, some squelch circuits will be open almost constantly and the set produces an almost continuous barrage of noise. Adjusting the squelch threshold control to eliminate all noise is likely to prevent a desired call from being received. This problem has been minimized by the patented Vocatron noise-immune squelch circuit used in the Vocaline ED-27. This circuit (Fig. 4) discriminates between noise pulses and a modulated carrier.

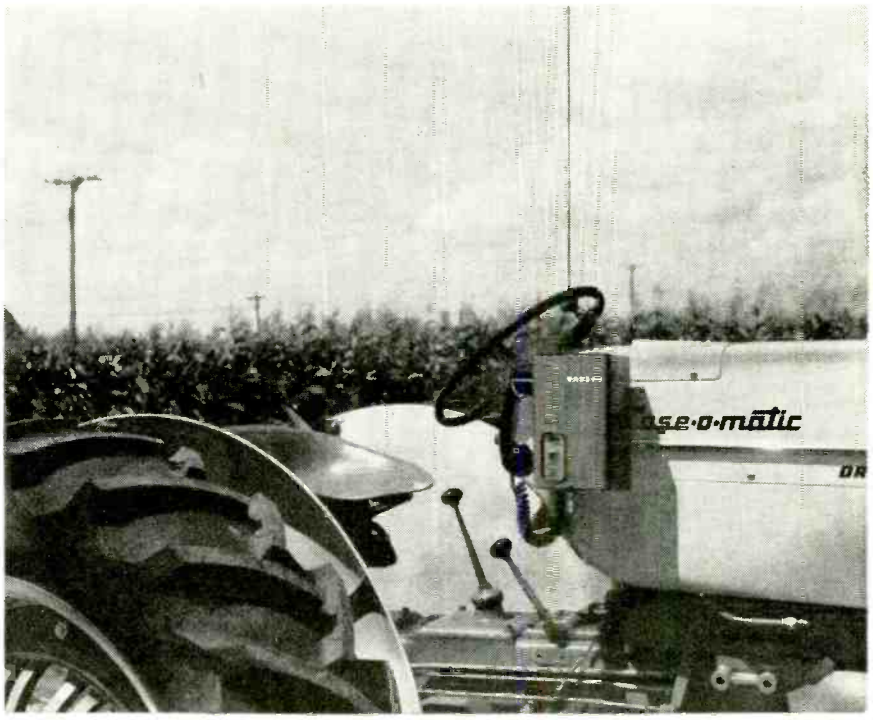
Detector V5-a and series type noise limiter V5-b are conventional and similar to those in the International CTZ-5A discussed in the September, 1959, issue. The grid of af amplifier V6-a is returned to the plate of the squelch tube (V7) — a sharp-cutoff high-transconductance pentode.

This tube is operated with its control grid connected to the B-plus line through the SQUELCH control and to ground through the detector load consisting of R17 and R18. The SQUELCH control places on V7's grid a delay bias which must be overcome by a voltage developed by an incoming carrier. The setting of the control determines the carrier strength required to open the squelch.

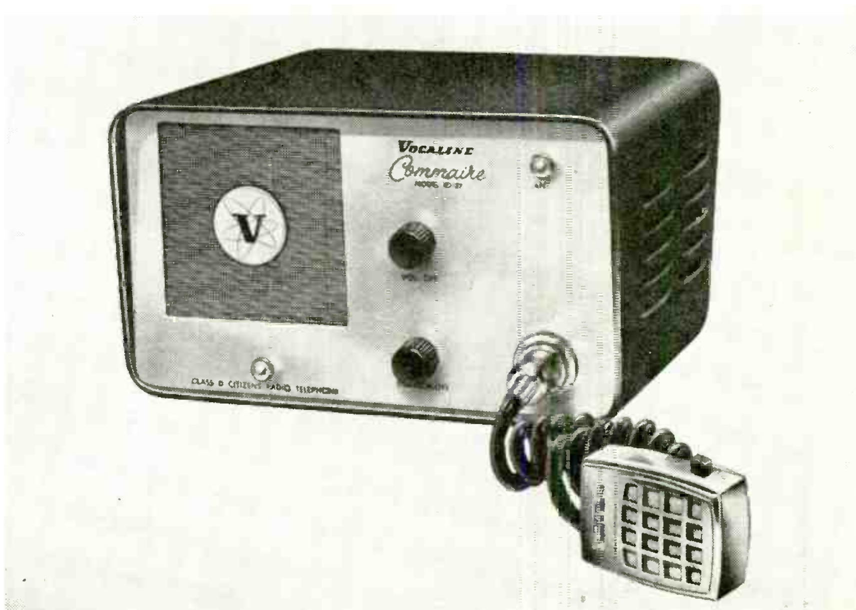
Under no-signal conditions V7 conducts heavily and its plate is close to zero voltage because of the drop across plate load resistor R25. The grid of af amplifier V6-a is connected to V7's plate through R23 and R30 and the tube (V6-a) is cut off by the high positive bias on the cathode.

An incoming rf carrier develops a negative voltage across R17 and R18, and C18 and C19 charge to a voltage proportional to carrier strength. As long as the carrier is not overmodulated, the voltage across C18 is sufficient to keep V7 cut off. (Overmodulation causes momentary breaks in the carrier, permitting C18 to discharge and bring V7 out of cutoff.) With V7 cut off, the voltage on the plate rises and C26 charges positively through R25. V6-a's grid is returned to C26 so its voltage rises to the point where the tube conducts and passes the audio signal to the power amplifier.

V6-a's grid resistor (R30) is connected to one of the diode plates in the tube. This diode is a clamp to prevent the grid from being biased positive with



A Radson RT-75 mounted on a tractor.



The Vocaline ED-27

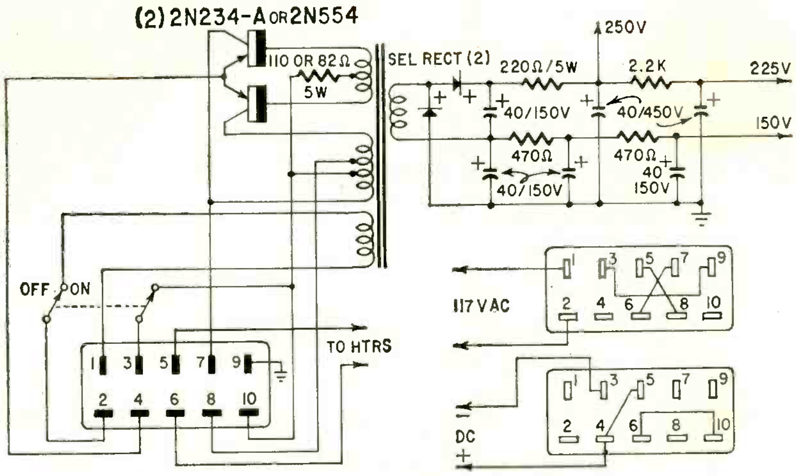


Fig. 5—Ac–dc power supply uses transistors.

respect to the cathode. If C26's charge rises above V6's cathode voltage, the diode conducts and develops a voltage drop across R23 and pulls the grid down to cathode level. The grid is then biased for normal amplifier operation by the diode's contact potential.

Now, assume that the receiver is on with the squelch operating and see what happens to a chain of noise pulses. Each pulse will be detected and will produce a negative voltage across C18 and C19. Each pulse drives V7 to cutoff and C26 begins to charge. However, the time constant of R17, R18 and C18 is so short that V7 conducts between pulses and prevents C26 from charging enough to override the cutoff bias on V6-a.

In other words, the time constant of the detector load circuit is so short (around .00005 second) and that of C26-R25 is so long (.05 second) compared to the interval between noise pulses that V6-a's grid remains substantially at zero (with respect to the ground) and the tube is cut off by heavy cathode bias.

Transistor power supply

The Vocaline ED-27 is one of the few transceivers using transistor type power supplies for direct-current operation (Fig. 5).

A pair of power transistors is connected as a push-pull oscillator developing an ac voltage in the collector winding on the power transformer. The secondary feeds a symmetrical (or full-wave) doubler set up to deliver 250, 225 and 150 volts without voltage dividers. For ac operation, the circuits are switched automatically in the ac line connector. END

IDENTIFY your calibration signals

By RONALD L. IVES

THE crystal-controlled calibration oscillator, introduced more than 20 years ago, has performed so satisfactorily that it is now either an integral part or a standard accessory of almost all communications receivers. Dependable calibration points consisting of the calibration oscillator's fundamental frequency and harmonics are available throughout the tuning range of the receiver.

There is, however, one problem encountered when using the crystal calibration oscillator as it is commonly constructed: it is virtually impossible to distinguish between the calibration-oscillator signal and a strong unmodulated carrier. This is entirely understandable when it is remembered that the output of the crystal calibrator is a clean sine wave, just like any good CW signal.

By applying well known principles, a calibration oscillator can be modulated by a neon R-C oscillator at low cost, at negligible increase in power consumption and without performing major surgery on the receiver.

The circuit used is shown in the diagram. This includes a standard crystal-calibrator circuit—the one used in the Technical Material–GPR-90 receiver—and a conventional neon oscillator. The interconnection is made by inserting the neon-oscillator output between the suppressor grid and ground.

The neon-tube oscillator–modulator is controlled by a pushbutton spst switch which opens and closes the power (B-plus) lead.

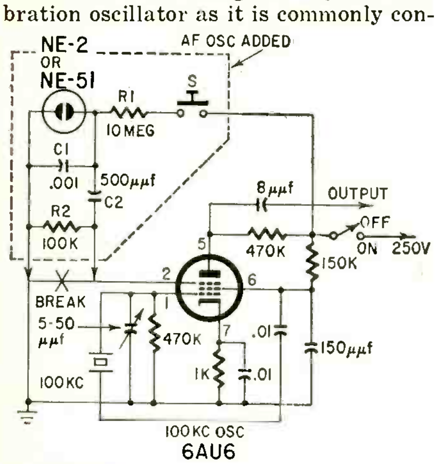
Frequency of the neon oscillator is determined by R1 and C1, if all other factors remain the same. Decreasing their product will increase the frequency; increasing their product will decrease the frequency. The upper-frequency limit is above 10 kc and is determined by the re-ionization time of the neon bulb.

Coupling capacitor C2 can have any value from 100 μμf to more than .002 μf without interfering with oscillator functioning, and suppressor grid resistor R2 can have any value from about 47,000 ohms to more than 1 megohm. If a very high resistance (such as 5 megohms) is used here, contact potential sufficient to reduce rf output markedly may be developed.

Construction is relatively simple and straightforward. The two capacitors, C2 and C1, and the suppressor resistor, R2, should be mounted as close to the tube socket as practicable to confine rf to the immediate area. The neon lamp—which can be either a socket-mounted NE-51 or an NE-2 soldered directly in place—can be mounted where convenient, but it and its leads should be kept away from low-level af circuits. The 10-megohm timing resistor, R1, should be as close to the neon lamp as practicable. The line from it—through the pushbutton to the load side of the crystal-oscillator B-plus switch—can be run almost anywhere, as it carries only dc.

The calibration oscillator is operated conventionally until there is some doubt as to the origin of the signal. This is resolved by pressing the pushbutton which turns on the identifier. If it is a signal from the calibration oscillator, 1,200-cycle modulation will be added to the calibration signal. If the signal is not from the calibrator, pressing the button will not change it.

Cost of this identifier is about $3 if all parts are bought new at retail. Installation requires about an hour of careful work. Six months of using the device on a communications receiver shows it is a good investment. END



R1—10 megohms
R2—100,000 ohms
Both resistors 10%, ½ watt
C1—0.001 μf
C2—500 μμf
Both capacitors 600 volts or higher
NE-51 or NE-2 neon bulb (socket required for NE-51)
S—spst pushbutton switch

Parts to be added are shown inside the dashed line.

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WORLD SERIES SPECIAL

By JAY STANLEY

A shirtpocket receiver that uses only two transistors, doesn't need an external antenna

THERE seem to be two types of pocket radios: superhets which work beautifully but are expensive and complicated to build, and simple one- or two-transistor sets that require as much as 50 feet of outside antenna really to pull in anything.

This set, small enough to slip easily into a teenager's shirt pocket, is a nice compromise. It uses only two transistors and a minimum of parts, yet it pulls in all the stronger stations in an area *without* an external antenna. The original model was built as the result of much prodding from my son, who kept reminding me that this was the year to build the long-promised pocket radio in time for the World Series.

Secret of the set's excellent performance is a combination of a reflex and a regenerative circuit—a simplified version of an excellent circuit developed by W6WXU. With only two low-cost transistors and two diodes, the radio has a regenerative rf stage, diode detector and two audio stages. Although regenerative, which adds a great deal to the sensitivity, the regeneration is fixed, and volume is controlled by a smooth-acting volume control. The set has none of the cranky tuning so common with straight regenerative receivers.

The radio is built with readily available miniature parts. Even so, it is not particularly difficult to wire since all components except the volume control are mounted on a small, perforated plastic board. When mounting the parts, feed all leads from the various resistors and capacitors through the holes and bend them over to secure them to the board. This method reduces the need for soldering clips and lugs to a minimum. Sockets are provided for the two transistors to simplify replacement, should it become necessary.

Of course, since all parts *are* small, the builder must wire carefully. A blob of solder in the wrong place could cause a lot of trouble.

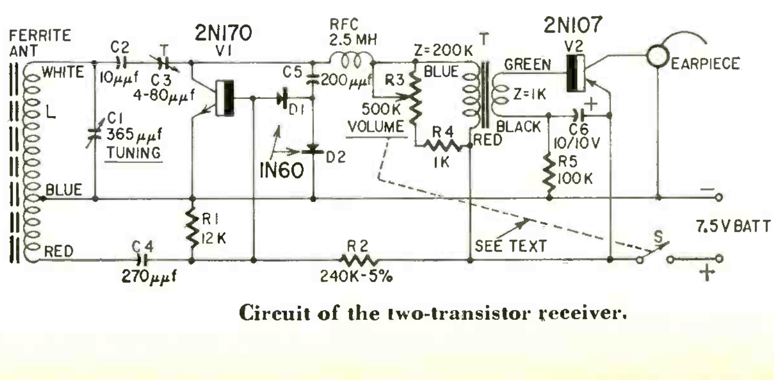
The parts layout is not particularly critical, with one important exception: the antenna coil *must* be kept as far as possible from the battery. Unless this is done, there will be a serious loss of signal strength. The perforated plastic chassis is secured to the plastic case with two small brackets and tiny bolts and nuts. The volume control is mounted on the case.

If you enjoy showing the "innards" of the set to friends, the clear plastic case is ideal. It can be dressed up by cementing panels, cut from heavy coverstock paper, to the outside. For durability, spray the paper with clear lacquer before pasting it down.

The rf choke is a 2.5-mh unit—and it must be small. In the set shown, a standard choke was used, after the metal ends were removed by clipping the ceramic rod core close to the end of the coils and making connections right to the windings. The choke is cemented to the mounting board. The battery leads are simply soldered to the 7.5-volt mercury battery. The battery is taped on both ends to avoid accidental short circuits.

To use the set, simply turn it on and tune in a strong station. Then adjust

R1—12,000 ohms
R2—240,000 ohms, 5%
R3—500,000-ohm pot, see text
R4—1,000 ohms
R5—100,000 ohms
All resistors ½-watt 10% unless otherwise noted
C1—tuning capacitor, 365 μμf, miniature (Lafayette MS-274 or equivalent)
C2—10 μμf, ceramic
C3—trimmer, 4–80 μμf
C4—270 μμf, ceramic
C5—200 μμf, ceramic
L—flat ferrite antenna (Lafayette MS-309 or equivalent)
S—spst on R3 (see text)
RFC—choke, 2.5 mh
V1—2N170
V2—2N107
D1, 2—1N60
T—miniature transformer: primary 200,000 ohms; secondary 1,000 ohms (Argonne AR-100 or equivalent)
Battery, mercury, 7½ volts (Mallory TR-145R)
Bakelite board, perforated, 2⁷⁄₁₆ x 3⅜ inches
Knobs
Miscellaneous hardware



Circuit of the two-transistor receiver.

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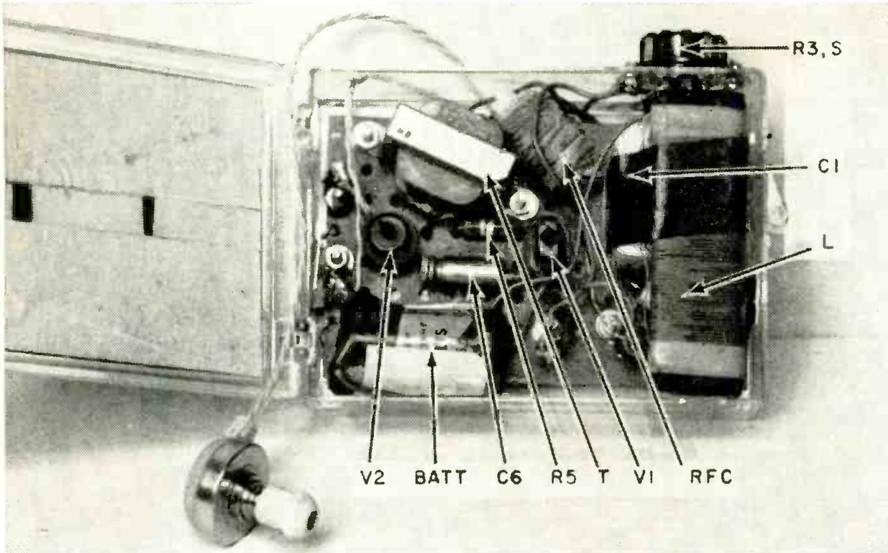


The top of the chassis as it looks mounted in its plastic case.

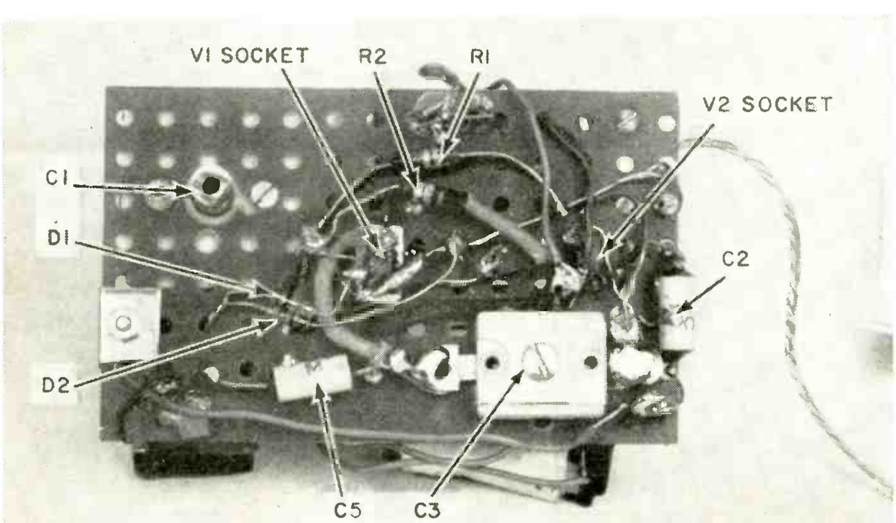
trimmer capacitor C3. With its screw almost all the way in, some stations will whistle as you tune across the dial with the main tuning capacitor, indicating that the set is regenerative and oscillating. Back off the trimmer adjustment until the whistling stops and the set remains slightly below the point of oscillation. Once this adjustment has been made, the trimmer can be left alone—and all tuning done with the tuning capacitor (C1) and volume control.

[Unfortunately, the volume control–switch used by the author has been discontinued. As a result a slight change is necessary. The builder can use a larger unit such as the Lafayette VC-39 and a larger plastic case to make room for it. Or if a size increase is not wanted, you can use two separate subminiature units to replace the combined switch–volume control. In this case, use units such as the Lafayette VC-18 for the volume control and SP-88 for the switch. They can be mounted one under the other on the side of the case.—*Editor*]

Transistors are not as uniform as tubes, and for that reason it may be advisable to try other transistors if the set does not work properly when tuned up. The 2N170 is the more critical of the two transistors, so if you run into trouble, try it first.

Likewise, the best value for bias resistor R1 may require some experiment for best results. This is especially true if the set exhibits some audio howl (a low-pitched growl just before the set breaks into oscillation).

The tiny antenna coil works surprisingly well—however, like all such coils, it is directional and some change in the position of the set may give an increase in volume. One more thing: use a *good* earpiece. A really sensitive earphone gives a lot of extra volume. END



Some components are mounted on the wiring side of the chassis.

tests to SINGLE OUT BEST STEREO system

A report of findings is expected to be filed with the FCC by the end of October by the National Stereophonic Radio Committee's revived field-test panel. It was given the job of testing six methods of broadcasting a stereo program over a single FM station. The FCC, in turn, is supposed to set standards for a single system of FM stereo broadcasting. Until then, manufacturers of receiving equipment cannot market "stereo adapters" for FM sets.

Station KDKA-FM in Pittsburgh will be used as the program source. Test material will be broadcast after regular transmission hours (midnight to noon).

The first test site will be at Uniontown, Pa., 40 miles from the station. After tests there are completed, the receiving equipment will be moved to a site in West Virginia. The third test site is still farther from the station. The idea is to see how the system works in strong, fair and weak signal areas.

Measurements will be made of signal-to-noise ratio, distortion, interchannel crosstalk, channel separation and frequency response. They will be made within the range of 50 to 15,000 cycles. A music tape will be played at the station and re-recorded at the test sites. The tapes will later be compared for quality. Each stereo method will also be tested to see how well the signal is received by a monophonic receiver.

The test panel was originally supposed to file a report by July 29. A 90-day extension was requested.

If the choice of a system is not difficult, the FCC might have a decision by the end of the year. It is much more likely, that hearings and discussions will continue much longer—perhaps a year. The fact that most new stereo tuners on the market are of the AM–FM type seems to indicate that the industry agrees.

The Crosby Telectronics, Calbest, Halstead (Multiplex Development Corp.) and British Percival (EMI) systems were described in RADIO-ELECTRONICS, July, 1959, page 73. General Electric and Zenith are sponsoring the other two systems.

Five of these six methods are of the subcarrier-multiplex type. The EMI system *places both channels on one carrier*. A narrow-band code signal tells the receiver how to divide the sound between the speakers. The multiplex systems use a subcarrier for one channel alone or a sum or difference signal. END

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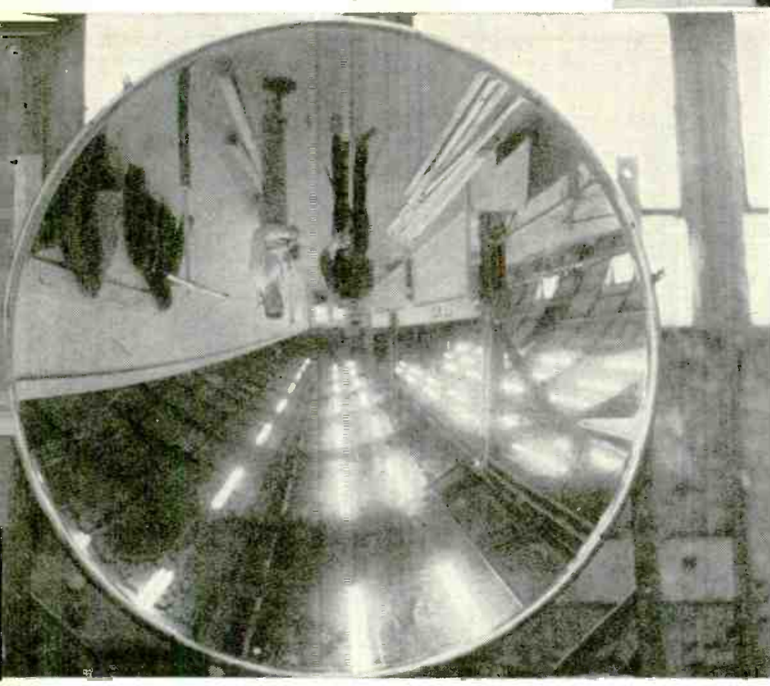
WHAT'S NEW

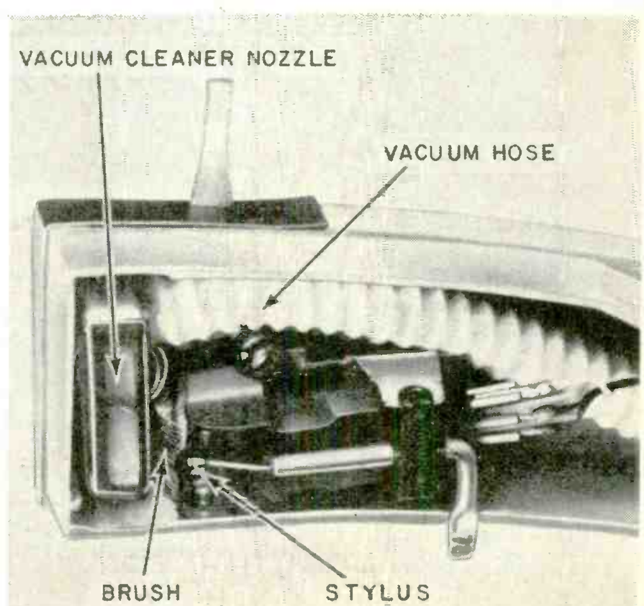


SOLAR DISH turns sunlight into 100 watts of electricity to power coast-to-coast radio network. Two stations were set up by Army Signal Research & Development Laboratory, one at Ft. Monmouth, N. J., and another at Los Angeles, Calif. The 20-square-foot solar dish came from Hoffman Electronics; transistorized transmitter-receiver from Hallicrafters.

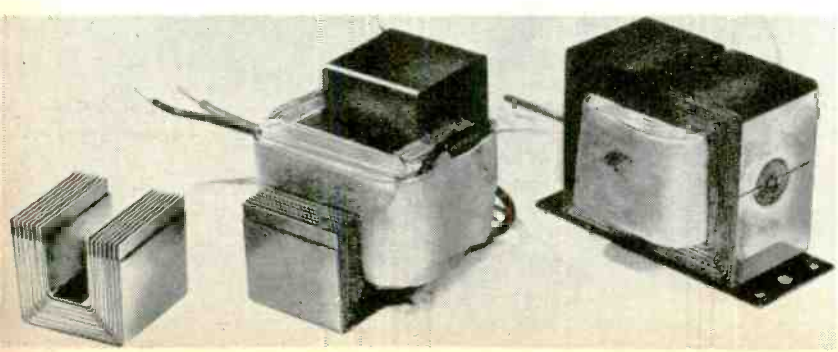
UPSIDE-DOWN image shows the near optical surface quality of this paraboloid radio mirror. Units are good uhf radiators (up to 100,000 mc). The 4-foot reflector shown was made by D. S. Kennedy & Co., Cohasset, Mass.

KEY TV lets TV viewer talk back. Two buttons on top of unit make it possible to take a quiz at home, participate in opinion polls or show like or dislike for program. Recording unit is installed on a utility pole outside viewer's home. Device introduced by Tele-PrompTer, New York, N.Y., as part of new pay-TV system.

WORLD'S SMALLEST VACUUM CLEANER is built into record player pickup arm to vacuum records clean while playing. Called "*Vacu-Magic*," the device is an acoustically sealed vacuum cleaner. G-E has incorporated the cleaner in their new phonograph line.



SMALLER TRANSFORMERS are result of nested laminations in transformer core. The construction shown, called Flexi-core, was developed by Sylvania. Nested laminations allow magnetic lines of force to flow continuously with the grain of the steel, rather than across grain.



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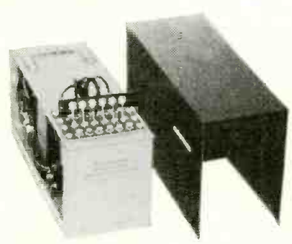

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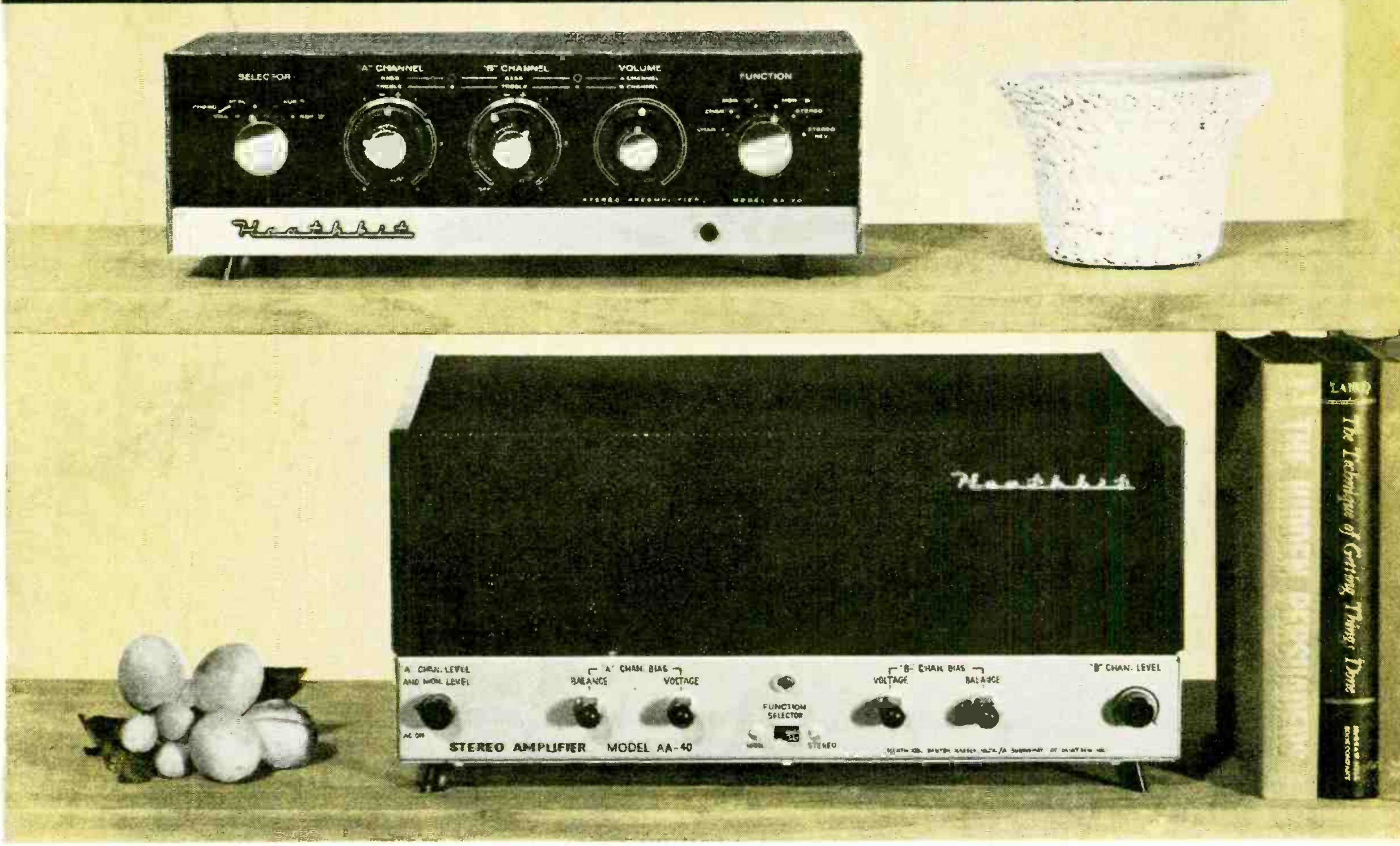

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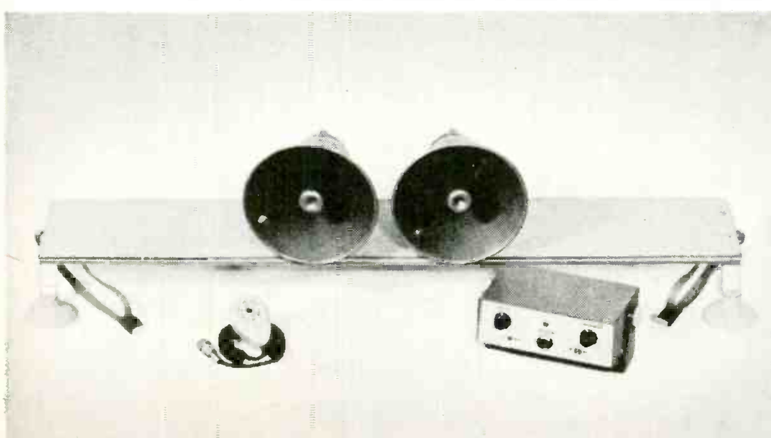

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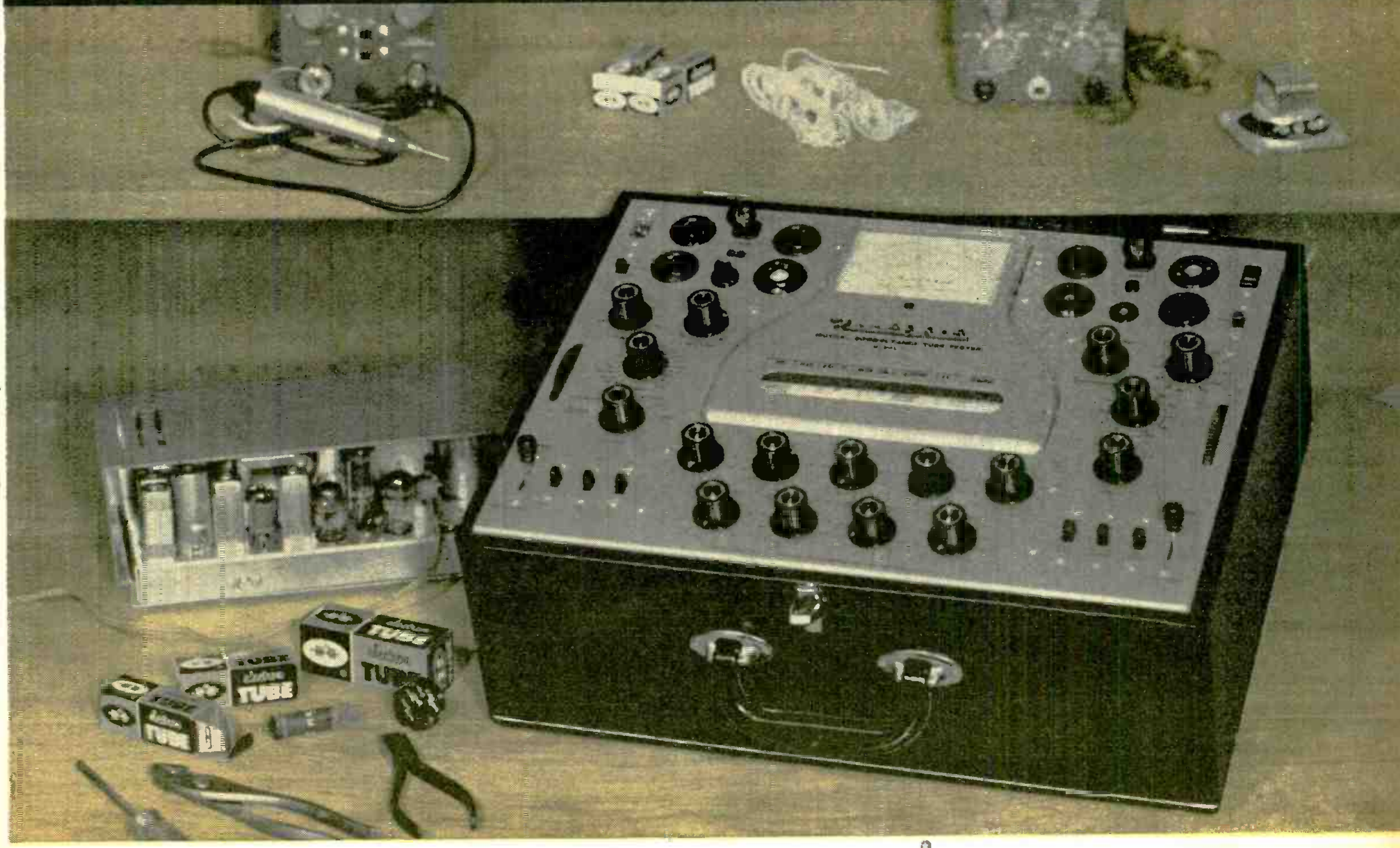

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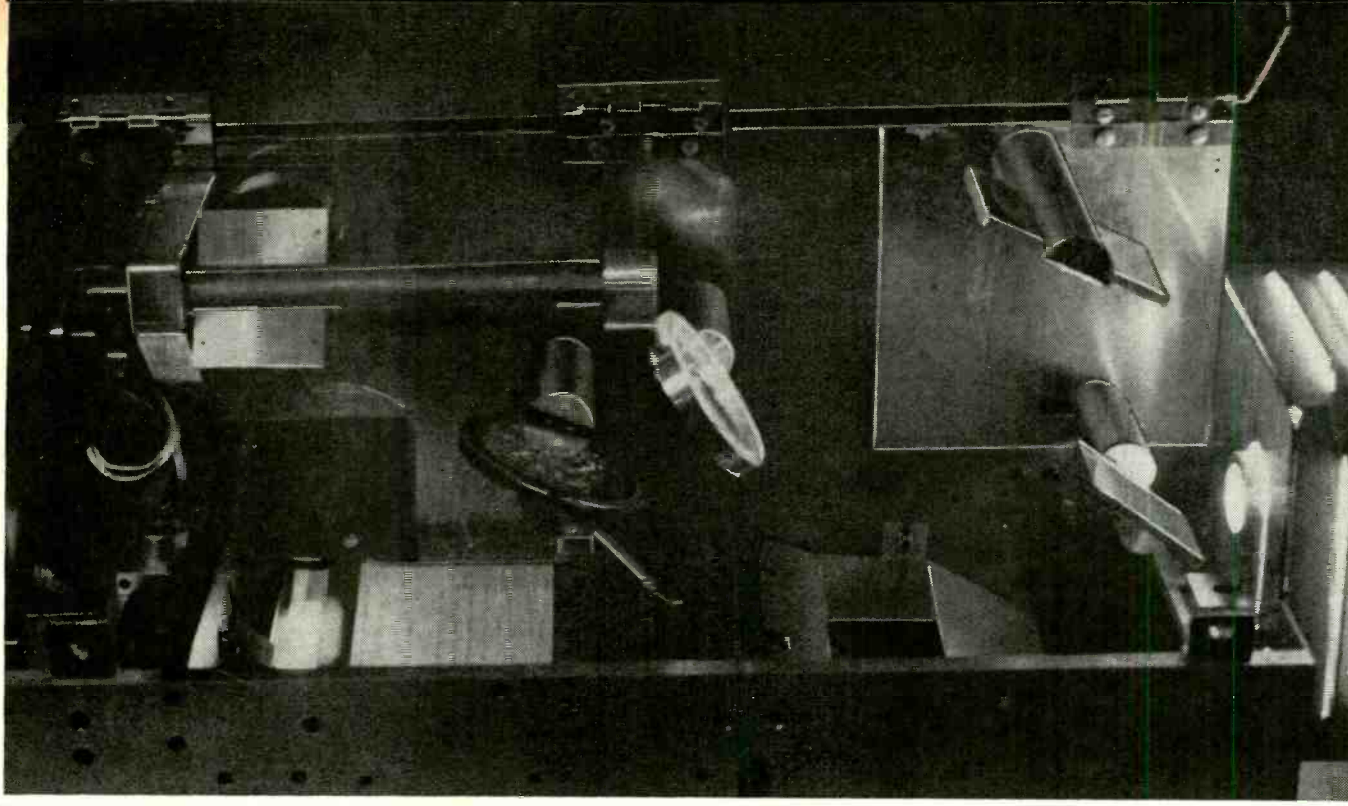
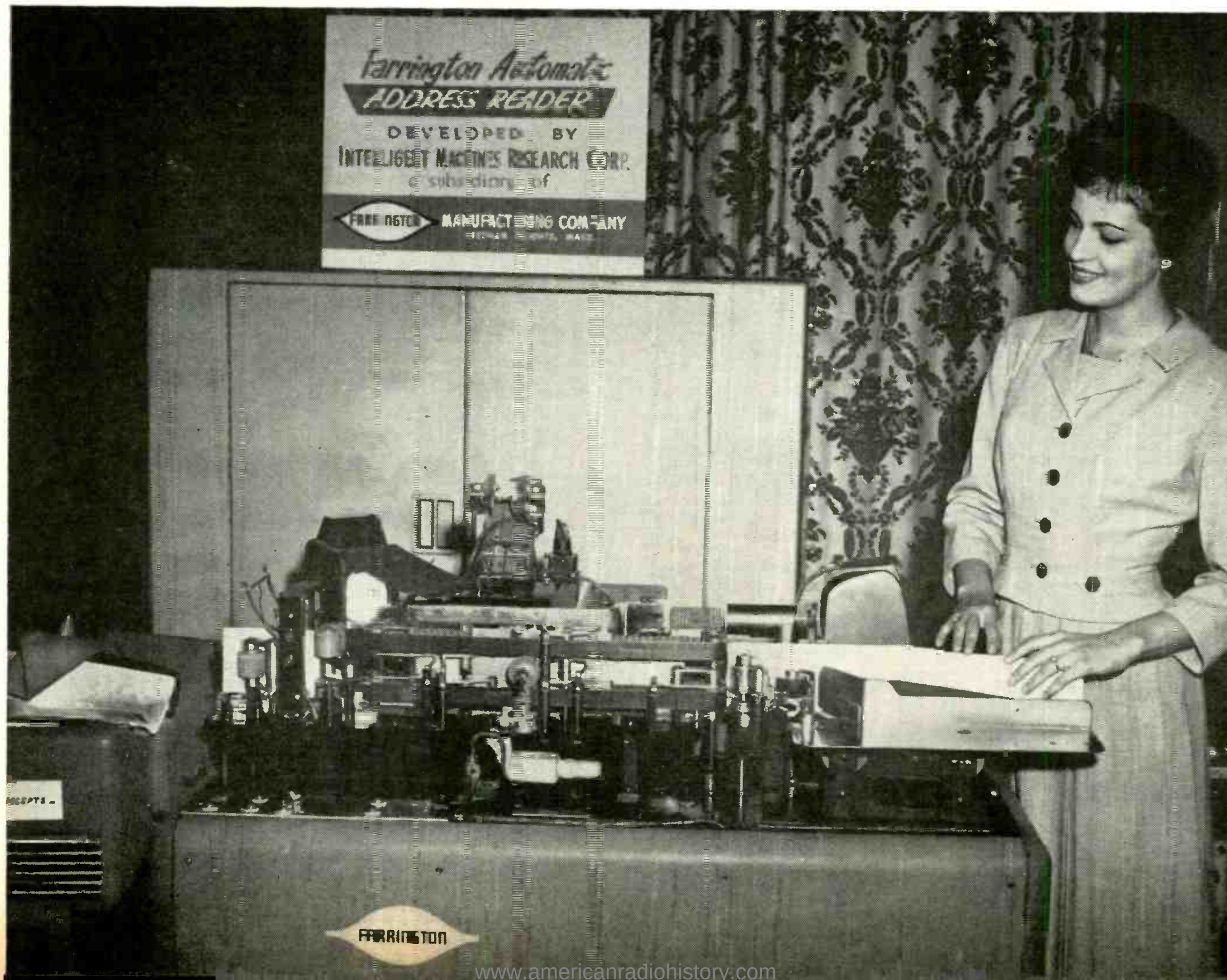


The "eye" of the Air Force print reader. It scans a message fed from the left. Light (at right) is transmitted through an optical projection system to the typewritten page where it is picked up by the scanning device.

MACHINES

This experimental address reader reads and sorts mail.



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Electronics combines with optics to make a device that translates printed matter into the punched-card language of the computing machines, or sorts letters, for various destinations

By JULES GRONICH and HAROLD BRIEFEL*

THAT READ

IN a few short years reading machines have become a valuable tool in automatic data-handling systems. Machines that can read words and numbers are extremely valuable for processing data for computers—turning text into a form the computers can handle, usually punched cards.

A trained keypunch operator can punch about 500 cards an hour. A reading machine can do 10,800 cards in the same length of time, and its self-checking operations make the spread even wider because of the time saved by not having to make corrections.

Reading machines of this type are used by many firms. American Telephone & Telegraph uses them to process 1,600,000 dividend checks three times a year. Four machines do this job, which once took an army of clerical help to handle.

The First National City Bank of New York uses reading machines to process travelers' checks; the National Biscuit Co. uses them to read sales report lists; Ohio Bell Telephone speeds its cash accounting system with reading machines and the Reader's Digest Book Club uses reading machines to read the names, addresses and account numbers of its members.

One sophisticated reading machine, developed by Farrington for the Air Force, reads entire pages of typewritten material and translates them into electronic signals at the rate of 2.5 lines per second. Farrington optical scanners are also being used in the drive to automate the postal system. An experimental all-transistor unit has been developed—it will sort mail to 40 destinations.

Soon-to-come applications for optical scanners include completely automated billing systems for utility companies; processing for book, record, gift and other monthly clubs; reading automotive registration records and reading subscription lists for the publishing industry.

* Farrington Manufacturing Co., Needham Heights, Mass.

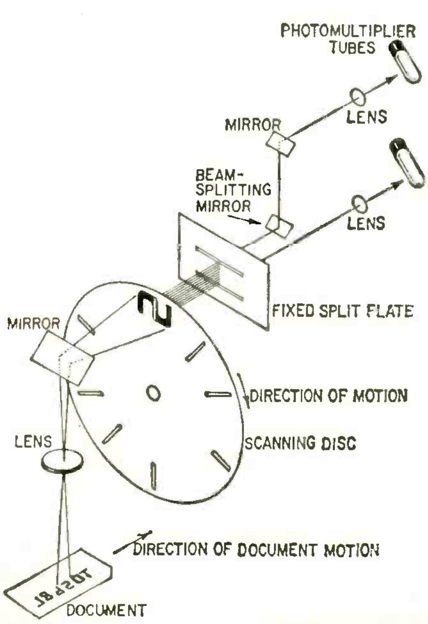

Fig. 1—The basic optical scanner.

Gasoline credit cards

A common use of the Farrington optical scanner is in the gasoline credit-card system. A customer buys gasoline and presents his credit card. The attendant puts the invoice (tabulating card) through an imprinter which prints the customer's credit-card account number on the back and front of the invoice card. Periodically, the cards are forwarded to the oil company's central accounting office.

This is where the optical scanner enters the picture. It reads the carbon impression on the back of the cards. A built-in checking feature verifies the reading operation and, if necessary, computes the value of a missing digit. When it is satisfied, the machine punches into each card the code for the customer's account number. After punching, the cards are rechecked to verify the accuracy of the reading operation. Reading and punching is done at a rate of 180 cards per minute.

To understand how these machines operate, let's take a look at a basic reading system. A batch of cards is placed in a feed hopper. From here they are transported one card at a time to the reading station where they are scanned horizontally—because of the card's motion as it passes the scanner—and vertically by the optical system.

Fig. 1 shows how the vertical scanning works. An optical system transmits an image of the desired information (numerals on the card) to a rotating scanner disk that has 25 radical slits .01 inch wide spaced at equal intervals. As each slit on the scanning disk passes under the projected image, a thin slice of the image falls on a fixed horizontal plate located directly behind the disk. This plate contains two horizontal slits approximately one character width apart. Therefore, a portion of the image passes through these slits only when the radial slit intersects with the fixed slits. The two beams passing through the horizontal slits are separated by a beam-splitting mirror. One beam goes directly through a lens to a photomultiplier. The other beam is redirected by a focusing mirror to a lens and a second photomultiplier. Separating the horizontal slits in this manner creates two reading stations. One reads the right side of a character at the same instant the other is reading the left side. To insure high resolution, scanning is rapid (more than 20 scans per character). Thus a single vertical line of nominal width is scanned several times. Fig. 2 shows how scanning dissects a character.

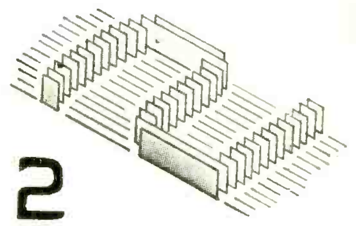

Fig. 2—View of a character dissected by scanning.

Light beams passing through the slits are sensed by the photomultiplier tubes which convert the light energy to electrical signals.

Fig. 3 shows the photomultiplier

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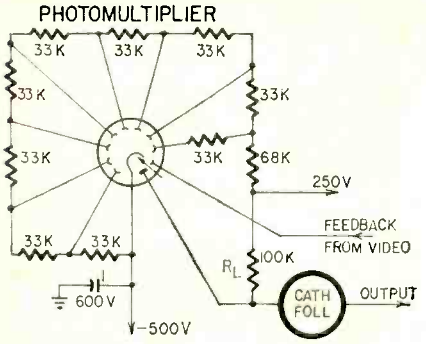

Fig. 3 — Circuit of photomultipler in scanning device.

hookup. Light falling on the tube's photocathode causes electron emission. The tube's action (due to secondary emission) from the dynodes causes a much larger emission of electrons than received from the cathode. For this reason small changes in current gain per dynode have a large effect on the output plate current.

A unique circuit much like TV agc, automatically compensates for variables such as light sensitivity, temperature and voltage. It uses the voltage between one pair of dynodes and a voltage-sensing feedback device controlled by the photomultiplier's output.

This is how it works. Current leaving dynode 9 is attracted to the plate and develops an output voltage across R_L, the 100,000-ohm plate load resistor. The plate current is proportional to light intensity so an increase in light increases plate current. Current flow through the load resistor makes the output signal most negative when light intensity is greatest. The slits are so spaced that there is a point of no intersection between slits, resulting in total darkness. This causes a reference pulse having the greatest positive polarity. This "black pulse" denotes absolute black and is used as the reference level for compensation. Since the pulses that represent portions of the character are developed from a darkening of the reflected light (any character reflects some light) their amplitude is always lower than the black pulse.

Character sensing is based upon the use of digital scanning signals which say either "yes, a portion of a character has been seen this instant" or "no, a portion of a character has not been seen this instant." This is done by having pulses of two standard amplitudes, +15 volts signifying "yes" and −25 volts "no". To obtain these levels, the video pulses are sent to a pulse-shaping network which decreases the rise and decay times, and then are clipped at +15 and −25 volts. However, this signal still contains the black pulse which is not needed for character identification, so it is blanked by a main timing pulse.

The main timing pulse is developed by placing an exciter lamp and photomultiplier tube on opposite sides of the scanning disk. Every time a slit passes over the photomultiplier tube a pulse is generated. This system is adjusted so the timing pulse occurs slightly before the point of no intersection at the reading station (black pulse) and represents the end of each scan or frame. The black pulse is thus blanked out between frames. This pulse system uses a video channel to control sensitivity, shape the pulse and clip it to a standard voltage level.

With the black pulse eliminated, we have a signal of standard voltage levels which electrically represents the scan of a character. It is known as the recognition signal and is analyzed to determine the character being scanned. Fig. 4 illustrates the development of the recognition signal.

The method by which characters are recognized and the shape distinguishing features of the characters are closely related.

Selfchek, the type face shown in Fig. 5, has been designed to give maximum recognition reliability by taking into account the more likely types of character deterioration caused by printing and handling. Also, the character segments are deliberately bold to increase the probability that they will be detected even if portions are missing. Characters are so formed as to avoid small enclosed areas which might be filled by dirt or extra heavy printing. The arrangement provides that any one character differs from the other nine by at least two line segments. This greatly reduces the possibility of confusion in identifying characters, and allows maximum recognition reliability with a minimum of electronic logic.

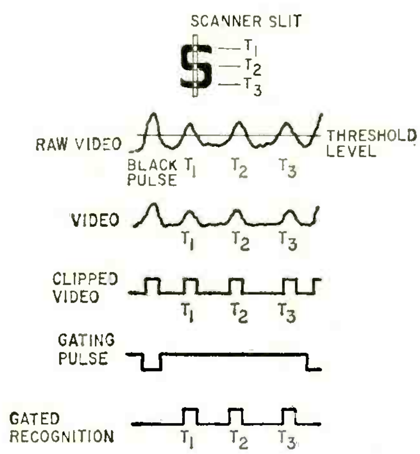

Fig. 4 — How recognition pulses are developed.

Note that this special type face *is not required for character identification.* Many machines now in use can identify a variety of type fonts. In these systems which do not use Selfchek, additional character-identification logic is employed to assure reliable performance.

Characters are identified by stroke logic. Each character is comprised of a number of short, straight vertical and horizontal line segments (Fig. 6).

Once the digits are identified, they must be checked to verify the reading operation and calculate the value of any single rejected digit if necessary. This is done by using a check digit that makes the sum of all the digits a multiple of 10. Also incorporated into this scheme is a method of detecting transposition errors. This is done by replacing the original digits in the units, hundreds and other *alternate* positions with a substitute digit (Fig. 7).

The substitute digit is obtained by multiplying the original digit by 2, the resultant being the new digit. However, if the multiplication results in a two-digit number, the digits are added to get the new number. For example, in Fig. 7 the units digit is 7. When doubled, it becomes 14. Then 1 plus 4 equals 5. Now the digits of the new account number are added, giving a total of 36. When the check digit, 4, is added, the total becomes 40. Since this is a multiple of 10, the number is correct. Any wrong number or transposition would have given another result and the card would have been rejected.

Here's how the checking logic works. When a digit is signaled, a control counter is set to the complement of the digit or of its substitute value, depending on whether the storage column is odd or even. The control counter is a 10-position counter and, when it is set, the pulse gate opens. Counting pulses pass through the pulse gate and advance both the control counter and checking counter. These pulses advance both counters until the control counter steps off the end, generating a reset pulse which closes the pulse gate. The number of pulses which have been admitted to the checking counter equal the value or substitute value of the input digit. Subsequent digits add into the checking counter so it always contains the units digit of the total as added according to the checking scheme. The condition of the checking counter is tested after reading the entire account number. If the checking counter is on zero (multiple of 10), the card is accepted and subsequent punching permitted.

The missing-digit calculation circuits use the 10-position control counter, the checking counter and a two-stage counter which counts the number of times that a digit is rejected. If one and *only* one character has been rejected at the reading field, the control counter is set on zero and the pulse gate opened. Counting pulses advance both the control counter and checking counter until the checking counter reaches zero. The number of pulses required for this are exactly the num-

12345
67890

Fig. 5 — Numbers used in the SELFCHEK type font. You'll find them on many credit cards.

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ber which would have been entered into the checking counter had the number been read correctly. The control counter which stepped along with the checking counter remains on the position signifying the number of pulses required to satisfy the checking counter and the control counter inserts that number or its substitute into the empty storage position.

Now the coded holes corresponding to the card numbers are punched.

Then the punched card passes over a bank of light-sensitive photocells which are activated according to the punched holes. This output is checked again. If the summation of the digits is equal to a multiple of 10, the entire reading operation is adjudged correct. However, if an error is detected, a signal is sent to the feed control which stops the machine. The faulty card is removed from the stacker so it will not be processed. Remember, this description is lengthy, but cards are read and punched at the rate of 180 per minute.

After the tickets are properly punched, they are ready for mechanical sort, billing and mailing. The machines which do these things are actuated by the holes punched by the Farrington Optical Scanner. END

	0	1	2	3	4	5	6	7	8	9
Long Vertical Left	+		−	−	−	−	+	−		−
Long Vertical Right	+	+	−	+	+	−	−	+		+
Horizontal Top	+	−	+	+	−	+	−	+	+	+
Horizontal Middle	−	−	+	+	+	+	+	−	+	+
Horizontal Bottom	+	+	+	+	−	+	+	−	+	−
Short Vertical Upper Left & Lower Right	+	−	−	−		+	+	−	+	+
Short Vertical Upper Right & Lower Left	+	−	+	−	−	−	−	−	+	−
Short Vertical Left & Right Simultaneously	+	−	−	−	+	−	+	−	+	+
Long Vertical Left & Right Simultaneously	+								−	
Middle Projecting Right					+					−

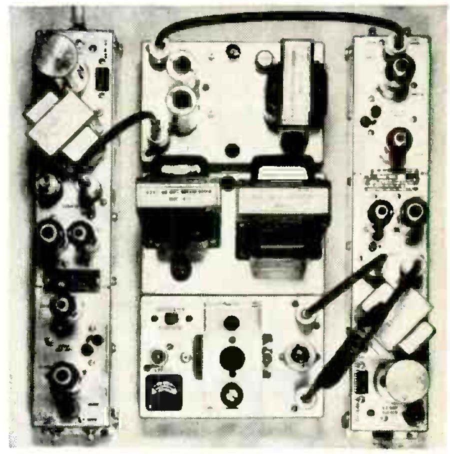
+ Condition must be detected
— Condition must not be detected

Fig. 6—The correct combination of detected and not-detected conditions is used to identify numbers.

Fig. 7—How a credit card number is checked.

Customer Account Number	6 4 1 2 9 8 0 3 7 (4)*
Columns to be Substituted	x x x x x
Substitute Digits	3 2 9 0 5
Digit Total	3+4+2 +2+9+8 +0+3+5=36
Required Check Digit	4
Total Including Check Digit	40 (Multiple of Ten)
Customer Self-checking Account Number	6 4 1 2 9 8 0 3 7 4
*Check number. Appears on credit card but not part of account number.	

V. H. F. TELEVISION TRANSLATORS



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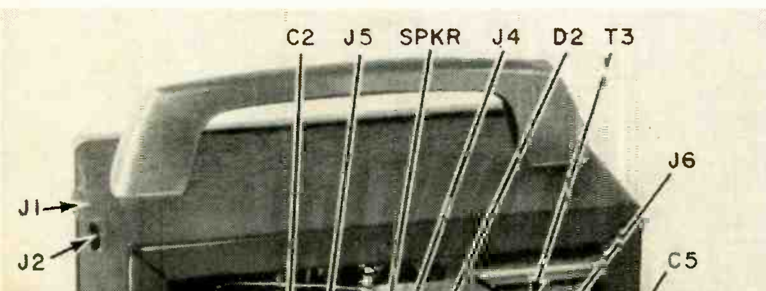
signal-trace industrial circuits

Simple professional-type instrument for checking industrial devices through audio signal tracing

By WILLIAM F. KERNIN



With its back removed, the parts layout inside the case is revealed.

INDUSTRIAL electronics—a fascinating name for an equally intriguing field. Not only does it cover motor controls, welding timers, furnace and power controls, but also almost all phases of electronics from closed-circuit television to simple sound installations. Nevertheless, servicing and maintenance techniques are virtually the same for all these electronic units. Usually the industrial installation must be serviced on the spot, creating the need for portable and versatile test equipment. Transistor test gear can and does satisfy the need for compact self-contained equipment. One such device is the portable transistor amplifier described in this article.

Essentially, the unit is a high-gain transistor amplifier designed for industrial service. It is an efficient rf, if and af signal tracer. The prototype unit was developed for servicing field radar installations in 1954.

Timing, range marker, sweep and delay circuits in a typical radar set may be checked quickly for go or no-go operation by using audio signal-tracing techniques. All these are primarily pulse circuits of various audio frequencies. Therefore, their signal or waveform can be heard when properly amplified and converted to sound. This technique can also be applied to trace return signals or the echo-box test returns from the video detector to the CRT.

Video return information, if strong enough, can be tracked through the if section by using the rf–if probe with the transistor amplifier. In addition, rf output may be monitored by placing the rf probe near the antenna. The

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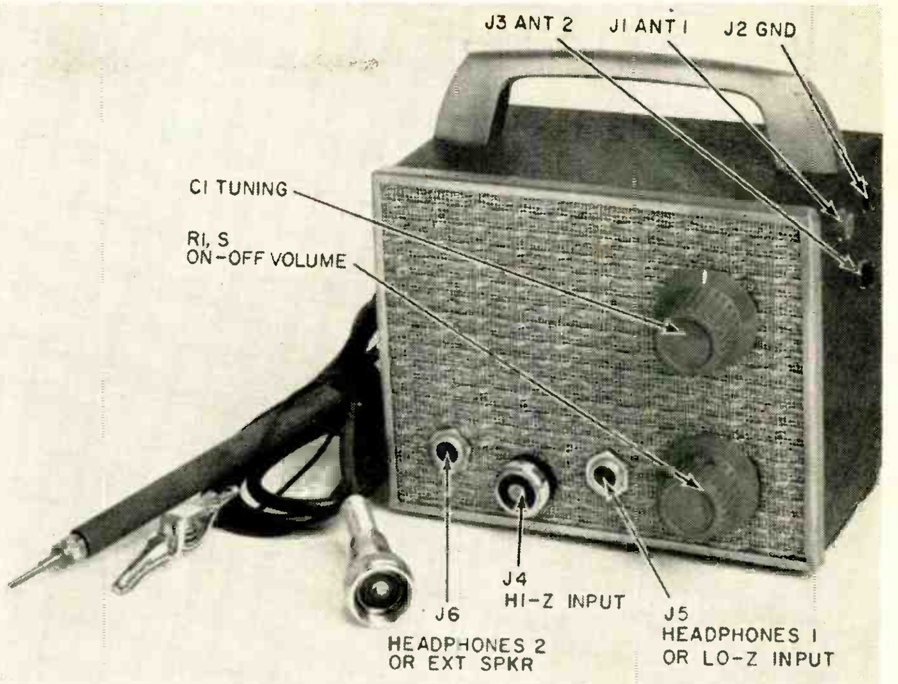
The completed instrument and its if–rf probe.



R1—pot, 10,000 ohms, audio taper with spst switch
R2, 6—3,900 ohms
R3—430,000 ohms, 5% (see text)
R4—15,000 ohms
R5—1,100 ohms, 5%
R7—820,000 ohms
R8—2,000 ohms, 5%
R9—47,000 ohms (see text)
R10—300 ohms
All resistors ½-watt 10% unless noted
C1—variable capacitor, 365 μμf (Lafayette MS-214 or equivalent)
C2—330 μμf, ceramic or silver mica
C3, 4, 5, 6, 7, 8—10 μf, 25 volts, tantalytic or miniature electrolytic
BATT—22.5 volts (Burgess U-15 or equivalent) or (Mallory RM-412R or equivalent)
D1, 2—HD2135 (Hughes) or 1N52
J1, 2, 3—tip jacks
J4—mike connector
J5, 6—phone jacks, closed-circuit
L1—see text
L2—antenna coil with 600-ohm tap and adjustable ferrite core (Miller 2002 or equivalent)
S—spst on R1
T1, 2—interstage transformer: primary, 50,000 ohms; secondary, 500 ohms (UTC H-1 ouncer or equivalent)
T3—line-to-voice-coil universal type transformer: 2,000 ohms to 6.8-ohm ratio is used (Olson T-110 or equivalent)
V1—CK721
V2, 3—CK722
Speaker, 12 ohms (Lafayette SK-39 or equivalent)
Case, 3 x 4 x 5 inches (Bud CU-728B or equivalent)
Miscellaneous hardware

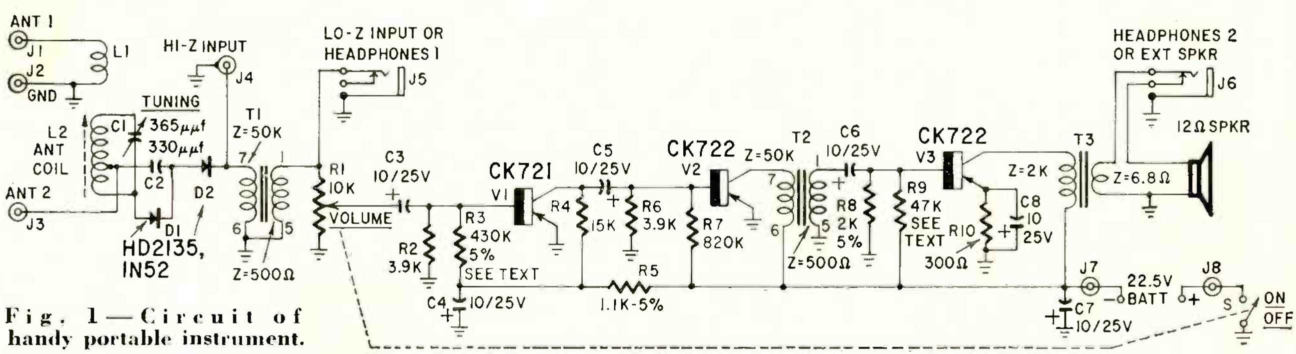


Fig. 1—Circuit of handy portable instrument.

transmitted radar pulses will be heard on the transistor amplifier's speaker as a tone equal in frequency to the radar's PRR (*p*ulse *r*epetition *r*ate).

To become familiar with the pitch, intensity and tone characteristics of each pulse-handling stage, monitor a properly working set. Then, when something is wrong in these circuits, it is often easy to track them down the line. Frequently, a simple signal-tracing system will do a job that would normally call for a scope.

A word of caution, there are high dc voltages in these circuits—treat them with the utmost respect. The voltage rating of the probe capacitor should never be exceeded and never use this system to check high-voltage high-power stages.

Circuit design

The amplifier's design makes efficient use of common components and economical transistors. Basically, it is a three-stage device—two stages of voltage amplification feeding a class-A power output stage (Fig. 1). A 0.15-mv input at 1,000 cycles will produce the maximum undistorted output of 310 mv across a 12-ohm load—8 mw.

Input signals across T1's moderately high-impedance primary are fed to the high side of volume control R1 by the low-impedance secondary. From R1's wiper the signal is coupled to the base of V1 by capacitor C3. The capacitor also isolates V1's base-bias current from R1.

The proper base bias for the CK721 is determined by the voltage-divider bias network formed by resistors R2 and R3. The value of R3 is adjusted for optimum gain with lowest noise. Resistor R4 is V1's collector load and maintains a low voltage on the CK721 collector—again for low noise—while providing sufficient load for good stage gain. Resistor R5 and capacitor C4 form a decoupling network that isolates the first stage and prevents motorboating.

Capacitor C5 couples the first-stage signal to V2's base. The bias for this stage is determined by resistors R6, R7 and the leakage resistance of coupling capacitor C5. Note well C5's polarity: it is reversed because V1's collector voltage is much more negative than V2's base bias. The values for resistors R6 and R7 are chosen for adequate stabilization with low internal noise. These values held true for numerous CK722's tried in this stage and should require no adjustment.

Transformer T2's primary is the load for V2. Capacitor C6 couples the signal from T2's 500-ohm secondary to V3's base. This third stage is designed as a class-A power amplifier with a more elaborate bias network than the previous stages. It is needed because of the final stage's increased susceptibility to drift with temperature changes. Resistor R10 gives a good amount of dc degeneration in the emitter circuit. Capacitor C8 effectively bypasses R10, thus retaining the stage's ac gain. The bias point is determined by the combination of resistors R8 and R9. Resistor R9 can be adjusted to provide a 30-mw power output. The value shown for R9 in Fig. 1 allows a maximum undistorted output of 8-mw. It is suitable for comfortable listening with the built-in speaker and is more than adequate for headphone use. If 30-mw output is desired, R9 should be approximately 18,000 ohms.

T3 is the output transformer. A standard 8-watt universal line-to-voice coil unit was used in place of the miniature transistor transformers available. It materially improved the amplifier's low-frequency response.

Numerous jacks are included to make the unit as useful as possible. Jack J4,

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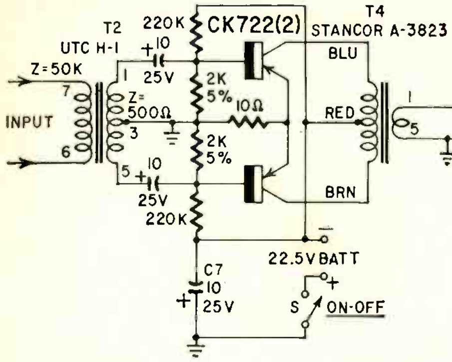

Fig. 2—Alternate power amplifier is used if greater power output is needed.

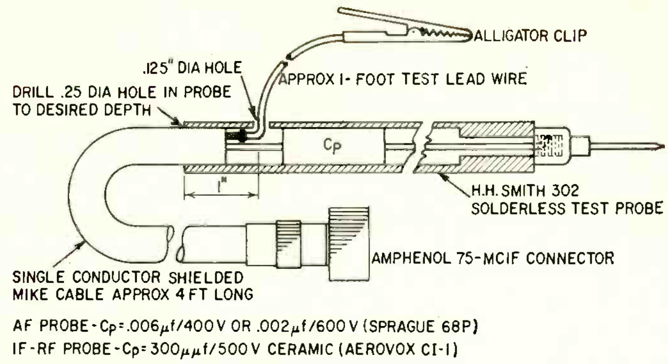

Fig. 3—Construction of the af and if–rf probes.

an Amphenol microphone receptacle, is the moderately high-impedance input. It also serves as a high-impedance tuner output. Jack J5 provides a low-impedance input to the amplifier. Jack J6 serves as the amplifier output jack when an external speaker or headphones are used in place of the built-in speaker. Headphones subdue ambient noise, especially in high-noise-level locations.

Fig. 2 is an alternate power amplifier for outputs up to 40 mw undistorted. Two CK722 transistors are used push-pull with another type of output transformer. The stage is run essentially class-AB1 to overcome the distortion introduced by the usual push-pull class-B amplifier—distortion resulting from the difficulty of selecting two transistors with matched dynamic characteristics even though their static characteristics may be identical.

Power for the amplifier is obtained from a small 22.5-volt battery. With the values shown in Fig. 1, total current drain is about 4 ma and the battery should last a month or more, assuming the amplifier is used a few hours a day. A 22.5-volt mercury battery would last two or three times as long with little drop in its voltage over the period of its useful service life.

Higher-power output circuits require a larger battery. This in turn necessitates a larger cabinet for the complete instrument.

To use the amplifier as a sensitive af, if and rf signal tracer, two simple probes were designed (Fig. 3). For audio tracing, a dc isolating probe is used to couple the audio signal to the transistor amplifier via jack J4. A similar probe, with a smaller value, ceramic capacitor, is used for if–rf work. The characteristic impedance of J4 consists of the parallel combination of T1's high-impedance primary plus two high-back-resistance diodes connected in series from J4 to ground. Thus, with the small probe capacitor, we have an efficient shunt diode detector. The rectified signals are coupled to the amplifier by T1 and amplified in the normal manner. Jack J6 may then be used for an output meter or external speaker as desired.

Using and building the amplifier

As a general rule, any pulse or audio circuit may be checked aurally with the technician's transistor amplifier and the appropriate probe. Typical devices encountered in industry include photoelectric counters, high-speed camera timing and sync circuits, closed-circuit TV, industrial tape recorders and decimal counter systems used in chemical and nuclear research. Industrial paging and communications systems lend themselves readily to audible signal tracing.

Much of the low-level high-gain equipment used for instrumentation and precise industrial control rely on well regulated dc supplies. These range from the low-voltage supply for strain-gauge bridges to high-voltage sources. The regulation and filtering of these supplies can be checked with the audio tracing system. Place the audio probe on the line in question. Ripple content will be heard on the amplifier's speaker —or headphones, if used. If excessive, remedial action may be taken while monitoring the line. Because of the transistor amplifier's high gain, it is possible to monitor minute ripple voltages.

Regulation of dc supplies used for speech, pulse or audio equipment may be checked by listening for audio signal on the dc lines. The greater the indication of signal on the supply line, the poorer the power supply regulation. Here again, the supply line may be constantly monitored while the necessary repairs are being made.

As mentioned before, don't exceed the probe capacitor's voltage rating in any of these checks.

An AM tuner added to the instrument becomes a handy source of accurate time signals. These are derived from a strong local broadcast station on the hour and every half hour. This station determines its time by station WWV. This secondary time standard proves helpful for setting or checking

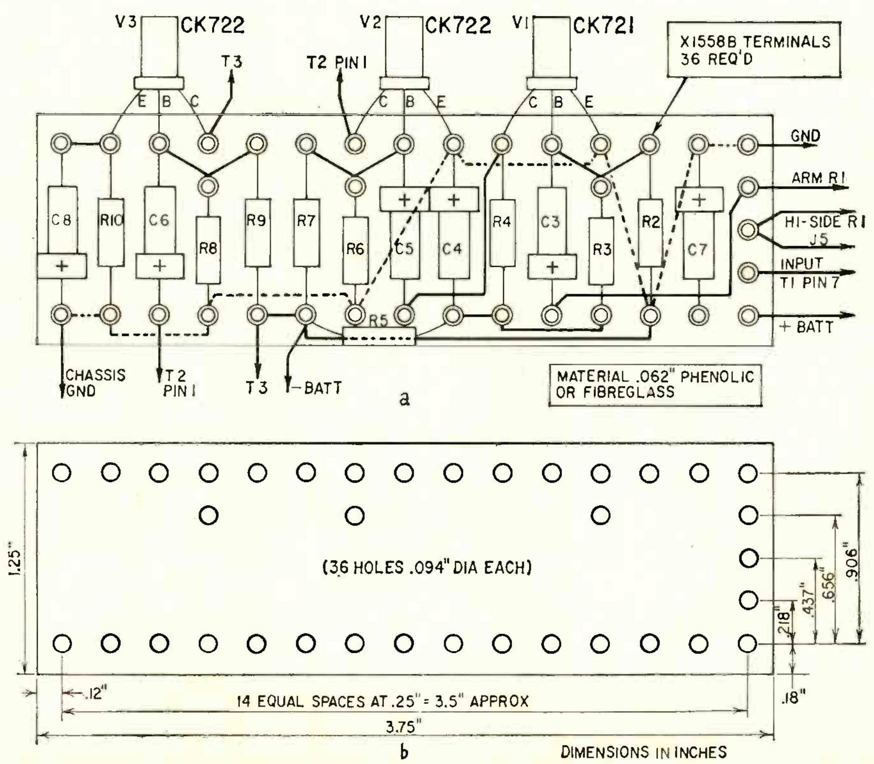

Fig. 4—Terminal board wiring keeps the instrument's size to a minimum.

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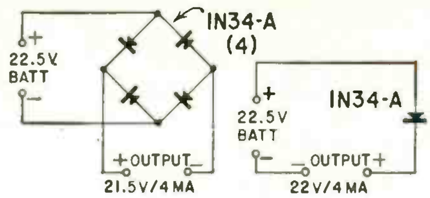

Fig. 5—Two protective circuits save components if battery is inserted incorrectly.

long-duration time switches and time clocks.

The tuner is a crystal set with a few design tricks that add to its quality. Coil L1 is used to couple a variety of antennas to L2. It consists of 75 turns of Litz wire scramble-wound on L2's coil form ¼ inch from L2. The resultant coupling gives a good degree of selectivity with little sacrifice in sensitivity. A voltage-doubler detector circuit is used with L2's 600-ohm tap for increased signal output. As with any crystal detector, optimum operation depends on as good an antenna and ground as possible. A pair of meter leads with alligator clips are handy for connecting an antenna and ground to the tuner input jacks.

The photographs show the suggested parts layout. A 3 x 4 x 5-inch utility cabinet was used as the basic package. The construction detailed in Fig. 4 insures a rugged, reliable test instrument for industrial electronics service. However, layout is not critical and any desired construction can be used. Just keep the input leads as far from the output circuit as possible. A special terminal board (Fig. 4) was used for mounting resistors, capacitors and transistors.

The battery must be connected with the polarity shown. Reversal of polarity will immediately destroy the transistors. Fig. 5 shows two protection systems that eliminate the polarity-reversal danger. The single crystal diode allows current to flow in one direction only. If the battery is connected wrong, little current would flow. The bridge circuit permits the battery to be connected either way and still provides the proper polarity output. Note the voltage drop indicated—approximately 0.5 volt per crystal diode at 4 ma.

The technician's transistor amplifier's main advantages in industrial servicing lie in its portability, small size, high gain with no internal hum, and versatility of input and output jacks. CK721's and CK722's are used because of their dependability and availability. With the advent of new, low-noise transistors (2N131, 2N133), the unit's noise level can be improved and its size reduced.

The finished unit has a neat professional appearance. Its front panel is covered with silver gray speaker grille cloth for a good-looking textured finish. This covering was fastened to the front panel with rubber cement. Gray knobs were used for the controls to blend with grille cloth. To match the plating on the jacks, stainless steel L-stock with a fine sandpaper finish was used as a picture frame. It protects the edges of the grille cloth and gives the panel a finished look. Finally, a well proportioned, brushed, stainless-steel handle was attached to the case for easy carrying, and ¼-inch thick felt was cemented to the bottom of the case to avoid the possibility of marring the finish of anything the unit is placed upon.

Although designed for industrial servicing, the transistor amplifier can also be used for radio, TV and hi-fi repair. It fulfills the requirements of a sensitive signal tracer with the added convenience of being self-contained and completely portable. END

UNGROUNDED EQUIPMENT CAN BE FATAL

THREE Florida workers were killed in a single month last year while using ungrounded portable drills. All could have been prevented if the state electrical code had been complied with. The code states, in part, "All portable electrical tools are to be grounded prior to use. All exposed noncurrent-carrying metal parts of portable electrical equipment operated at more than 50 volts to ground shall be effectively grounded regardless of use or location."

In one case, a carpenter standing on a wet terrazzo floor held a tool ready to drill holes in the floor. The hot side of the line shorted to the case of the drill. The carpenter's body completed the circuit to ground.

In the second accident, a worker was drilling holes in a copper hood at a private residence. Although the house belonged to an electrical contractor *and had polarized receptacles*, the drill had a two-wire cord and was not grounded.

The third worker was drilling holes outdoors while standing on wet ground. The tools had three-wire cables, but the location did not have the proper outlets. Adapters were used, but the man had not taken the trouble to attach the ground wire.

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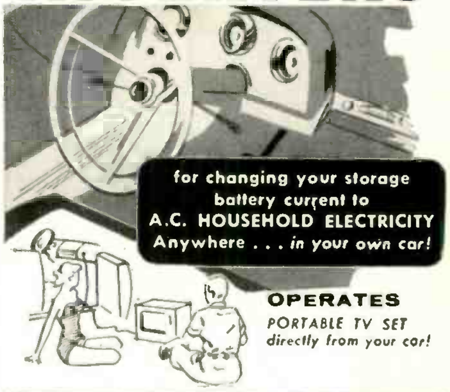

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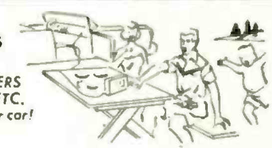

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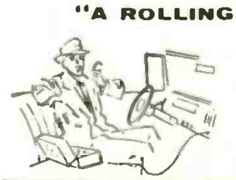

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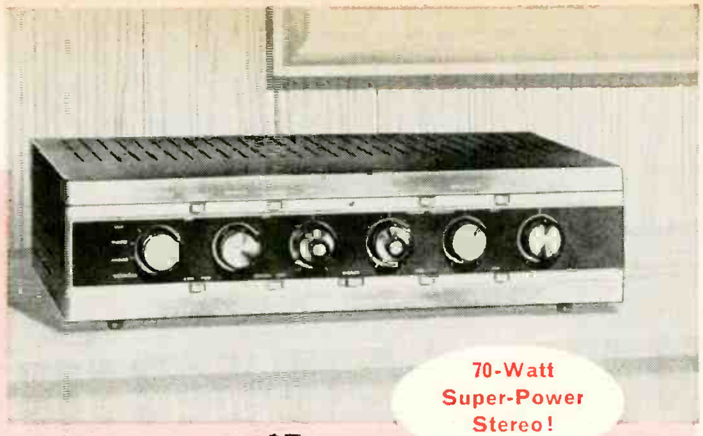

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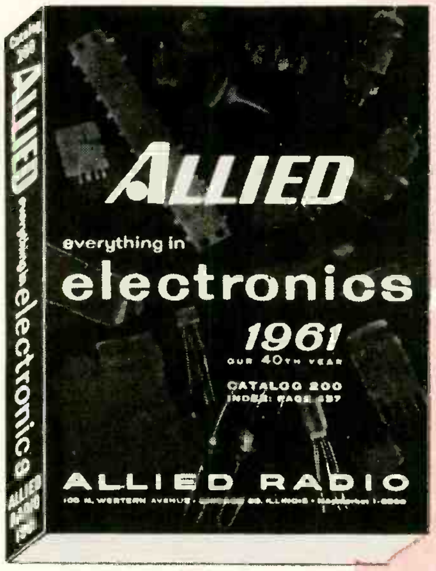

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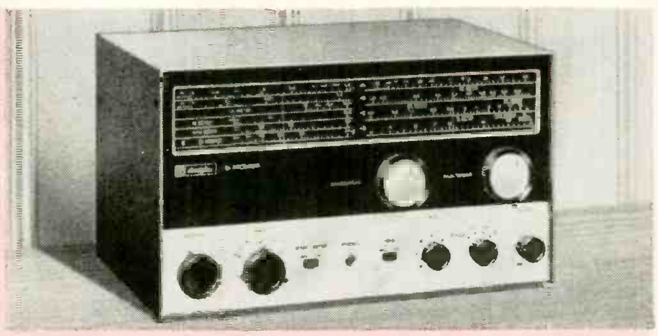

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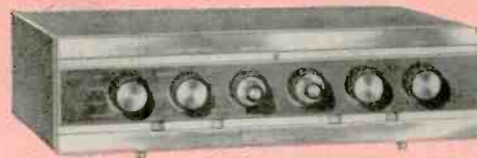

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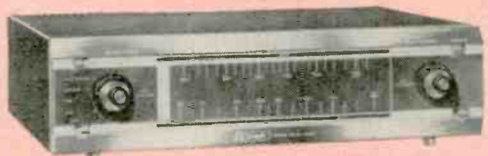

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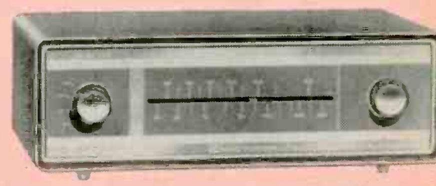

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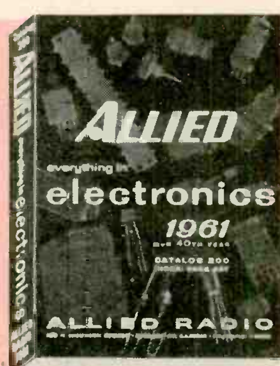

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MANY service technicians feel that the scope is as dead as the dodo. Some feel that it is an unnecessarily complicated instrument which is not needed—that the work done by a scope can be accomplished quicker and easier by other methods. It has been suggested that a volt-ohmmeter is just as useful as a scope and can take its place.

The belief is quite false, but it is understandable. It is a matter of statistics. Most trouble is caused by tubes. It does not require a scope (or any other instrument) to locate a bad tube. All we need to do is to plug in new tubes and see if the set resumes operation. Even a PhD can do it himself.

Since bad tubes cause 80% or more of TV troubles, we can operate nicely 80% of the time without a scope. The second greatest troublemaker in service work is the faulty capacitor. In many cases, it can be located by picture and sound analysis, plus a little trial-and-error substitution.

But we sometimes run into capacitor troubles that require a tremendous amount of trial-and-error to localize. Not all of these situations can be quickly cleared up by a scope, but a sizable number of them *can* be.

The same thing applies to other components, such as coils and even a few resistors. Parasitic oscillation is a very good example.

Because the scope is not usable as often as a volt-ohmmeter, we tend to become lazy. We tell ourselves that a scope is not worth using, and after a while we begin to believe it. So we forget how to work it and when we need it we are up the well-known creek.

It is all a matter of viewpoint. Some maintain that TV servicing requires no knowledge of circuit action. I attended a training course some years ago in which a *presumably* excellent college instructor said that "after all, TV repair consists of replacing a resistor or a transformer or a capacitor—what else does a technician need to know, if he can handle simple tools?" I quit the training course in disgust.

Unfortunately, we find this same type of thinking in some shops. It's the bunk. Let's clean house!

Shrinking picture

The picture shrinks about 1½ inches on each side after a Setchell-Carlson 551 has played about an hour. Taking the sleeve completely out of the yoke makes little difference. Can you help me?—O. P., Escanaba, Mich.

Your shrinking picture could be caused by several different things: the most likely prospect is a slightly weak or gassy 6BQ6-GA in the horizontal output stage. This is the cause of most shrinkage trouble with a 1-hour time constant. If the tube has already been changed, try replacing the horizontal oscillator and damper tubes.

The easiest way to catch a long-time-constant trouble like this is to monitor the various voltages which could cause it (as many of them at the same time as possible). These would be the dc drive voltage on the 6BQ6-GA grid, the plate supply voltage for the horizontal oscillator and the screen voltage on the 6BQ6-GA. For instance, set up your vtvm to read the grid-drive voltage and the bench vom the plate voltage. If another meter is available, hook it onto the 6BQ6-GA screen (Fig. 1). Turn on the set and log the readings while the width is sufficient. Now go ahead and do something else and come back in an hour. If the width has decreased, see which voltage has dropped off.

If it isn't one of the tubes, look out for drifting resistors. I had a very similar problem with a 6BQ6-GA screen resistor that very gradually increased in value as the set warmed up until it had dropped the screen voltage enough to reduce the width. Incidentally, it might be wise to cover the set with a cloth or cardboard box to keep it warm (as it would be in the cabinet).

Orphan TV set?

We've got a set in the shop and can't find out anything about it! It's a 20-inch DeForest, and the only numbers on it are 20A-05-A. We need a schematic and some information. Can you help us?—S. Y., Kansas City, Kan.

This is a TV set built by the students at American TV Schools, in Chicago. I am enclosing a schematic I finally obtained. The A-series is the only one I could find.

Fine-tuning

How is the fine-tuning control connected to the capacitor on an Admiral 12YP3D? I'm having trouble with this job. Is it advisable to install another fine tuner on the case or on the back?—J. T. H., Baltimore, Md.

The fine tuner on this series Admiral is a very small capacitor on the front wall of the tuner. Check for a broken connection between it and the tube socket; this is common. Because of added capacitance, I don't think it would be advisable to attempt to install an additional control.

Flashover in RCA yoke

Here's the problem. In an RCA 2T60, I hear a snapping noise, I see a flash of light in the yoke, and the picture goes out completely. It comes back a few seconds later. After a while of this, the width shrinks and the brightness goes down. What can I do to get this set back to the customer in good working order?—A. C. R., Matawan, N. J.

Since this is not a new set by several years, I'd recommend taking the yoke off, drying it thoroughly, then spraying with HV insulation. This trouble seems to be caused by intermittent flashover in the yoke. Check the leads and the internal crossover wiring in the yoke, and replace aged spaghetti where nec-

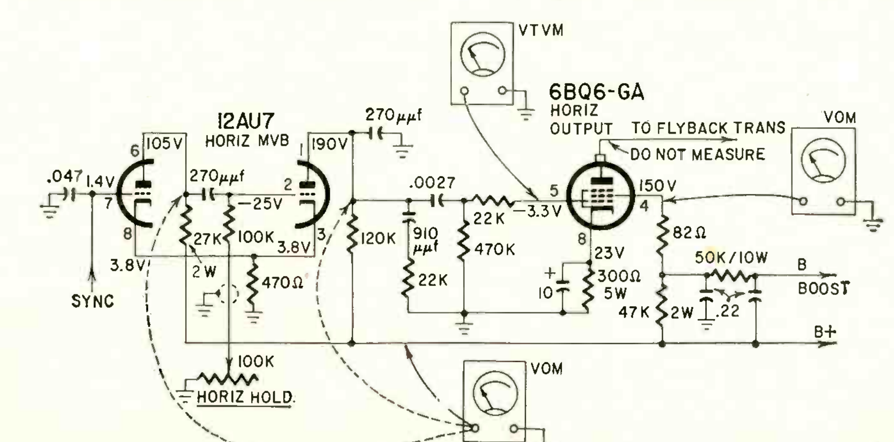

Fig. 1—Monitoring the different voltages that could affect the width will indicate which has changed.

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essary. If this doesn't help, replace the yoke.

Glass for metal

I have a Stewart-Warner 21T9210 in the shop with a 21AP4 picture tube. This is a metal tube and the life doesn't seem to be as long as for a comparable glass tube. The customer would like to substitute a 21-in. glass tube. Any suggestions?—J. C. S., Carbondale, Pa.

The 21ZP4 is a direct electrical replacement for the 21AP4 metal-cone tube. In this chassis, I would recommend using the 21ZP4B, which is aluminized. Both tubes use magnetic focus and the bases are the same.

Your only problem will be mounting the glass tube on the chassis. The easiest way is to obtain one of the parts kits made for just this purpose. They are designed for specific TV sets. Order by make and model number from your distributor.

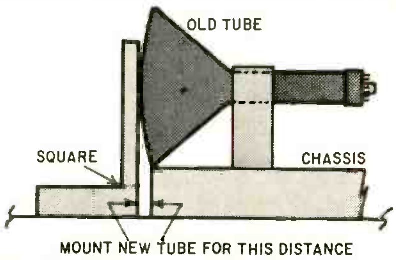

Fig. 2—Use a carpenter's square to measure the distance between the chassis apron and the picture-tube face.

When mounting the glass tube, be sure to set it so that the faceplate is exactly the same distance from the front of the chassis so the control shafts will come through the cabinet the correct distance. The best way is this: Before dismounting the old tube, set a large carpenter's square vertically against the tube face. Then measure the distance to the front of the chassis (Fig. 2). When setting the new tube, get this dimension exactly the same by correctly spacing the wooden mounting blocks provided. Then, the set will go back into the cabinet easily. As the glass tubes are some ¾ inch longer in the neck, you may have to cut a hole in the plastic cup on the back of the set.

Burning resistors

In a Philco 7L40 chassis, the audio output tube's cathode resistor is burning. Grid 1 reads 10 volts, cathode measures 15 volts, from 145 volt source. The coupling capacitor and electrolytic filter have been replaced without effect. Several 6CU5 tubes have been tried also with no effect. B-plus reads about 255 volts. Any suggestions?—J. W., Columbus, Ohio.

This chassis uses a stacked-B-plus circuit. The high voltage is applied to the 6CU5 audio output plate; the video if tubes are fed from the cathode of the audio tube.

Since the cathode resistor is "burning up," it is obviously overloaded. The voltage readings you give for the 6CU5 show that there isn't any trouble there:

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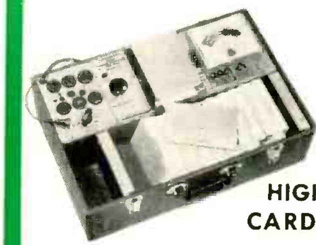

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the grid reads −5 volts to the cathode. This bias will hold the plate current drawn by the 6CU5 itself down to normal values.

The most likely prospect and the one which gives the most trouble in the field is a heater–cathode short (or other short) in one of the video if tubes. Unlikely as a heater–cathode short sounds as a cause of this trouble, it can do it if the cathode has a bias resistor in series. This causes the bias to drop to zero and the resulting increase in plate current is often enough to overheat the 6CU5's cathode resistor. Grid–screen shorts are the most common causes of complete resistor burnouts. In any case, this trouble is going to be in that +145-volt line.

Measure the cathode voltage of each if tube. If the voltage is low, look for a heater–cathode short. If the voltage is high, the tube is passing excessive current.

Loss of focus

I have a Dumont RA-164. The raster on this set seems normal, but the picture is out of focus except on extreme closeups, when it seems quite clear. Do you think a dc restorer would help this? Can you suggest any circuit changes to improve the picture?—P. D. S., Salt Lake City, Utah.

This set will not need dc restoration, due to the circuitry used (Fig. 3). You already have partial dc restoration in the video amplifier stage in this cathode-coupled C-R tube. Therefore, your trouble must be somewhere else.

It could be caused by a slightly gassy or weak picture tube. However, this would show up on other scenes such as the closeups you mention. The first step here would be to check the focus of the raster. Using a blank raster, set the ion-trap magnet very carefully for maximum brightness, moving the trap back and forth along the neck of the tube. Next, move it *very slightly around* the neck at this point, always keeping it at maximum brightness point. At some point very close you should notice a decided improvement in the focus of the scanning lines. Keep the brightness and contrast at normal setting. It might be necessary to change the focus voltage on pin 6. It now has about +260 volts. Try different values, to see if it helps.

Loss of fine detail in the background

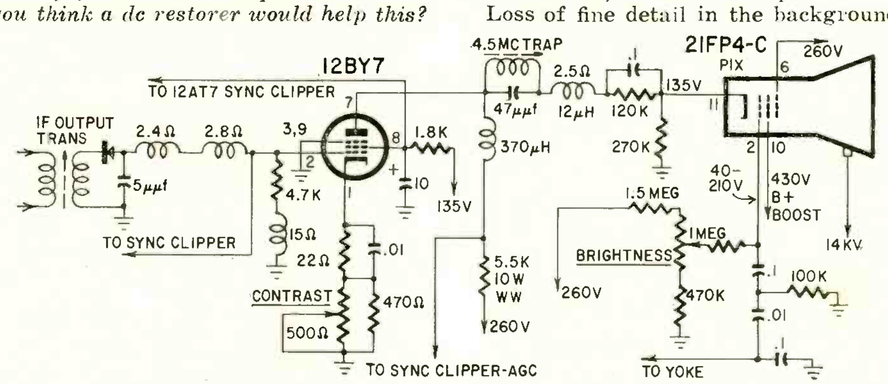

Fig. 3—Video-output circuit of Dumont RA-164, 165.

For An Important Message Concerning Your Career In Electronics See Page 69

could be due to poor alignment in the video if's. Run a complete sweep alignment on these stages, and check the peaking coils in the video amplifier plate. (Watch out for high-end regeneration.) The video detector might also be changed, as an experiment.

No raster

In a G-E 21T7 TV set, we have plenty of high voltage (we can draw a fat spark from the lead), the bias on the picture tube grid is exactly right and varies like it ought to, but no raster. We measured the voltage between the picture tube grid and cathode and it goes up and down between the limits. Cathode voltage runs from 20 to about 110 when the brightness control is moved. We used another picture tube out of another set of the same kind and it won't light either. We tested both tubes, and they're OK. What do you think is the matter?—T. H., Ft. Smith, Ark.

In this chassis (and several others of the same vintage, not the same make) the accelerator grid of the picture tube, pin 10, is supplied from the B-plus boost line, through a 2.2-megohm resistor (Fig. 4). There is a 3.9-megohm resistor connected from this grid to chassis, bypassed with a .01-μf capacitor. This is at the horizontal blanking

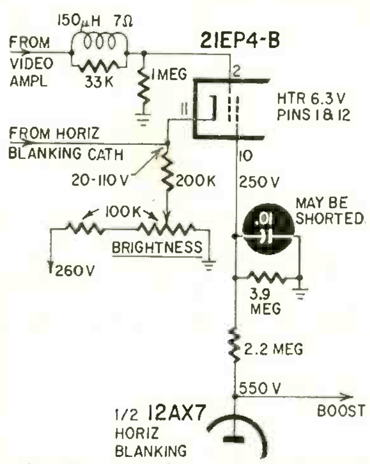

Fig. 4—Picture-tube socket connections in GE 21T7. If circled capacitor is shorted, no raster will appear.

tube (half of a 12AX7) socket. I think you'll find this capacitor shorted out, and no voltage at all on pin 10 of the CRT.

If all other voltages on the picture tube are OK, the tube(s) are good and the brightness control varies the grid-cathode voltage within the rated limits for the tube, this *must* be the trouble. In a case like this, there are only two possibilities: the CRT itself is defective (open elements, such as cathode, grid) or the electron beam is cut off by excessive bias. As you have properly eliminated both of these possibilities, there is only this one left. This is a fairly common trouble in sets using this circuit. Later models connected the accelerator directly to the B-plus line, eliminating this bypass capacitor. END

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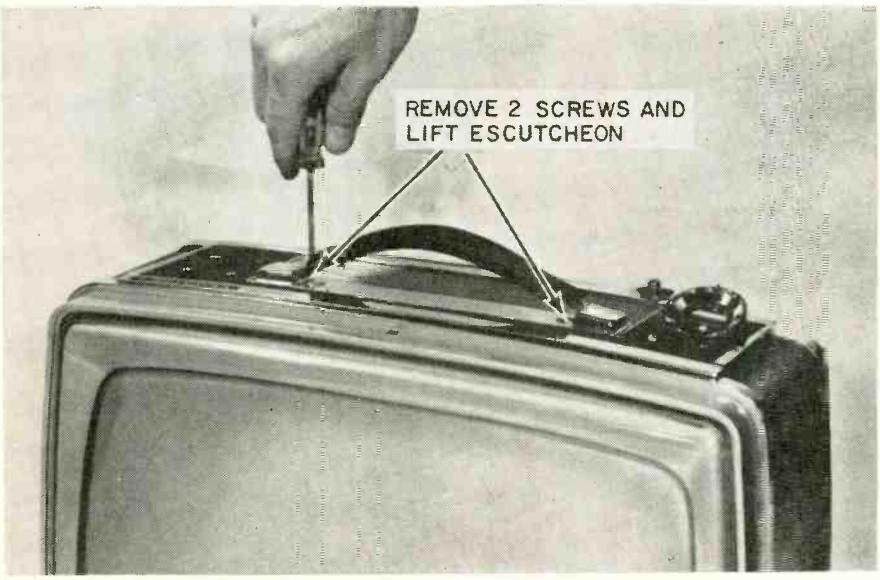
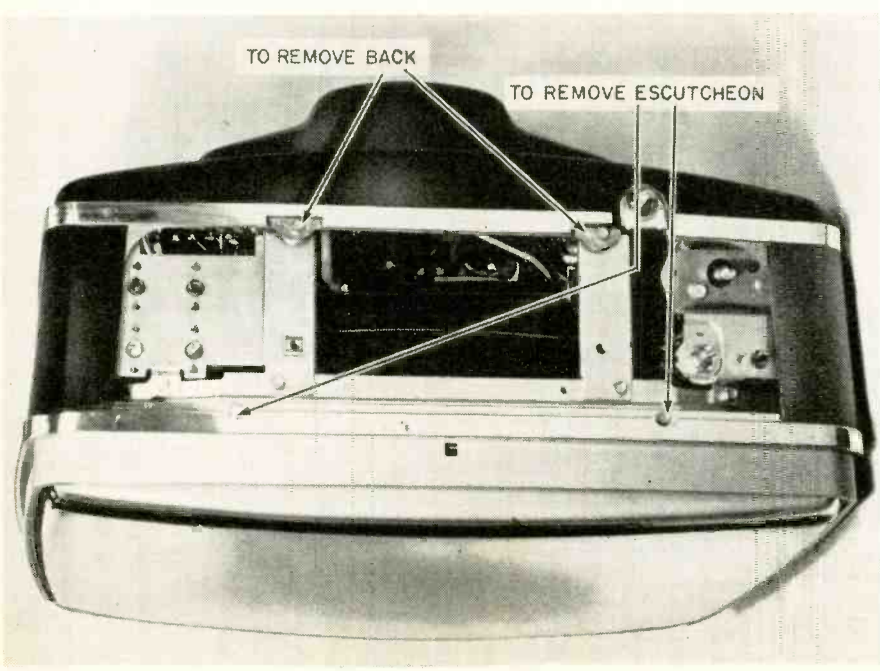


Photo 1 (Above)—First disassembly step is to remove knobs and carrying handle.

Photo 2 (Below)—Top screws must come out before you can open back or remove bezel.



JUST a couple of months ago, Motorola introduced a portable, transistor TV that has a 19-inch screen. A lot of these sets are going to appear in homes throughout the country and from time to time, the TV service technician is going to be called upon to repair them. To do a proper repair job, there are several things he must know about the set—how to get at the chassis, how to remove the back, how to remove the picture tube. And just as important, he must know something about the circuits he will encounter—they are not the same as the ones he is accustomed to seeing.

This article will show how to get at the chassis should repairs be necessary, we will see how to change the picture tube and we will take a brief look at the set's circuitry to learn a little about how it operates.

To get inside the set, the first step is to remove the knobs and the two screws from the plate where the carrying handle is mounted (Photo 1). The plate lifts right off and reveals four more screws—the two in the rear are unscrewed if you want to remove the set's back cover; the two above the picture tube are removed if you want to take off the front bezel (Photo 2). As a final step there are four more screws on the bottom of the set—again two for the back and two for the bezel (Photo 3). When the back and bezel are both off, the face of the picture tube and the back of the chassis (the side the transistors are mounted on) are exposed.

As transistor failure is not common, you will probably want to get at the wiring side of the chassis. To do so you have to take out six more screws, four on the top of the set and two on the bottom, that hold the chassis to the picture tube (Photo 4). Once these screws have been removed, slip the chassis off the picture tube, reverse it and place it back around the tube (Photo 5).

To remove the picture tube, take the chassis off as just described. Then disconnect the yoke, high-voltage lead and CRT socket. Next remove the two screws that hold the retaining band around the picture tube. Now the CRT will come out easily.

So much for disassembly, now let's look at the circuit. The set uses 24 transistors, 10 diodes, a vacuum-tube high-voltage rectifier and a 19-inch picture tube. There are controls for tuning, brightness, contrast, volume and a range switch to adjust for strong, medium or weak signals. Of course, there is the usual group of rear chassis service controls.

The tuner

There are three transistors in the turret type tuner, Fig. 1. The incoming signal, either through the 300-ohm input for an external antenna or through the 75-ohm monopole antenna, is fed to the base of the rf amplifier. The gain of this common-emitter transistor

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stage is controlled by a forward-bias agc voltage fed to its base. The base and collector circuits are tuned to the desired channels by turret switched coils. The rf amplifier's collector is inductively coupled to the mixer's emitter. The oscillator output is capacitively coupled to the mixer emitter. The output to the if strip is taken off the mixer collector.

Video if strip

A three-stage video if strip is used (Fig. 2). The first and second if's are controlled by a forward-biased gated agc system. To avoid variations in the if response curve with changes in the agc voltage, the first- and second-stage outputs are broadly tuned. The if transistors are operated common emitter for best gain. Neutralizing networks and emitter stabilizing resistors provide maximum stability.

Video detector and amplifier

A junction-diode detector rectifies the if output to form the signal input to the video amplifier. The first video amplifier operates in a dual fashion. A 4.5-mc trap in the emitter circuit acts as a high impedance at video frequencies. As far as video signals are concerned, the first video amplifier operates as an emitter follower that provides a high-impedance input for proper matching to the video detector and low-impedance output to drive the video output stage.

At the sound if, the 4.5-mc trap bypasses the emitter resistor and the 4.5-mc tuned circuit in the collector circuit rises in impedance and loads the collector. At 4.5 mc the stage operates as a common-emitter amplifier. At video frequencies the stage operates as an impedance-matching device while, at 4.5-mc audio if, it is an amplifier.

Sound if and audio system

The 4.5-mc sound if signal is amplified by the first video and the 4.5-mc if stage. Limiting is in the audio if collector circuit and the ratio detector. A matched pair of junction diodes comprises the ratio detector which feeds an audio driver and, in turn, a pair of matched class-B output transistors which provide a 500-mw output.

Gated agc circuit

The transistor agc circuit uses the saturation characteristics of the transistor rather than the cutoff characteristic. This is necessary since transistor cutoff characteristics are rather abrupt and not very well suited to agc control. The basic difference between tube and transistor agc circuits is that the transistor is biased into saturation rather than cut off to reduce gain.

Range selector switch

There are three range positions—FRINGE, SUBURBAN and LOCAL. For fringe reception, the rf amplifier is operated at full gain. This is done by disconnecting the rf transistor from the agc system and returning its base to its emitter in the FRINGE position.

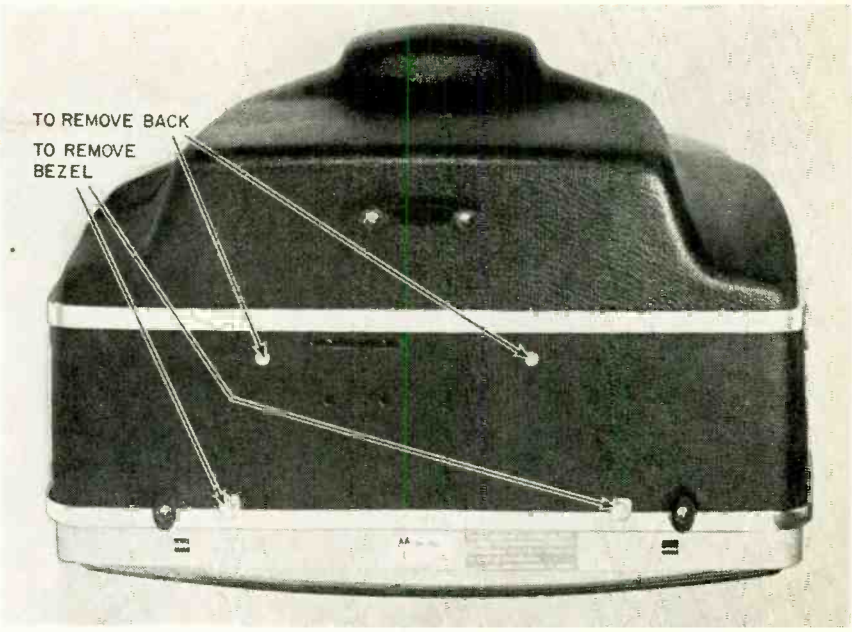


Photo 3—Bottom screws also hold bezel and back in place.

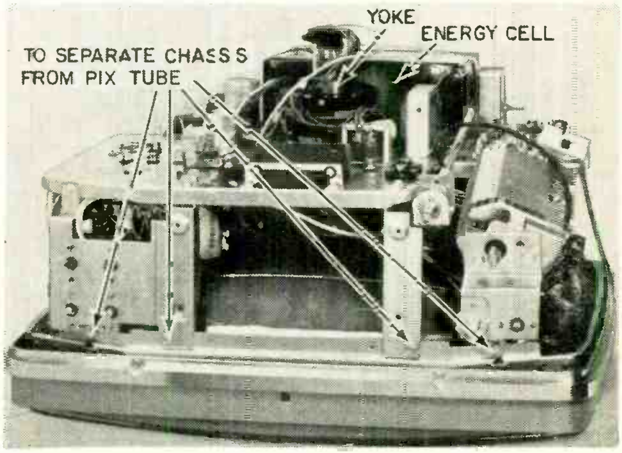
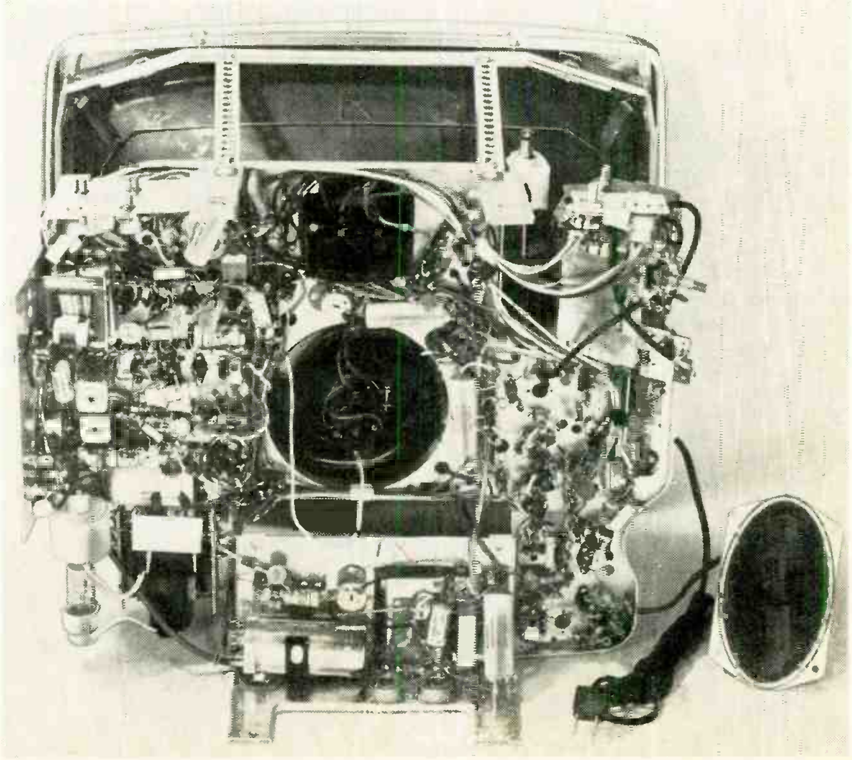


Photo 4—Four top screws hold chassis to picture tube. Two others are on bottom.

Photo 5—How set looks with chassis reversed and placed on picture tube for servicing.



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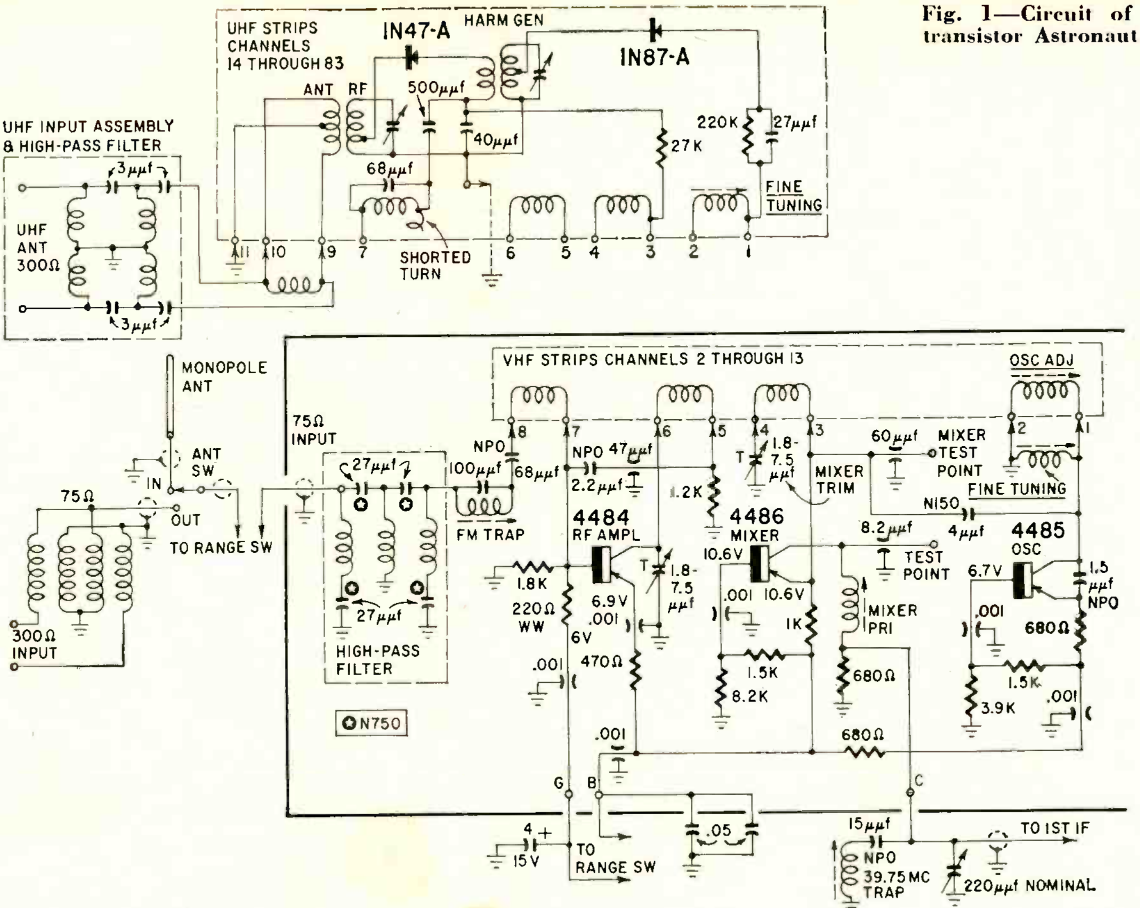

Fig. 1—Circuit of three-transistor Astronaut tuner.

The first two if stages are still fed an agc voltage. On suburban or medium strength signals, it is still desirable to operate the rf amplifier for full gain for best signal-to-noise ratio.

However, at the high end of the suburban signal range, signal strength reaches a point that will cause overloading with full rf gain. So agc to the rf amplifier is delayed until the signal reaches a point near the overload level. At this point rf afc comes in fast to protect against overload. This is done by inserting a 390-ohm resistor between the agc line and the if amplifier bases. It places a fixed amount of agc on the if stages to produce, say, 20-db attenuation. This is equivalent to a 20-db delay on the rf agc and lets the signal rise to a level where noise is no longer a factor before rf agc is developed. In the LOCAL position the circuit is set up the same as in the SUBURBAN position. The only difference is that an antenuation pad is switched into the antenna circuit.

Horizontal circuits

The basic requirements for a horizontal deflection system are a deflection yoke, a source of dc voltage to supply deflection current and a means of switching the applied voltage at the horizontal frequency. In the Astronaut the switch is, of course, a transistor.

Bias applied to the bases of the output transistors is arranged to drive them just into saturation. If the 2.7-ohm resistors between emitter and base should change in value, bias may go up or down. If it goes up, the driver transistor will have to supply a stronger pulse to the output transistors, and the driver will draw excessive current. If the bias goes down, the output transistors will not saturate, causing their internal resistance to rise, raising dissipation. So always check this carefully.

If the drive voltage should fail, the output transistor is cut off and no damage is done. The thing most likely to damage the output transistor is improper drive waveform or off-frequency operation. When in doubt, remove the yoke plug, turn on the set and check the waveforms and frequency of the horizontal circuit. If you think the output transistor is bad, check it with a vacuum-tube type ohmmeter—short-circuit from base to collector indicates a bad transistor.

The high-voltage supply uses a conventional flyback type circuit with a 1S2-A vacuum-tube rectifier to power the picture tube anode. Two taps on the flyback supply voltage to silicon rectifiers to provide positive and negative voltages (about 70–100 volts). The positive tap supplies a positive bias for the CRT cathode and G2. The negative tap supplies the collector of the video output transistor.

To check the high-voltage use a high-voltage probe. *Never draw an arc from the high-voltage system or you may damage the output transistor.* For this reason if any of the high-voltage rectifiers show signs of corona, replace them immediately.

The high-voltage secondary is resonant at the horizontal frequency. The high voltage is greatest at resonance and is controlled by the HORIZ SIZE, an adjustable air gap.

Phase detector and horizontal oscillator

The phase-detector circuit compares the incoming signal with a sample waveform from the horizontal output circuit. The 180° out-of-phase sync pulses are fed to opposite ends of the comparison network. The sawtooth waveform from the horizontal deflection circuit is fed to the center of the two selenium diodes. When the oscillator is out of phase with the signal, an unbalance occurs, resulting in a dc voltage at the junction of the two 100,000-ohm resistors. This voltage is positive or negative, depending on the type of correction required.

The balance point of the phase detector is returned to ground through a divider network which furnishes adjustable forward bias to the blocking oscillator. This bias is fed to the base of the horizontal blocking oscillator. The phase detector adds or subtracts from this voltage to hold the blocking oscillator in sync.

To set up the oscillator, short the ringing coil and disconnect the phase detector. Now adjust the free-running oscillator to bring the picture into horizontal sync (sync will hold only momentarily, but this is normal). Next the ringing coil is reinserted into the circuit and adjusted for best sync. Lastly, reconnect the phase detector.

(*Text continued on page 90*)

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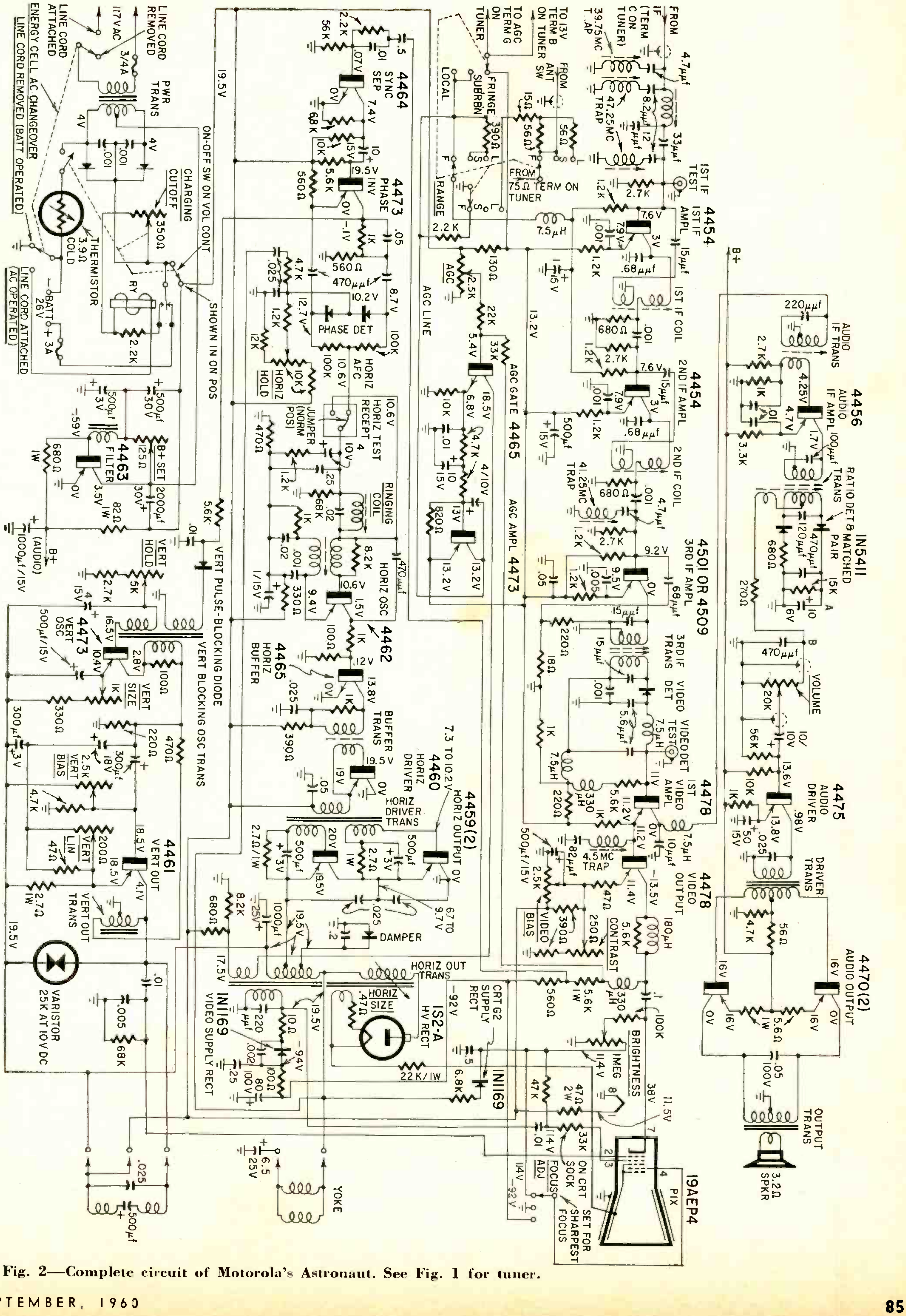

Fig. 2—Complete circuit of Motorola's Astronaut. See Fig. 1 for tuner.

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TELEVISION

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(*Continued from page* 84)

Sync separator and phase inverter

The sync signal is taken off at a 560-ohm point on the video output collector load resistance. The agc system maintains the sync tips in the video output at or near saturation. Therefore, a lot of sync clipping has taken place when the signal reaches the sync clipper. The output of the sync separator remains constant for all settings of the contrast control. As the transistor is driven far into saturation, noise clipping is very effective. The stage is a common-emitter type, so the negative output pulse is out of phase with the input pulse. The negative pulse from the sync separator drives the phase inverter in the forward direction. The phase inverter provides a balanced output to the input of the horizontal phase detector. The full value of the negative-going sync at the collector is integrated to form the vertical sync pulse.

Vertical deflection system

Vertical sync is integrated and coupled to the vertical blocking oscillator through the third winding in the blocking oscillator transformer. The vertical hold control is part of an R-C network which controls the discharge rate of the base return circuit and determines the free running time of the oscillator. The transformer provides a positive feedback loop from the collector to the base circuit. The output is controlled by a variable-emitter resistor which is used to adjust vertical size.

Power supply and charging circuit

The set is powered either by the ac line or its own Energy Cell (battery). The Energy Cell is a silver-cadmium unit that requires no maintenance. It will operate the set for 4 or 5 hours and recharges overnight.

For ac operation, the line cord is plugged into the back of the set. This activates an automatic changeover switch that connects the power transformer to the ac line, disconnects the negative terminal of the Energy Cell from ground and connects it to the charging relay. The on–off switch (when turned on) connects the receiver to the ac power supply and opens the charging circuit.

When the ac switch is turned off, the power transformer is connected to the charging circuit. When the Energy Cell is fully charged, the charging relay opens. The CHARGING CUTOFF control sets the point at which the cutoff relay operates. The control must be set so the relay opens when the battery is charged to 26 volts.

For battery operation, simply remove the line cord. This connects the Energy Cell into the circuit. Then turn on the on–off switch and the Energy Cell powers the set. END

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NEW automatic TV BRIGHTNESS CONTROL

Automatic control varies the brightness to match light conditions

By HENRY O. MAXWELL

INNOVATIONS in TV circuitry have a way of appearing and disappearing at fairly regular intervals. One of these features (now making a comeback) is an automatic brightness control that adjusts pictures brightness according to the level of the light in the room.

A photosensitive device is mounted on the front of the TV receiver where it receives the full effects of the ambient light level. Changes in the voltage output (or resistance) of the photosensitive element are used to adjust the set's brightness level. The latest automatic brightness control is Hoffman's Lite Scope used in the series 354 TV chassis. The photocell is visible just below the center of the right edge of the cabinet in the model shown.

Without an automatic brightness control, the receiver's brightness control must be set to balance the light level in the room. Assume that the set is turned on in the late afternoon while the light level is still high. The brightness control must be set fairly high for a good contrast ratio. As the afternoon wears on, the sun sets and the brightness must be turned down to prevent glare. Shortly afterwards, the room's lights are turned on and the brightness must be reset to prevent the picture from washing out. Thus, without automatic brightness control, the viewer may adjust brightness three times within a comparatively short period.

Lite Scope circuit

The Lite Scope circuit is shown in Fig. 1. The control element is a cadmium-sulphide photocell bridged across a large section of the picture tube's cathode-biasing resistance. The cell's resistance varies inversely as the light falling on its sensitive surface as in Fig. 2.

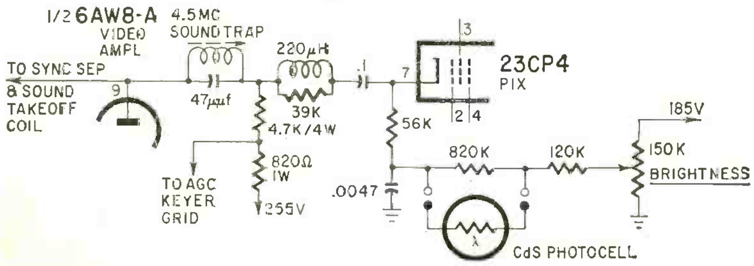

Fig. 1—Cathode circuit of the Lite Scope set.

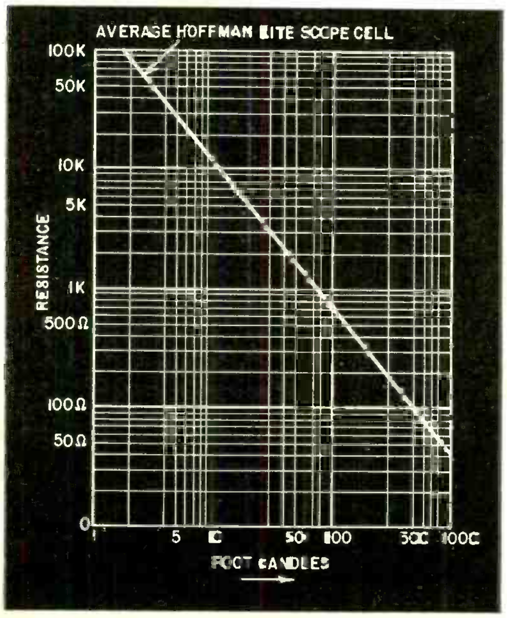

Fig. 2—Resistance of Hoffman photocell plotted against light intensity.

When a set with the Lite Scope is turned on, the effective value of the C-R tube's cathode resistance is determined largely by the light on the CdS photocell. When the ambient light increases, the photocell's resistance decreases. This reduces the C-R tube's bias and increases the brightness. Similarly, a decrease in light level decreases picture brightness by increasing the cathode resistance and picture-tube bias.

The earlier version of the automatic brightness control, used in some 1953 Westinghouse receivers, was much more complex than the Lite Scope. It used a 1P41 phototube and a 12AU7 or 6BK7-A as a 2-stage dc amplifier controlling the screen voltage of a video amplifier tube. The basic circuit and its explanation appeared in the article "Automatic Contrast-Ratio Control" in the August, 1953, issue. END

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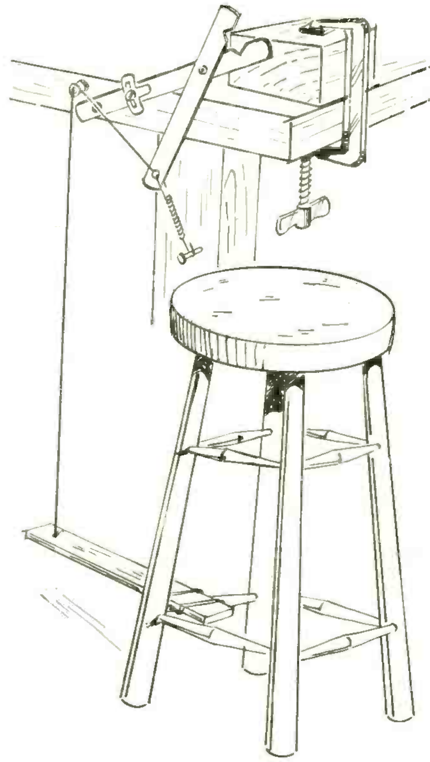
TEST INSTRUMENTS

WIRE STRIPPING with a foot pedal



Electronic technicians and experimenters often face the problem of stripping a large quantity of wire. When only a hand stripper is available, this can be a very tedious task. However, with a few parts from the "goodie box" and 10 minutes you can make a foot-operated stripper.

The drawings show a hand stripper mounted to the bench. A spring about 2 inches long from an old phonograph turntable is connected between the movable arm of the stripper and the bench. A pulley is needed so the stripper can be foot-operated. I use a standoff spacer and washer on a nail. Any board from 2 to 6 inches wide and 1 to 2 feet long makes a good foot pedal. To keep the pedal from slipping, fasten the heel to the bench foot rest, or to a rung of the stool. This is not intended to be a permanent installation, so heavy cord will do to tie the foot pedal to the stripper.

A much neater job of stripping can be done if all the wires are stripped to the same length. All you need is a backstop made from a block of wood and clamped to the bench with a large C-clamp. Cut all the wires to length first. Then feed them to the stripper.—*Harlan H. Hughes*

For An Important Prophecy From General David Sarnoff See Page 68

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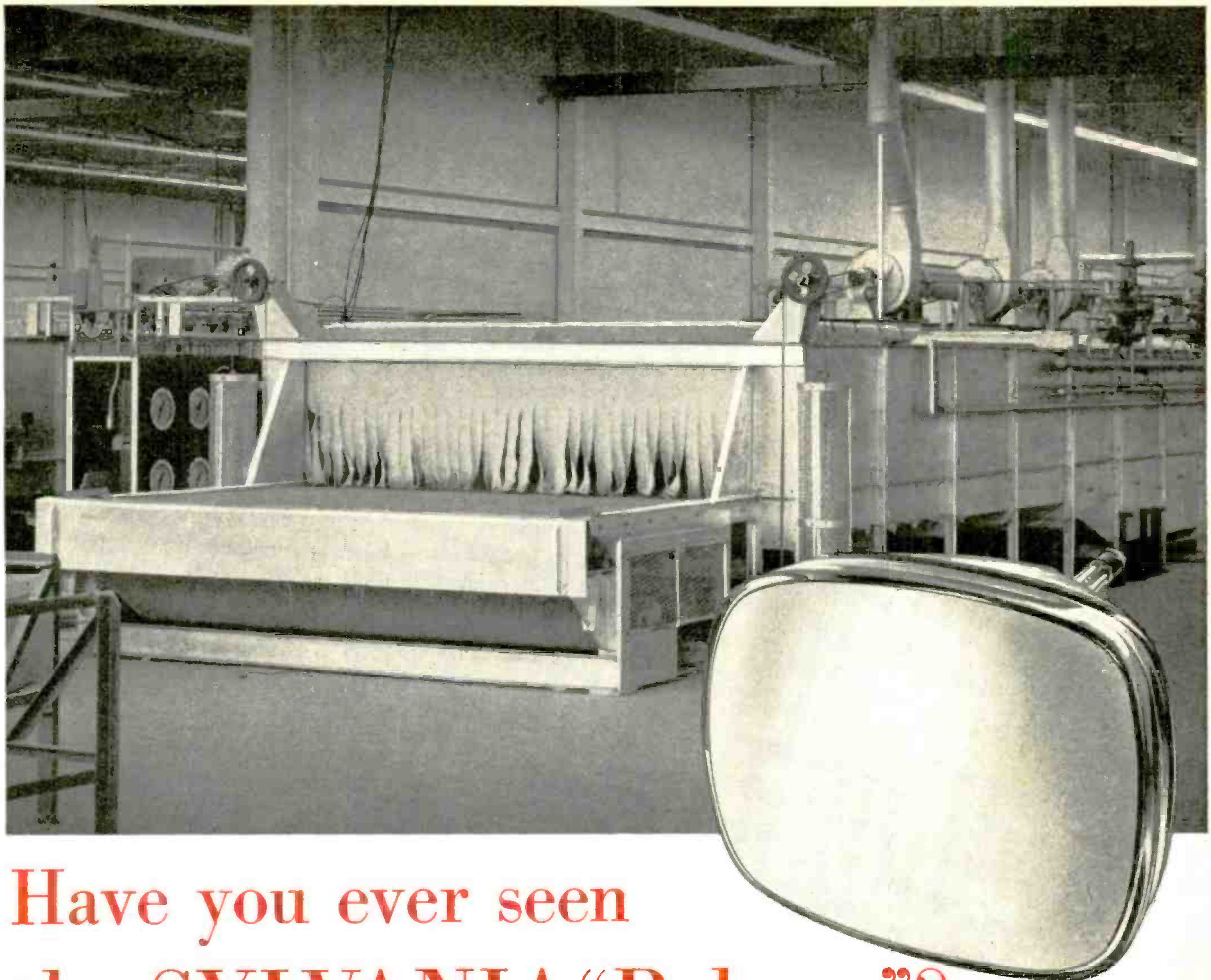

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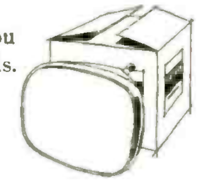
The giant ovens heat-treat the glass and bake the phosphor screen and other internal coatings. Important, too—this process removes residual volatile materials such as lacquer and water used in applying the phosphor screen.

This treatment must be done slowly, under careful controls and is very essential to the proper processing of the bulb. This process also assures "stronger" glass, free of undesired strains. It extends picture tube life by ridding the bulb of contaminants that could later cause inter-element leakage, gassing and loss of emission. The manufacturer who employs expensive equipment such as this can assure you of a consistently top-quality product.

So, when you recommend a replacement picture tube, recommend the finest . . . a Sylvania Silver Screen 85. It gives your customers what they want: better pictures for a longer time. Gives you what you need: profitable TV service calls.



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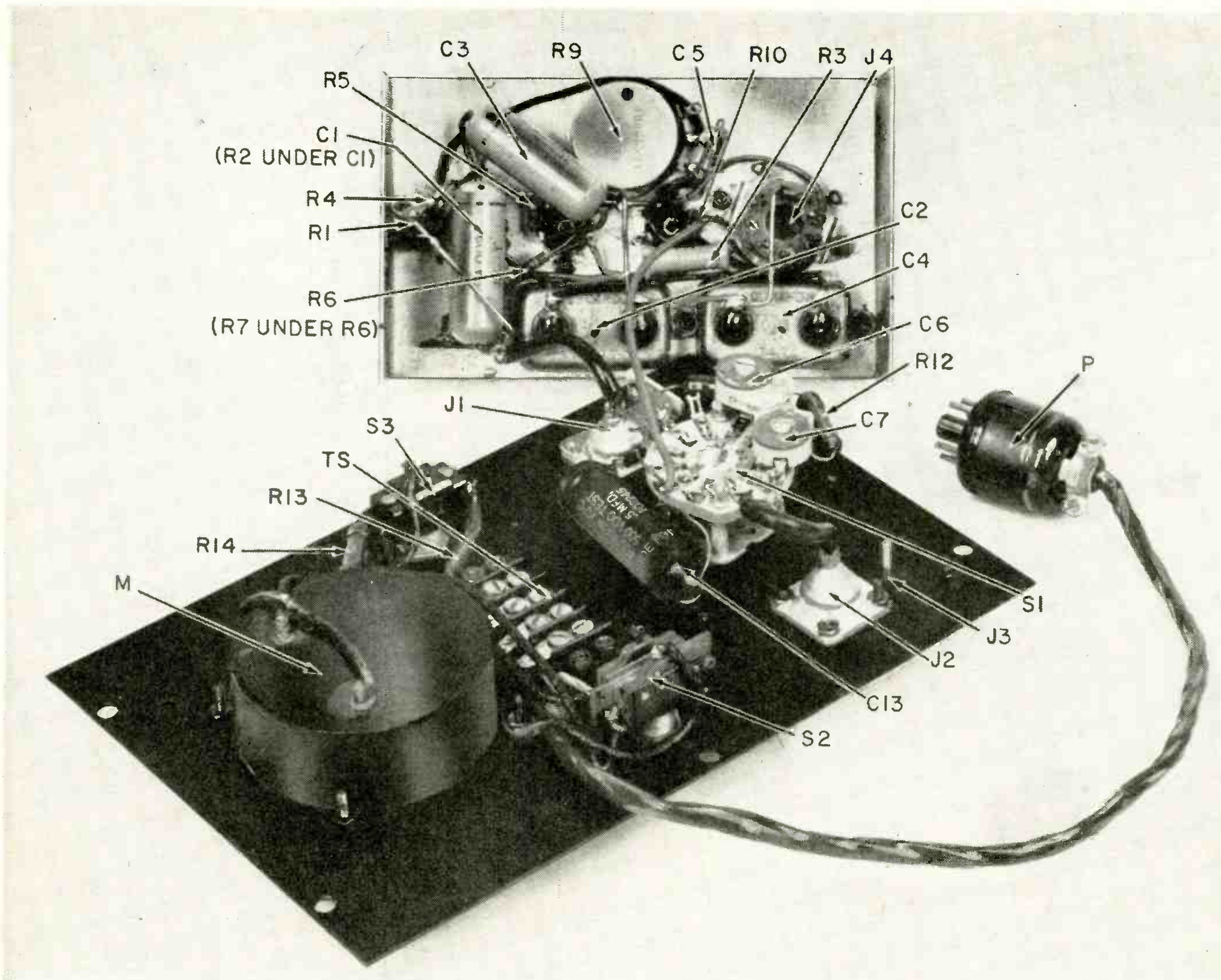
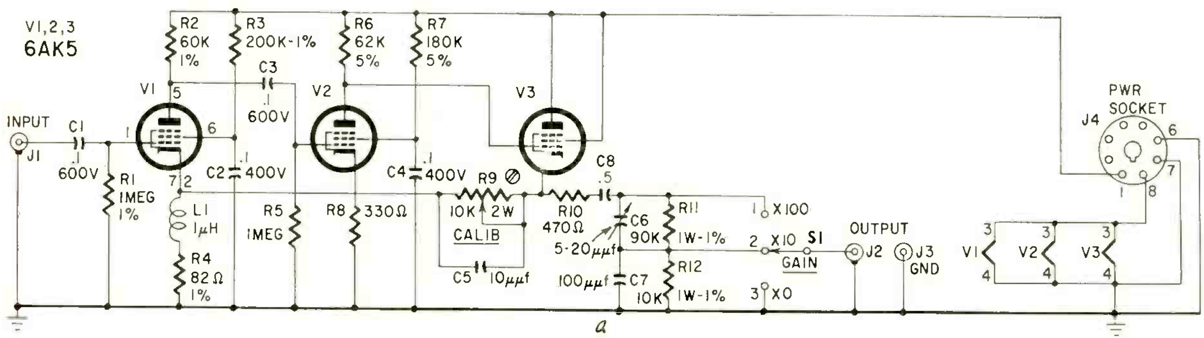


Disassembled unit shows construction details.



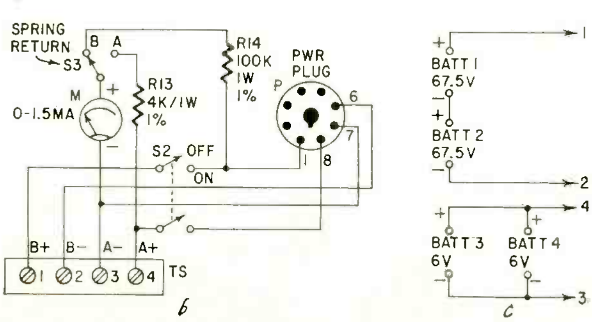


Fig. 1—a—Circuit of the 3-tube amplifier; b—metered battery power supply; c—battery arrangement. Batteries connect to corresponding terminals of TS.

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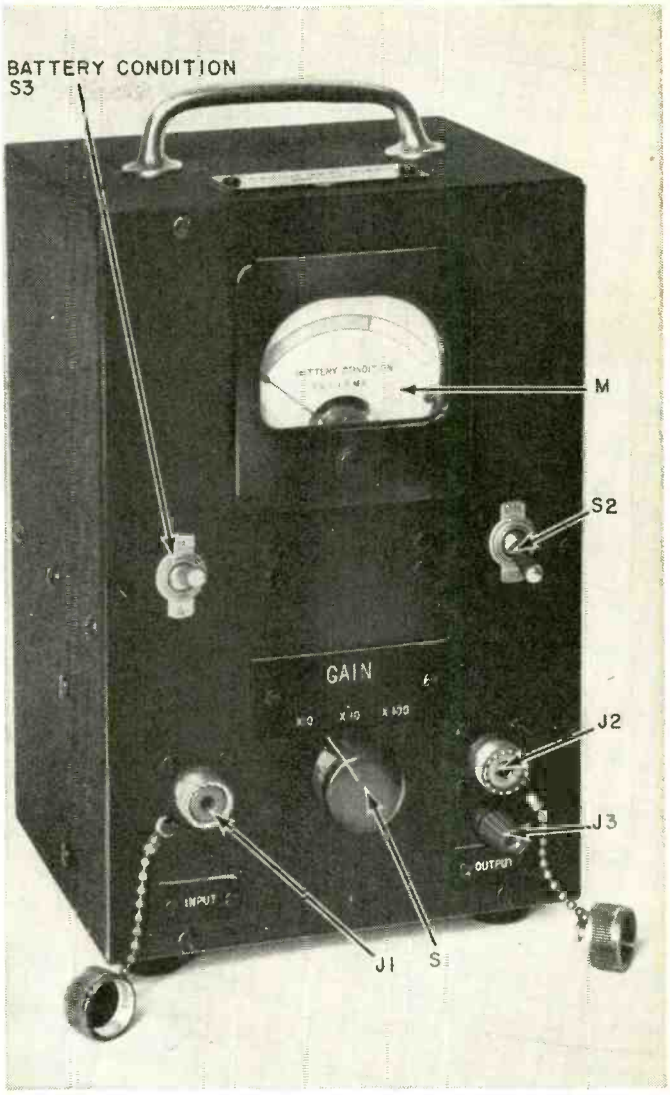
measure MILLIVOLTS *with a* DECADE AMPLIFIER

Combined with scope or vtvm, an instrument with a 1% accuracy for making really low-level measurements.



By C. L. HENRY

R1—1 megohm, 1%
R2—60,000 ohms, 1%
R3—200,000 ohms, 1%
R4—82 ohms, 1%
R5—1 megohm, 10%
R6—62,000 ohms, 5%
R7—180,000 ohms, 5%
R8—330 ohms, 10%
R9—pot, 10,000 ohms, 2 watts
R10—470 ohms, 10%
R11—90,000 ohms, 1 watt, 1%
R12—10,000 ohms, 1 watt, 1%
R13—4,000 ohms, 1 watt, 1%
R14—100,000 ohms, 1 watt, 1%
All resistors ½ watt unless noted
C1, 3—0.1 μf, 600 volts, paper
C2, 4—0.1 μf, 400 volts, surplus oil filled (use 0.1 μf, 600 volts, paper)
C5—10 μμf, ceramic
C6—5-20 μμf trimmer
C7—100 μμf, Mica
C8—0.5 μf, 600 volts, paper
BATT1, 2—67.5 volts (Eveready No. 467 or equivalent)
BATT3, 4—6 volts (Burgess F4H or equivalent)
J1, 2—coaxial connectors
J3—binding post
J4—octal socket
M—0-1.5 ma
P—octal plug
S1—single-pole 3-position ceramic rotary switch
S2—dpst toggle
S3—spdt, spring-return toggle
TS—4-terminal barrier type terminal strip
V1, 2, 3—6AK5
Sockets, 7-pin miniature (3)
Case, 9 x 6 x 5 inches (Budd CC-1095 or equivalent)

SERVICE technicians, laboratory workers, experimenters and amateurs would often like to measure voltages smaller than 0.1. However, millivolt vtvm's are costly and very few shops have them.

We often get around the lack of a millivoltmeter by using an oscilloscope. But in many circuits, even a low-capacitance probe loads the tiny signal and there isn't enough left to give a readable trace. For example, when troubleshooting the front end of a TV receiver, the signal is often too small to produce a scope trace.

The perfect solution to these problems is the amplifier described in this article. It has a gain of 100 from 10 cycles to 500 kc within 1%, and 5 cycles to 1 mc within 2%. Connect a vtvm to the amplifier's output and the meter's 0- to 1-volt scale now reads 0- to 10-mv. When connected to the input of a scope with a 50-mv-per-inch deflection sensitivity, the scope's total sensitivity is boosted to 500 μv per inch.

The amplifier circuit is uncomplicated and straightforward. (See Fig. 1). Three 6AK5's are used, powered by a self-contained battery or an ac supply. The amplifier is a feedback type. V1 is the controlled stage, V2 gives most of the amplification, and V3 controls the first stage. This is done with a wide-band feedback network from V3's cathode to V1's cathode resistor. The output thereby varies the bias on the input stage and tends to cancel any overall gain variations. Feedback potentiometer R9 adjusts the total gain to exactly 100.

The amplifier's rise time is 0.3 μsec, and the tilt on a 0.1-second pulse is 2%. Like all feedback amplifiers, frequency response cuts off very sharply at the higher frequencies. The cutoff frequency of this amplifier is 1.5 mc. Input impedance is 1 megohm shunted by 10 μμf, and output impedance is 1,000 ohms shunted by 20 μμf on the ×100 position. A simple step attenuator at the output gives a ×10 position, which is sometimes useful. A ×0 position is also included. It is used to

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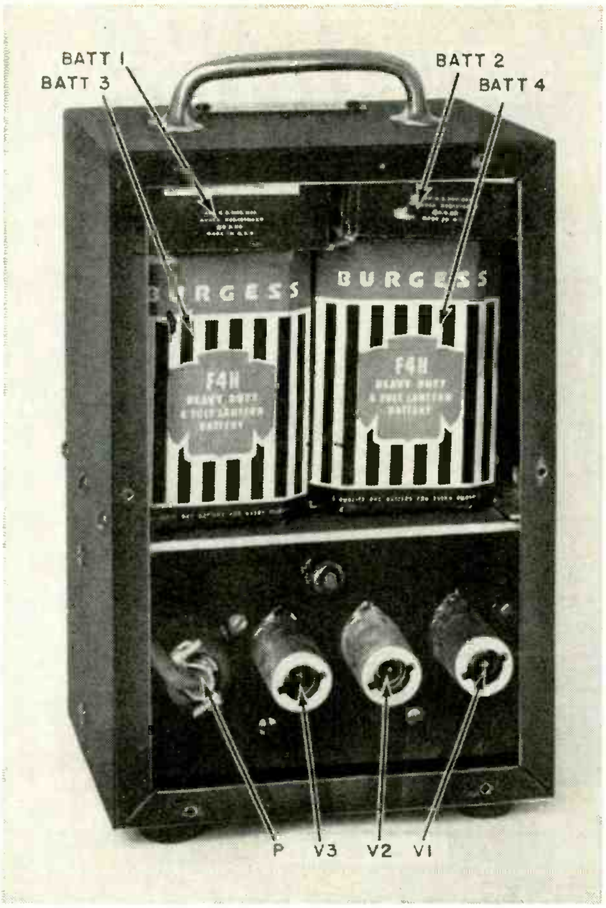
check the zero adjustment on the vtvm used with the amplifier. This ×0 position shorts the amplifier's output jack.

When building the amplifier, I decided noise output should be as low as possible so I use deposited-carbon resistors for R1, R2, R3 and R4. Most noise in this type of battery-operated circuit can be traced to current flow in a standard carbon resistor. The amplifier's noise output with its input shorted is 300 μv. This is equivalent to an input noise of 3 μv. Such a noise level is so low that measurements in the 30- to 1,000-μv range can be easily made.

Capacitors C5 and C7 are trimmers in my unit. However, the listed values were established as optimum and fixed units as shown in the parts list can be used.



With the back removed, batteries and tubes are exposed.

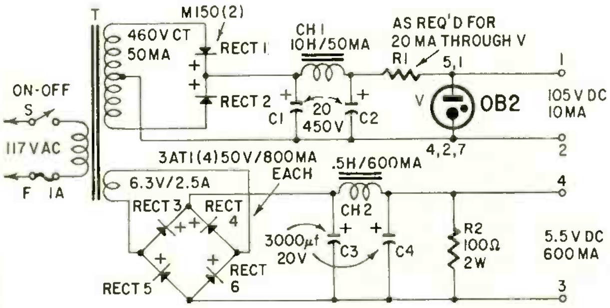


Fig. 2—Ac supply designed for use with the decade amplifier.

R1—resistance required for 20 ma through V with load disconnected
R2—100 ohms, 2 watts, carbon
C1, 2—20 μf, 450 volts, electrolytic
C3, 4—3000 μf, 20 volts, electrolytic
CH1—10 henries, 50 ma
CH2—0.5 henry, 600 ma
F—fuse, 1 amp
RECT1, 2—M150 (Sarkes-Tarzian)
RECT3, 4, 5, 6—3AT1 (International Rectifier)
S—spst toggle
T—power transformer: primary 117 volts; secondary: 460 volts ct, 50 ma; 6.3 volts, 2.5 amps (Stancor PC-8418 or equivalent)
V—OB2
Chassis to suit
Miscellaneous hardware

The amplifier input overloads at 0.25 volt, which is equivalent to a 25-volt output. A power socket is included for applications where an external power supply might be desirable. I recommend using an ac supply (Fig. 2) only where the amplifier is operated continuously for long periods of time. In ordinary measurement work, one set of batteries will last several months and the hum problems of an ac supply are avoided.

(For your protection it would be wise to use a jack from the power supply and a plug on the chassis. This avoids the possibility of getting a jolt from a hot plug or accidentally shorting a battery. *—Editor)*

The meter on the instrument's face shows the battery condition and is not connected to the amplifier. It is simply calibrated on a good–bad basis. First I found the point at which a further decrease in battery voltage affects the amplifier's calibration. From this point down, the scale is painted red. S3 is a spring-loaded toggle which normally connects the meter to B-battery. When S3 is held in its other position, it is connected to the A-battery.

How to use it

Applications for the amplifier are too numerous to mention fully. Possibly the first that comes to mind is voltage measurements. With a conventional vtvm monitoring the amplifier output, voltages from 1 mv to 0.1 volt can be measured accurately. The amplifier lets your vtvm function as a millivoltmeter and it is limited only by the frequency response of the vtvm or the amplifier, whichever is less. However, if you have a millivoltmeter, adding the amplifier lets you measure voltages from 10 μv to 1 mv. But remember, amplifier noise is equivalent to a 3-μv input.

When used with a scope, the amplifier has several advantages. It is useful for measuring signals that are normally too small to produce an adequate indication on the scope and for amplifying the output of a crystal probe. Another application worth noting is the use of the amplifier with a low-capacitance probe. Probes with a 1-μμf input capacitance and an attenuation of ×100 can be connected to the amplifier's input. The output is fed to a scope and the unknown signal is viewed at its normal value, with practically no circuit loading. This is very important in critical circuits, since even a slight loading distorts the true waveform. Since the amplifier's gain is very stable and accurate, the unit can be used to measure the attenuation of pads and networks.

Construction is simple and, after using it in my shop for about two years I find more uses for this decade amplifier every day. Built as a general-purpose amplifier for the shop, it will more than repay your effort. END

BENCH TESTED

Connect to a vtvm and you have a meter that will read 0–10 mv on what used to be a 0–1-volt range. Hook the decade amplifier to a scope (50-mv-per-inch deflection sensitivity) and get 500-μv-per-inch deflection sensitivity.

This decade amplifier was tested by a member of the staff of RADIO-ELECTRONICS. His report states that the unit operates as described by the author. The amplifier was tested by feeding it signals at various frequencies. Their amplitudes were measured at the amplifier's input and output, both with a scope and a vtvm. Only minor slips off exact ×10 and ×100 multiplication were noted; both these were within the tolerances of the test equipment used. Frequency response seems slightly different from that stated by the author—instead of 5 cycles to 1 mc within 2% it is 7 cycles to 1.4 mc. Noise level is also somewhat better than stated—the author says 300 μv, the tests show 275 μv.

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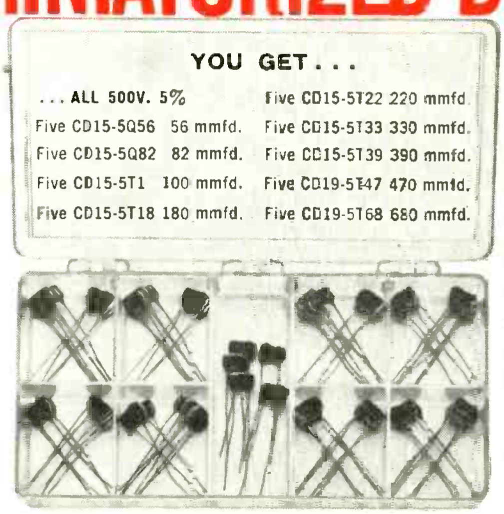

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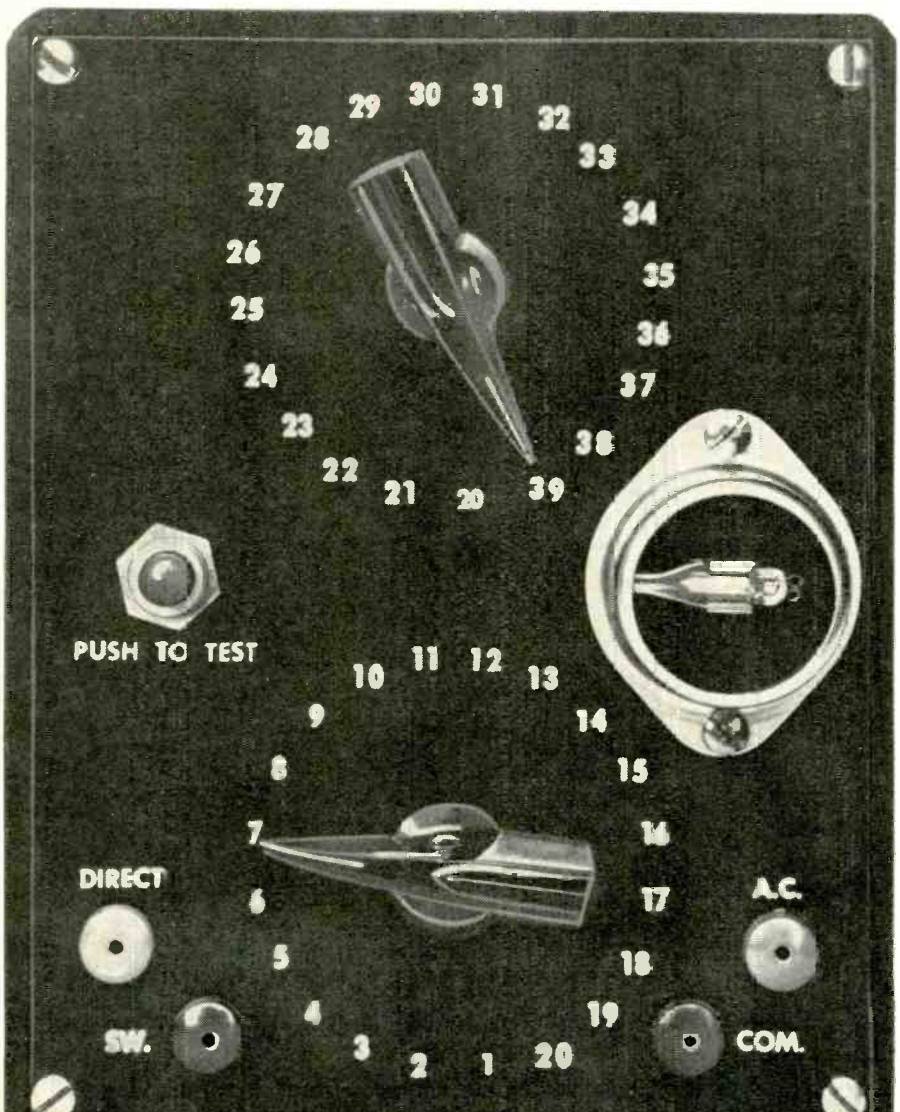
NEON LAMPS

By LYMAN E. GREENLEE



There are only three controls on the indicator's front panel.

IN all types of modern electronic gear there is an increasing need for measuring surge voltages. Sudden sharp voltage peaks do not register on an ordinary voltmeter. With the proper accessories, they can usually be observed with an oscilloscope, but a scope is not always convenient to carry for field use. A voltmeter is usually satisfactory for measuring ordinary ac and dc voltages encountered in routine service work. The amount of circuit loading depends on the sensitivity of the meter, but the input resistance is rarely more than 10 or 11 megohms. This resistance does load some electronic circuits to such an extent that accurate measurements are impossible.

A neon bulb is particularly good for indicating high-voltage surges. A good example of this is its use as an ignition tester for automobile spark plugs. Nobody would ever think of trying to measure an ignition pulse with an ordinary voltmeter, but the neon bulb, used with the proper load resistance, is perfect for such an application.

The problem of measuring and evaluating voltage surges becomes much easier and perhaps safer with the piece of equipment shown in the photos. Small 1/25-watt neon bulbs (NE-2) have an average starting voltage of 68–70. Two of them in series will start at 135–140 volts dc. By combining a series string of these NE-2 bulbs with 1-megohm protective resistors, we can make a voltage indicator that checks the applied voltage in steps of 70 volts. Unlike a voltmeter, this type of indicator puts *no load* on the circuit until the bulbs actually fire and start to conduct.

Using two 20-position switches, we get 39 multiples of 70 volts, or a total range of from 70 to about 2,700 volts ac or dc. Any unknown voltage surge can be spotted within 70 volts. This is close enough for checking vibrator power supplies and numerous other

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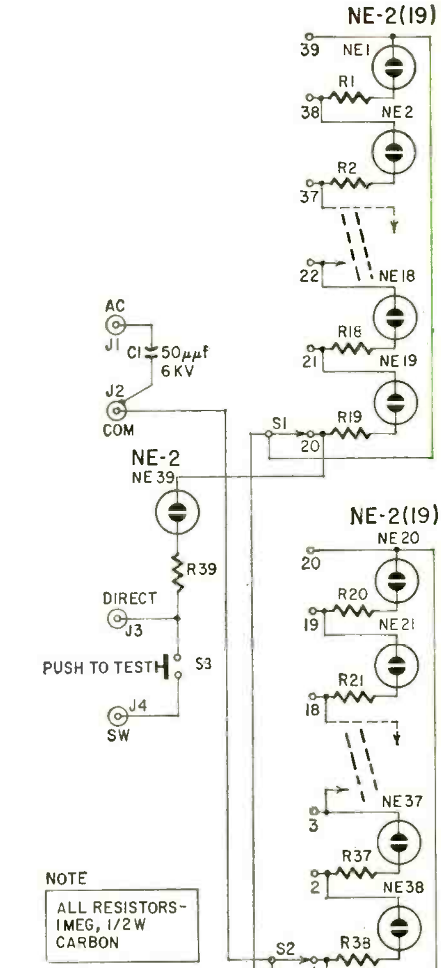
MAKE A VOLTAGE INDICATOR



C—50 $\mu\mu$f, 6 kc, ceramic
J1, 2, 3, 4—pin jacks
NE1–NE39—neon lamps NE-2
R1–R39—1 megohm, ½ watt
S1, 2—single-pole 20-position, nonshorting rotary switch
S3—spst pushbutton, normally open
Bakelite instrument case and panel 6 13/16 x 5 9/32 x 2 5/16 inches
Miscellaneous hardware

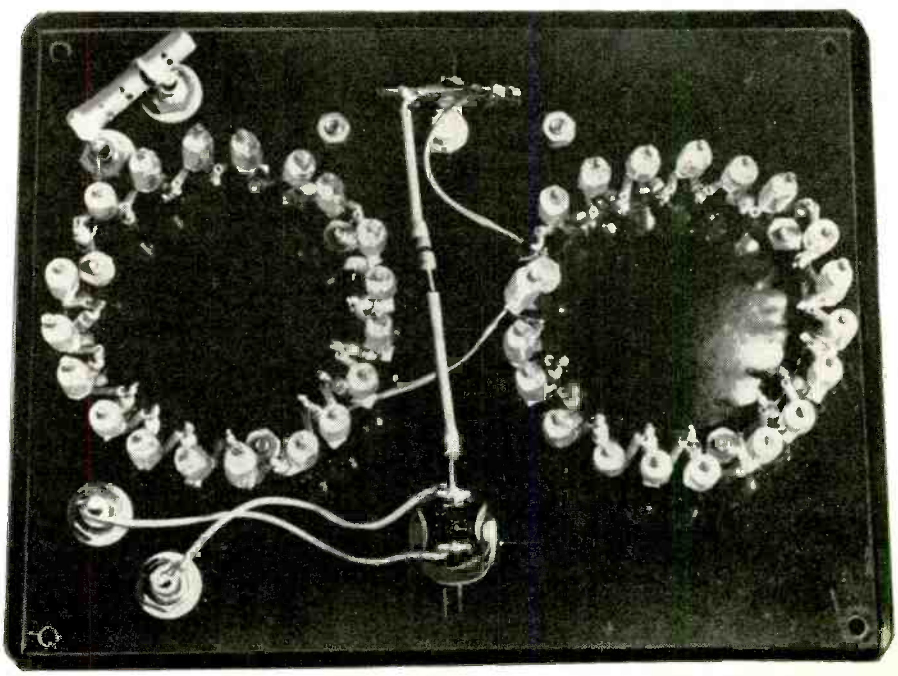
Circuit of the indicator. Lamps NE3–17, R3–17, NE22–36 and R22–36 were omitted for simplicity.

applications where a higher degree of accuracy is not required, since we are primarily interested in knowing whether a voltage surge is present and its approximate peak value.

Construction is simple. All the neon bulbs and series resistors are soldered directly to the switch contacts. The entire assembly fits a stock bakelite instrument case 6 13/16 x 5 9/32 x 2 5/16 inches, and the various parts are mounted as shown in the photographs. One neon bulb is mounted on the front panel in a 3AG fuse clip. It is covered with a socket well as a light shield to allow easy observation of short flashes of the neon bulb in daylight. (Paint the inside of this shell black.)

There are four pin jacks on the front panel. J2 and J3 connect directly to the series string of bulbs and resistors. J1 provides for inserting a 50-$\mu\mu$f capacitor to eliminate the dc component from a circuit where both ac and dc are present. J4 allows the insertion of pushbutton switch S3, a big convenience if the circuit must be closed momentarily to observe electrostatic potentials or for safety reasons when checking an unknown voltage. Note that all bulbs and resistors are normally in series, and switches S1 and S2 short out the portion of the series string not being used.

The quantity of electricity required to flash the neon-bulb string is so small that it will produce no noticeable deflection on a 0- to 20-μa meter hooked in series. The discharge of a 10-$\mu\mu$f capacitor can be observed. Pushbutton switch S3 is used when measuring small electrostatic potentials. Starting with S1 and S2 in positions 39 and 20, respectively, the bulbs and load resistors are progressively shorted out one at a time until there is a momentary flash in the indicator bulb on the front panel at the instant that S3 is depressed. This is done by turning S1 down from 39 to 20. If at 20 the indicator has not lit, turn S2 down from 20 toward 1. The total voltage is equal to the number of bulbs in the string multiplied by 70. This is the peak voltage within 70 volts. Polarity of dc circuits and capacitors may be checked, and any unknown voltage may be checked regardless of frequency. This includes rf voltages as well as surges. Probably the most unique and useful feature of the device is its ability to indicate the very minute charge stored in a very small capacitor. The voltage checker has many practical uses on the test bench, and one preliminary check on an unknown voltage could easily save the cost of an expensive meter. END



Internal construction gives a very symmetrical layout.

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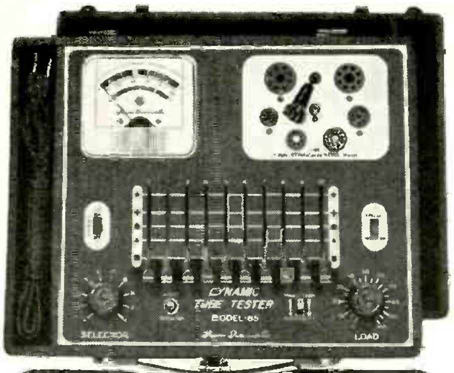
Superior's New Model 85—a *DYNAMIC type*

TRANS-CONDUCTANCE
TUBE TESTER



Model 85—Trans-Conductance Tube Tester. Total Price—$52.50. Terms: $12.50 after 10 day trial, then $8.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

- Employs latest improved TRANS-CONDUCTANCE circuit. Tests tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

- **SYMBOL REFERENCES:** For the first time ever in a trans-conductance tube tester, Model 85 employs time-saving symbols (★, +, ●, ▲, ■;) in place of difficult-to-remember letters previously used. Repeated time studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes more necessary and advantageous.

- **THE "FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube. The addition of an extra switch position permits the application of the necessary grid voltage needed for dynamic testing and insures against possible obsolescence due to changes in basing design.

- **NEW IMPROVED TYPE METER** with *sealed air-damping chamber* provides accurate, *vibrationless* readings.

- **FREE FIVE (5) YEAR CHART DATA SERVICE.** The chart provided with Model 85 includes easy-to-read listings for *over 1,000 modern tube types*. Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers *at no charge* for a period of five years after date of purchase.

- **SPRING RETURN SAFETY SWITCH** guards Model 85 against burn-out if tube under test is "shorted."

- **7 AND 9 PIN TUBE STRAIGHTENERS** have been included on the front panel to eliminate possibility of damaging tubes with bent or out-of-line pins.

- **AN ULTRA-SENSITIVE CIRCUIT** is used to test for shorts and leakages up to 5 megohms between *all* tube elements.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. Only......

$52.50

SUPERIOR'S NEW MODEL 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V.T.V.M. made by any other manufacturer at any price

Model 77—VACUUM TUBE VOLTMETER ... Total Price $42.50—Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary!

- ✓ Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only $42.50.
- ✓ Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- ✓ Model 77 uses new improved SICO printed circuitry.
- ✓ Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, intermittents are easily found, isolated and repaired.

- ✓ Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- ✓ Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- ✓ Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

SPECIFICATIONS

- **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms • **DECIBELS**—10 db to + 18 db, + 10 db to + 38 db + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only.........................

$42.50 NET

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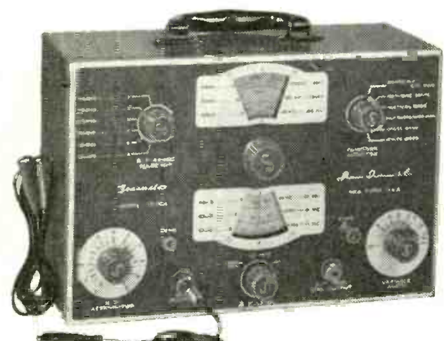
7 Signal Generators in One!



Model TV-50A—Genometer. Total price—$47.50—Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary!

- ✓ *R.F. Signal Generator for A.M.*
- ✓ *R.F. Signal Generator for F.M.*
- ✓ *Audio Frequency Generator*
- ✓ *Bar Generator*
- ✓ *Cross Hatch Generator*
- ✓ *Color Dot Pattern Generator*
- ✓ *Marker Generator*

A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

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

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

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency).

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

$47.50 NET

EXAMINE BEFORE YOU BUY!

USE APPROVAL FORM ON NEXT PAGE

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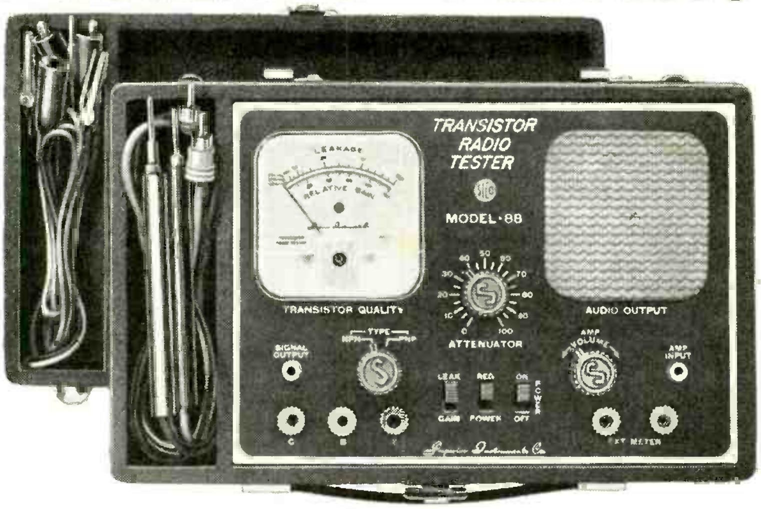
The Model 88....A New Combination

TRANSISTOR RADIO TESTER and DYNAMIC TRANSISTOR TESTER



The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no *adequate* provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices under *dynamic conditions*.

AS A TRANSISTOR RADIO TESTER

We feel sure all servicemen will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a new simplified rapid procedure — a technique developed *specifically* for radio's and other transistor devices.

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble whether it be a transistor, some other component or even a break in the printed circuit is located and pinpointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength.

The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors incuding NPN and PNP, silicon, germanium and the new gallium arsinide types, without referring to characteristic data sheets. The time-saving advantage of this technique is self-evident. A further benefit of this service is that it will enable you to test new transistors as they are released!

SPECIFICATIONS:

Model 88 operates on a self-contained 4½ volt battery and is always ready for instant use on the bench or in the field.

Signal Injector:

The signal injector used in the Model 88 is a new departure in signal source design. Previously, signal sources were provided by signal generators operating on a single frequency and requiring retuning. The Signal Injector of the Model 88 employs a transistor in a grounded emitter self-modulating blocking oscillator generating a low R.F. frequency providing stable harmonics to 30 megacycles. A power output of over 2.5 volts peak to peak is provided. An attenuator prevents overload of the receiver or the amplifier under test.

Signal Tracer:

Two high-gain grounded emitter transistors are utilized in a high gain amplifier with sufficient output to operate the built-in 4½" Alnico V Speaker. A diode is used as a "clamp" to prevent overloading of the output stage. A volume control permits attenuation of strong signals. Provision is also made on the front panel for the addition of a meter or an oscilloscope for quantitative evaluation of the signal strength.

Transistor Tester:

The transistor tester used in the Model 88 measures the two most important transistor characteristics needed for transistor servicing; leakage and gain (beta).

The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 ohms to 100,000 ohms covers all the leakage values usually found in both high and low power transistor types.

The gain test (beta) translates the change in collector current divided by the base current. Inasmuch as the base current is held to a fixed value of 50 micoamperes, the collector current calibrated in relative gain (beta), is read directly on the meter scale.

The Model 88 will test *all* transistor types, including NPN or PNP, germanium, silicon, gallium arsenide and the newer diffused junction and mesa types.

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-On Cables for Transistor Testing, an R.F. Diode Probe for R.F. and I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete—nothing else to buy! Only **$38.50**

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Aerovox Type HCB units are polarized electrolytic capacitors designed especially for use in industrial applications such as battery eliminators, power supplies, electric fence controls, sound movie projectors, etc. For non-polarized applications such as welding and control equipment they are available as Type NPB electrolytics.

Both types feature heavy-duty, moisture resistant bakelite-cases which eliminates the need for outer cardboard insulating tubes. Units are high capacity etched plate, high quality electrolytics designed for trouble-free, long-life operation.

SPECIFICATIONS

- Operating Temperature Range: −40°C. to +85°C.
- Capacitance Tolerance up to 150 VDCW −10+100%, over 150 VDCW—10+50%.
- Available in capacitance values from 15 mfd to 12,000 mfd in voltage ratings of 6, 12, 18, 25, 50 VDCW and 125, 300 and 450 VNP.
- Stocked for off-the-shelf delivery by your Aerovox Distributor.

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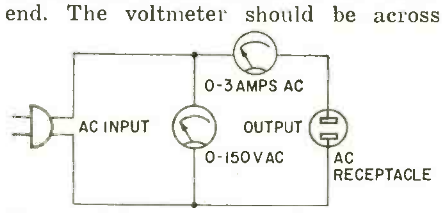
make a POWER tester

By R. L. WINKLEPLECK

THE power a piece of electronic equipment uses is an important indication of its condition. A watts or volt-amperes reading is a useful, though frequently overlooked, service aid because it narrows the field of possible faults.

Equipment cost is an ever-present problem and wattmeters are quite expensive. Fortunately, there is a simple way to get the information wanted by assembling a small, portable, power-measuring unit. The total cost is under $8 and the unit has one advantage over the more expensive wattmeter.

This power-test unit consists of two inexpensive meters; one to measure ac volts and the other ac amperes. The ranges selected seem best for radio–TV service work but other combinations may be used; for appliance repair, for instance. The wiring is almost a straight-through proposition from the line cord at one end of the small case to the convenience outlet on the other end. The voltmeter should be across

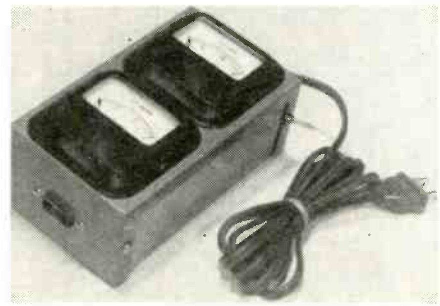


Circuit of the instrument. Note that voltmeter is connected across input.

the line on the input side so the ammeter measures only the external load. The ammeter may be inserted in either side of the line.

This unit measures power as the product of voltage and current ($P = EI$) for pure resistive loads such as heaters, broilers, toasters and coffee makers. For loads with a reactive component (inductance or capacitance) the EI product expresses volt-amperes rather than watts. To determine watts for a reactive load, the product of volts times amperes must be multiplied by the cosine of the phase angle (the power factor).

For all practical purposes, we can determine the wattage of any load by ignoring the power factor of the resistive loads previously mentioned since it is unity. Motor driven equipment such as vacuum cleaners, hair dryers and sewing machines can be treated the same way since their power factor will be around 0.99. Transformer-powered radio and TV receivers as well as the transformerless ac/dc types are handled by arbitrarily assigning them a power factor of 0.90 or 0.95. Thus, if we have a TV set which draws 1.5 amperes at 120 volts, we can figure that it is drawing 1.5×120, or 180 volt-amperes, and 180×0.95, or 171 watts.



Completed unit fits into 2¼ x 3 x 2⅛-inch case.

If it was rated at 150 watts, we can be sure some part of the circuit is working too hard. A filter capacitor may be getting leaky or a resistor has shorted or changed value, causing it to draw too much current or biasing a tube to overconduction. Too much heat is being generated somewhere and we look for a hot spot. Conversely, the set may be rated at 200 watts and we know that somewhere some circuit isn't using its current allotment because of an open resistor, a nonconducting tube or something of the kind. The power reading doesn't pinpoint the trouble but it does establish the category and can materially shorten the time required to locate the defective component. Many of the newer fact sheets give the power rating of radio and TV receivers as *x* amperes at 117 volts and the conversion to watts isn't necessary.

Straightforward wiring makes assembly job a matter of minutes.

The advantage this unit has over its high-priced cousin the wattmeter? It measures line voltage and this you must always consider. Most electronic equipment is designed to operate over a moderate range of line voltage fluctuation. In many locations, however, the available voltage varies considerably. In rural areas and in some of the rapidly growing suburban developments, it's not unusual to find a voltage shift of 25% or more. Many shrinking pictures and marginal performance difficulties can be traced to low line voltage with this little test box. END

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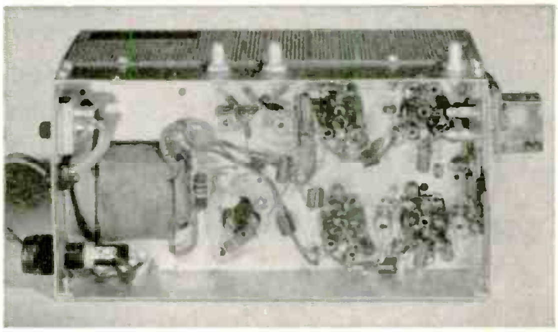
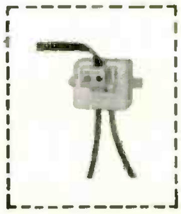


Wired like a Laboratory Instrument

Flush mounted Line Tap



Surface mounted Line Tap

2-way coaxial Line Splitter

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NEW TUBES and SEMI-CONDUCTORS

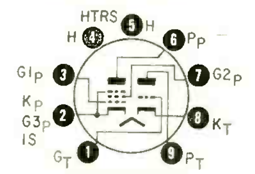
LIKE most summer months, new tube releases have run a little slow, but the few that did come through were interesting.

Entertainment types

We lead off with a vertical-oscillator output tube, continue with a note on when tetrodes may be triodes and end up with a tube for the hi-fi booster.

6HC8, 17HC8

These two triode-pentodes come in 9-pin miniature envelopes and are identical except for heater characteristics. The 6HC8 heater is rated at 1.2 amps at



6HC8,17HC8

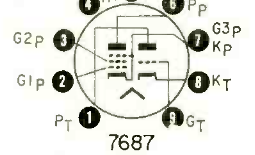
6.3 volts. The 17HC8 at 450 ma at 16.8 volts. The tubes are intended for use as vertical deflection oscillator and amplifier in TV receivers.

The advance data sheet for the Sylvania 6HC8 and 17HC8 lists their average characteristics in vertical deflection use as:

	Triode Oscillator	*Pentode Amplifier*
V_P	250	250
V_{G2}	—	250
V_{G1}	−3	−18
I_P (ma)	1.4	38
I_{G2} (ma)	—	3
g_m (μmhos)	2,000	5,100
μ	68	8.7
R_P (ohms) (approx)	34,000	55,000

7687

A tube for the high-fidelity man, the 7687 is a triode-pentode whose pentode section is particularly suited for pre-



7687

amplifier service while the triode is intended for use as a phase splitter. The 7687 features exceptionally low hum and noise. It is similar to the 7199 and is an improved low-noise version of that tube. Basing differs so the tubes are not directly interchangeable.

Characteristics of the Sylvania 7687 in typical operation are:

	Triode	*Pentode*
V_P	215	220
V_{G2}	—	130
V_{G1}	−8.5	—
$R_{K\ bias}$ (ohms)	—	62
I_P (ma)	7.5	10
I_{G2} (ma)	—	3.4
g_m (μmhos)	2,500	5,800
μ	18	—
R_P (ohms)	7,200	500,000

Tetrode is a triode

When the 6ER5 was first announced it was called a tetrode. However, in the latest manufacturer's tube data, this has been revised and the tube is listed as a triode. This is what happened:

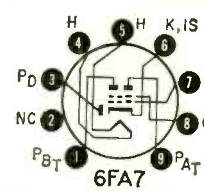
The original data called the tube a tetrode. However, the Electron Tube Industry Standards Group pointed out that the No. 2 grid was actually a shield and not an active element. As such the tube is properly classed as a triode. Also, the plate characteristic of the 6ER5 is typically that of a triode. This same construction is used in the 6ES5, 6FH5 and 6FQ5. These tubes are also classed as triodes.

Industrial types

We have an interesting tube with a split-plate tetrode section, a group of p–n–p–n silicon switches, a ceramic–metal uhf beam power tube and a few news notes.

6FA7

A diode, sharp-cutoff twin-tetrode in a 9-pin miniature envelope that is very useful in frequency-divider and complex-



6FA7

wave generator circuits of electronic musical instruments.

The diode and tetrode use a single cathode. The twin plates of the tetrode are on opposite sides of the cathode to minimize interaction between the electron streams from the cathode to each plate.

Maximum ratings of the RCA 6FA7:

Tetrode Unit	
$V_{P(A)}$	330
$V_{P(B)}$	330
V_{G2}	330
V_{G1} (neg bias)	50
(pos bias)	0
$P_{P(A)}$ (watts)	1.5
$P_{P(B)}$ (watts)	1.5
Diode Unit	
I_P (ma)	1

7649

A ceramic–metal tube with perfectly aligned grids that is specifically designed for pulse applications where dependable performance under severe shock and vibration is essential. The small forced-air-cooled uhf beam power tube is used in grid-pulsed and plate-and-screen pulsed rf oscillator and amplifier service at frequencies up through 2,000 mc.

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The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Oynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator, Amplifier, and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $26.95. The Signal Tracer alone is worth more than the price of the entire Kit.

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You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are twenty Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator, Amplifier and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls, switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

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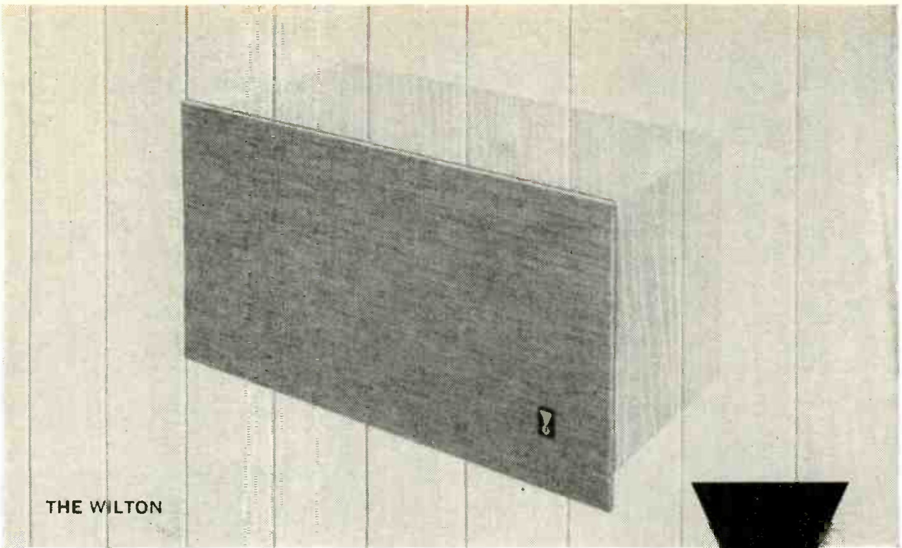
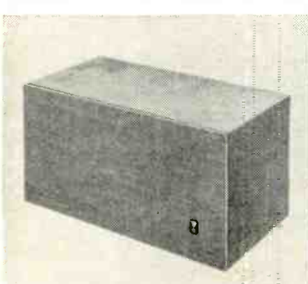


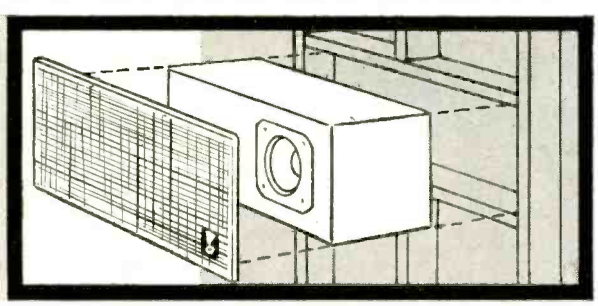
NEW JBL UTILITY ENCLOSURE FOR BUILT-IN SYSTEMS

JBL

"What's the best way to build a JBL Linear-Efficiency Speaker into a wall or cabinet?" This is the question most frequently asked of us since the introduction of the precision-made, long-linear-excursion, relatively-high-efficiency JBL loudspeakers. The answer is provided in the new Wilton systems. The Wilton is a minimum-volume acoustical enclosure for use with either the LE8, eight-inch, full-range, Linear-Efficiency Speaker (System D47LE8) or with the S5 two-way, network-divided Linear-Efficiency System (D47S5). It must be ordered with a system factory-installed; it is never available separately. The Wilton is an unfinished birch enclosure measuring 11¾" x 23¾" x 11¾". The surface is sanded at the factory on four sides ready for finishing, and may be used as a free-standing enclosure either vertically or horizontally. You have your choice of either a flush-mounted grille for this use or an overlapping grille for custom, built-in installations. Using the Wilton is an excellent way to convert a piece of furniture into a components cabinet. For a complete description write for your free copy of JBL Bulletin SB1019.

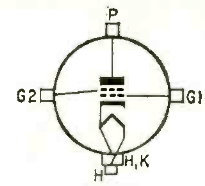


Free-standing Wilton is factory-sanded on four sides so enclosure can be placed either horizontally or vertically. Grille snaps out for convenience of home craftsman who wants to apply his own finish.



Custom-installation version of Wilton has snap-on grille that overlaps enclosure 1½" on all four sides to cover gap between enclosure and wall framing or cabinet opening.

JAMES B. LANSING SOUND, INC., LOS ANGELES 39, CALIFORNIA



7649

Maximum continuous commercial service ratings of the RCA 7649 are:

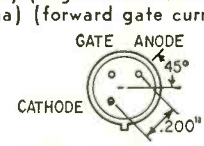
	Grid-and screen pulsed	*Plate-and screen pulsed*
V_P	1,500	3,000
V_{G2} (peak pos)	750	750
V_{G1}	−200	−200
I_P (during pulse) (ma)	3,000	3,000
I_P (ma)	80	50
$P_{G2\ input}$ (watts)	4.5	4.5
$P_{G1\ input}$ (watts)	2	2
P_P (watts)	115	115

TI 010, TI 025, TI 050

Three 1-ampere 50-volt p-n-p-n diffused-silicon switches that have selected switching specifications. All come in a welded case and are ruggedized to meet military requirements.

Maximum ratings of these Texas Instruments semiconductors at 125°C:

V_R (peak inverse voltage)	50
$V_{F\ (off)}$ (forward voltage in off condition)	50
I_F (ma) (avg rect fwd current)	300
I_G (ma) (forward gate current)	100



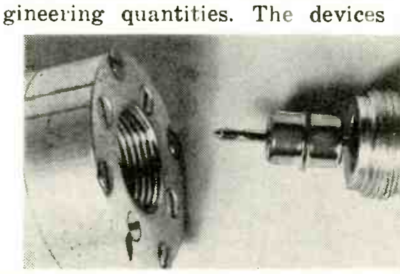
TI 010, TI 025, TI 050

Switching specifications at 25°C:

	TI 010	*025*	*050*
Max anode current for gate switching off (ma)	10	25	50
Max gate current to switch on (ma)	5	10	20
Max gate voltage to switch on	1.5	1.5	1.5
Max gate current to switch off (ma)	5	10	20
Max gate voltage to switch off	5	5	5
Max holding current (ma)	5	10	25

Semiconductor briefs

Philco has begun marketing microwave coaxial MADT transistors in engineering quantities. The devices are



said to have a power gain of 8 db when operating into a cavity under matched neutralized conditions at 1,000 mc.

GE announces a 47% price reduction for two lines of medium-current silicon controlled rectifiers and a 51% cut for a third line. This was made possible by widespread acceptance of the controlled rectifier in military and industrial applications which has lowered manufacturing cost per unit. END

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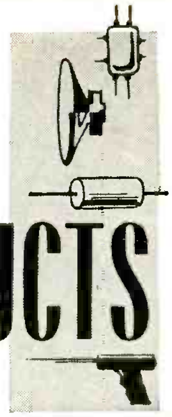
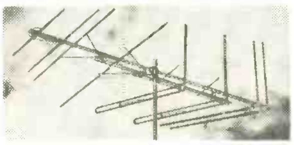
new PRODUCTS



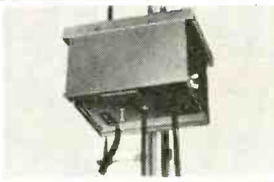
TV ANTENNAS. All-channel units eliminate side-lobe pickup, reducing co- or adjacent-channel interference. *Models 707-5, 707-6*



and *707-8* (shown) for local, medium and fringe-area reception, respectively—**Technical Appliance Corp. (TACO)**, Sherburne, N. Y.

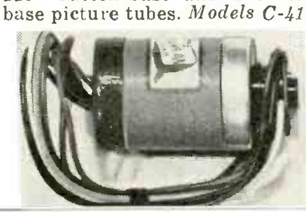
ANTENNA TOWER *No. 55.* Rigidity and strength in heights up to 450 feet. 10-foot hot-dipped galvanized sections constructed on 18½-inch triangular pattern.—**Rohn Manufacturing Co.**, 6718 W. Plank Rd., Peoria, Ill.

BOOSTER for single TV channel mounts on antenna



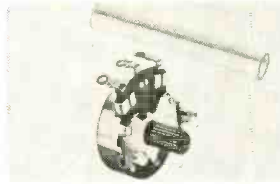
mast. *Model CB*, 15 to 17-db gain, depending on channel. 300-ohm input, 75-ohm output. Built-in power supply.—**Blonder-Tongue Laboratories, Inc.**, 9 Alling St., Newark, N. J.

TUBE BRIGHTENERS for 110° button-base and duodecal-base picture tubes. *Models C-412,*



C-403, C-411 and *C-311* cover most tubes in use today regardless of heater voltage ratings.—**Perma-Power**, 3100 N. Elston Ave., Chicago 18, Ill.

TWIST-TAB CONTROLS *model TT* in values from 200 ohms to 7.5 megohms. Short shaft used in hidden TV con-



trols. Polyethylene shaft extension. ½-watt rating. 15/16-inch diameter, 7/16-inch depth. —**Centralab**, 900 E. Keefe Ave., Milwaukee 1, Wis.

CRT TESTER and reactivator *model 800* handles black-and-white and color tubes. Checks emission, shorts, leakage, opens. Burns out shorts, rewelds, opens,

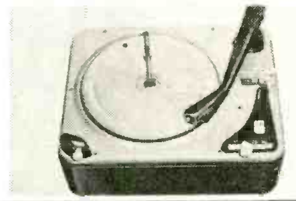
reactivates low-emission tubes. 4½-inch meter. Filament voltages 6.3, 8.4, 2.35.—**Mercury Electronics Corp.**, 77 Searing Ave., Mineola, N. Y.

OHMMETER *model 309* covers 0–2,000, 0–20,000, 0–200,000 ohms, 0–2 and 0–20 megohms. Zero-adjust control on side of

case.—**Triplett Electrical Instrument Co.**, Bluffton, Ohio.

STEREO AMPLIFIER *model 299B* improved version of *299*. Monitoring for recording. Power increase to 50 watts (IHFM standards). Extra-high-level input for electronic organs.—**H. H. Scott, Inc.**, Dept. P., 111 Powdermill Rd., Maynard, Mass.

STEREO CHANGER *model 1007* handles up to 10 records. Moistureproof crystal cartridge. Response 20 to 16,000 cycles: 20 to 10,000 cycles ±1½ db. Output 0.4 volt, 10 mv with magnetic input adapter (both at 5 cm/sec). Eliminates center-hole chipping with "elevator-action" spindle. 4 speeds; intermediate idlers of different sizes rather



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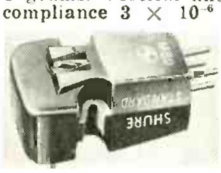
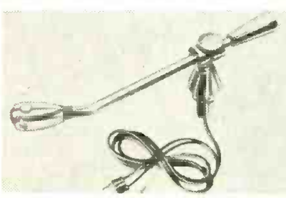
than stepped motor shaft.—**Electronic Instrument Co., Inc. (EICO)**, 33-00 Northern Blvd., Long Island City 1, N. Y.

STEREO CARTRIDGE *model M8D* for record changers. Response 30 to 15,000 cycles; channel separation at 1,000 cycles, more than 20 db. Tracking force 5 to 8 grams. Vertical and lateral compliance 3×10^{-6} cm/-



dyne. Output voltage 5 mv per channel. Recommended load impedance 47,000 ohms. — **Shure Brothers, Inc.**, 222 Hartrey Ave., Evanston, Ill.

PICKUP ARMS *Micropoise Model S-220*, 12 inches; *S-260*, 16 inches. Permanently attached cable has two color-coded plug-in leads, shields, ground wire. Gimbals have twin 5-ball 1-mm

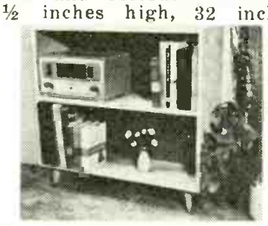


bearings. Plug-in low-resonance shell. Single-hole mounting. Stylus force adjustable 0–6 grams. —**Rek-O-Kut Co., Inc.**, 38-19 108 St., Corona 68, N. Y.

RECORD PROTECTOR, *Selecto* allows needle to be placed lightly anywhere on the record.

Small brush sweeps dust out of grooves ahead of needle.—**Duotone Co.**, Keyport, N. J.

BOOKCASE in unfinished birch holds hi-fi components, books and records. *Model 10* 29½ inches high, 32 inches



wide, 12 inches deep.—**Homewood Industries,** 26 Court St., Brooklyn 1, N. Y.

FM TUNER *model S-3000 III*. Inverse feedback improves response, lowers distortion. Space on chassis for plug-in multiplex adapter. Sensitivity 0.95 µv for

20-db quieting, 1.8 µv for 30 db. Response 20 to 20,000 cycles ±½ db. Hum and noise —60 db. Has automatic noise squelch. Muting eliminates hash.—**Sherwood Electronic Laboratories, Inc.**, 4300 N. California Ave., Chicago 18, Ill.

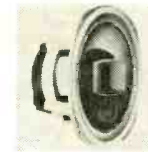
FM TUNER *model FM-50*. Response, 20 to 20,000 cycles ±1 db (including standard 75-µsec de-emphasis). Sensitivity 1.9 µv for 20-db quieting, IHFM standards. Multiplex-adapter output. Local–distant switch and agc.

Tuning meter may be used for level indicator when taping off air. Noise suppressor. If bandwidth —6 db at 200 kc. 2 amplifier, 2 recorder outputs.—**Fisher Radio Corp.**, 21-21 44th Dr., Long Island City 1, N. Y.

SPEAKER SWITCH *No. 1486*. Either main or remote or both pairs of stereo speakers may be used. Supplied with knob and

instructions.—**Centralab**, 900 E. Keefe Ave., Milwaukee 1, Wis.

COAXIAL SPEAKER. Improved version of *model 6201*. Response 28 to 18,500 cycles. Built-in 2,500-cycle crossover. Handles 35 watts. Brilliance control on 3-foot cable. Impedance 8–16 ohms.—**University**



Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.

MICROPHONES for home recording 12-foot cable. *Model 304C* (Ceramic): output level —60 db. *Model 304X* (crystal): output level —54 db. Both response 60 to 10,000 cycles. Desk

stand and lavalier assembly.—**Turner Microphone Co.**, 909 17th St. N. E., Cedar Rapids, Iowa.

TAPE HEAD for 4-track record and playback. Right- or left-hand mounted. Response to 15,000 cycles at 3¾ ips with standard compensation. Meets

dimensional requirements of EIA. — **Fidelitone, Inc.**, 6415 Ravenswood Ave., Chicago 26, Ill.

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Model 210

FOR BROADCAST AND HI-FI RECORDING

Crisp, clean sounds; vivid, high-note sounds; deep, low tone sounds . . . all reproduced faithfully — just as you hear them. Every subtle shading picked up without distortion. Has excellent suppression of unwanted background noise. Superior sensitivity and very high frequency range make the Model 210 ideal for monaural and stereo taping. The 210 Dynamic is electrically phased. Non-directional pattern to 2,000 cps, becomes somewhat directional at high frequencies. Response; 40 — 20,000 cps. Level; 50 ohm —86 db, 200 ohm —80 db (—59 db Ref Hi Z). Complete with 20-ft. rubber covered three conductor shielded cable. High impedance models also available. List Price $125.00.

Model 95D

FOR AMATEUR USE

The Turner Model 95D dynamic combines beautiful styling with good performance and economical price. Has high impedance wired single ended (single-conductor shielded 20-ft. cable). 50 and 200 ohm models wired for balanced line. Response; 100 — 10,000 cps. Level; —58 db. List price $37.50. List price with on-off switch $41.00.

Model SR90D

FOR MOBILE USE

Ideal hand-held mike for mobile communications. Clear voice reproduction. Designed to fit hand comfortably with switch in normal grip. Zinc alloy case in permanent satin chrome. The Turner Model SR90D is furnished with hook for hanging and bracket for wall or dash mounting. Response; 200 — 10,000 cps. Level; —48 db at high impedance. 11" (retracted) shielded Koiled Kord. List price $42.50.

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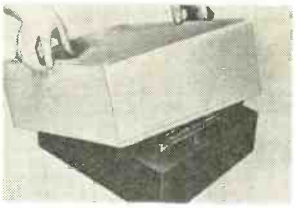
RIGID CHANGER COVERS. Heavy plastic on collapsible metal frame. *Models CC-6*, white; *CC-7*, brown; *CC-8*,



clear. 15½ x 12 x 5 inches.—**Robins Industries Corp.**, 36-27 Prince St., Flushing 54, N. Y.

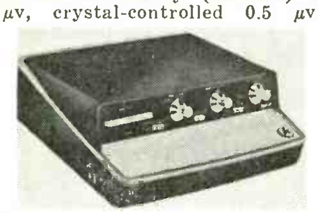
POWRPAGE *model PP-1T*. 25-watt transistor PA system. On phono with microphone button depressed, music level reduced 6 db so dubbed voice

can be heard. Leather carrying strap.—**University Loudspeakers, Inc.**, 80 S. Kensico Ave., White Plains, N. Y.

2-WAY RADIO TEST SET *Model 500* combination crystal checker, crystal-controlled rf signal source, field-strength indicator, monitor and transmitter tuning and loading aid. Self-contained and portable transistorized. Checks activity of fundamental and overtone type crystals, supplies unmodulated rf for checking receiver

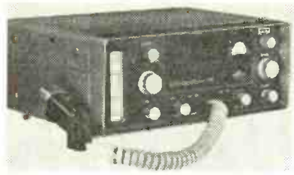
squelch action, modulated rf for peaking receiver circuits. May be modulated by external source. Transmitter modulation can be checked on meter and phones. 2¼ x 3¼ x 6¼ in., 1½ lbs. Supplied with battery and 15-foot remote cable. — **Seco Electronics, Inc.** 5015 Penn Ave. S., Minneapolis 19, Minn.

TRANSCEIVER KIT for Citizens band. *Knight-Kit C-27*. Crystal-controlled or tunable dual-conversion superhet receiver. Sensitivity (tunable) 1 μv, crystal-controlled 0.5 μv.



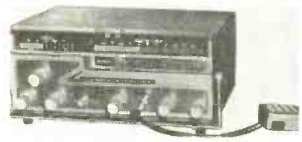
Input power 5 watts. Noise limiter and squelch. High-impact styrene case. — **Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

TRANSCEIVER *Communicator IV* for 2-meter amateur band. Triple-conversion receiver, high sensitivity, low noise. Power input 20 watts with 100% modulation (AM).



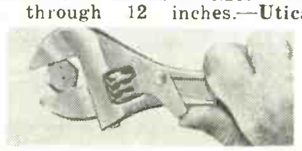
6 switched frequencies. Anl, squelch, panel-mounted speaker, sliderule dial. Built-in 117-volt ac and 12-volt dc power supply. 22 lbs.—**Gonset Div., Young Spring & Wire Corp.**, 801 S. Main St., Burbank, Calif.

TRANSCEIVER for 6-meter amateur band. Built-in vfo. *Mobiline Six* either mobile or fixed. Power supply 117 volts ac, 12 or 6 volts dc. 20 lbs. Final



amplifier 2E26 rated at 20 watts input. Built-in squelch.—**Globe Electronics**, 22-30 S. 34 St., Council Bluffs, Iowa.

ADJUSTABLE WRENCH. Jaws lock in any position. *Select-O-Lock* series in sizes from 4 through 12 inches.—**Utica**



Drop Forge & Tool Div., Kelsey-Hayes Co., Utica 4, N. Y.

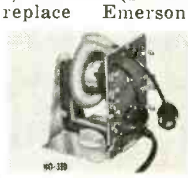
LOOP WRENCH, *Persuader*, turns round objects without scratching. Loop material will not soak up grease or oil. 4- and

5-inch loop sizes.—**Long Industries Inc.**, 15 N. Madison St., Chilton, Wis.

CONTACT CLEANER. *Liquid Burnisher*. Burnishes without scratching. Aerosol container with extension tube. Prevents rust, corrosion and pitting. No residue, will not stain. Noncon-

ductive, nonflammable and nontoxic.—**Tankit Co., Inc.**, 560 Belmont Ave., Newark, N. J.

FLYBACK TRANSFORMERS. Exact replacements. *Models HO-309, HO-310* (shown), *HO-311* replace Emerson Nos.



738138 (A), 738142, 738155, respectively. — **Chicago Standard Transformer Corp.**, 3501 Addison St., Chicago 18, Ill. END

All specifications on these pages are from manufacturer's data.

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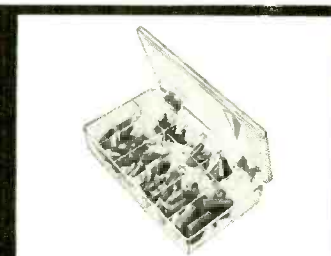
Handsome tan plastic, high impact cabinet with 9 drawers, contains 45 assorted Mylar*-paper Gold Dip capacitors, type 151. Practical . . . convenient . . . for storage in your shop, or home. Actual value of the Jewel Box with 45 Gold Dip capacitors—$19.50, dealer net only $9.25.

Gold Dip capacitors are also available in Clear-Vu paks . . . 5 to a package. Find them on Pyramid's new Whirl-o-mat on your favorite parts distributor counter.

"GOLD STANDARD" 111 KIT

Clear lucite hinged box containing 75 Pyramid's popular assorted Gold Standard Mylar* capacitors. You'll find so many uses for the Gold Standard 111 Kit. Actual value is $26.00, dealer net only $13.00.



515 LYTIK-KIT

Hinged cover, clear lucite box with 15 assorted miniature low voltage electrolytic capacitors for transistorized circuit replacements, type MLV. This Kit is a constant companion to any busy serviceman. Actual value, $20.60, dealer net only $10.30.

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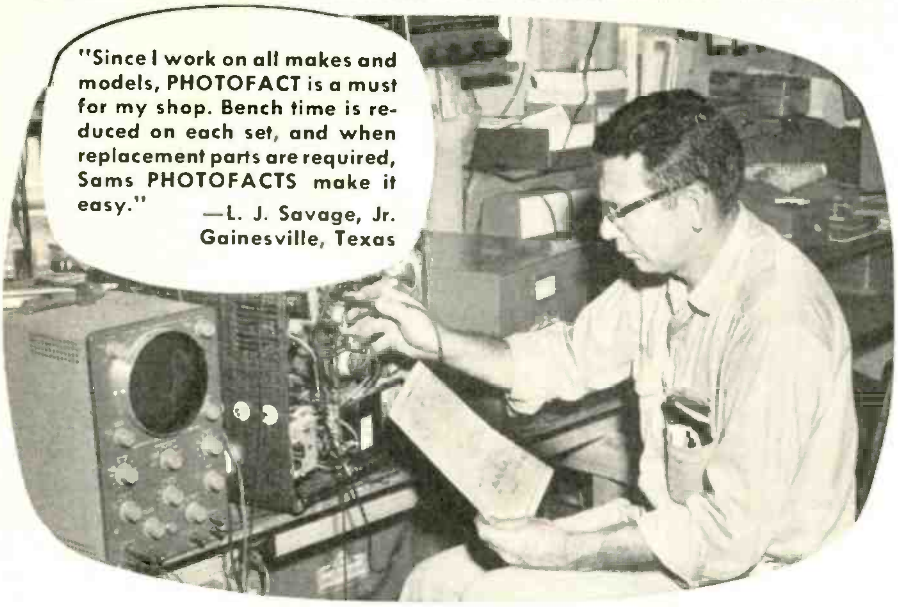

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TECHNICIANS' NEWS

VOLUNTARY LICENSING

The North Carolina Federation of Electronic Associations' training-and-licensing program is moving along in high gear, according to L. L. Leathers, chairman of the NCFEA Educational Committee.

The state has a three-part training program. Part I is for the man with little or no technical schooling. It is mostly math and theory. Part II covers TV servicing. Part III is advanced black-and-white and color TV.

In April of this year, the NCFEA adopted a resolution to license technicians. A man must have passed Part II of the training program or pass an exam given by the state's Department of Public Education to get a license.

The NCFEA has planned a large-scale program to let the public know that a man *must* be technically qualified to get the license.

AD PROGRAM

The Television & Electronic Service Association of Greater Buffalo (N.Y.) has undertaken a mass advertising program using newspapers, store displays and other media. The high point of the campaign is a triple guarantee offered by association members: a guarantee by the company that does the servicing, parts guarantee by the manufacturer and a guarantee backed by the association.

TRI-STATE TAKES ACTION

Service-charge questionnaires are being sent to all legitimate shops in the Delaware Valley area as the result of a plan adopted by the Tri-State Council of TV Service Associations. At their annual convention, Telerama '60, held at Atlantic City last June 24, 25 and 26, the council decided to attempt to arrive at definite conclusions as to *fair prices* for TV service.

According to a letter to RADIO-ELECTRONICS from Tony DeFranco, editor of the *Vanguard*, the plan is not to educate the public to accept higher and higher prices as such, but rather to make them realize that a technician *must charge a reasonable rate to make any profit.* "Everyone," he says, "knows that a profit must be made. To do this, a man must keep records, pay taxes and in general be a responsible business man. In return, the technician should get the respect of the manufacturer, distributor and the consumer." To do otherwise is

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to encourage the "illegitimate" part-timer and the "tube-jerker."

As to how to determine fair charges—that is up to the individual. The shop's overhead must be taken into account as well as what a technician would consider a fair-standard-of-living return (comparable to a similar profession).

Mr. DeFranco goes on to say that it is the responsibility of *all* concerned to intelligently explain to the consumer what shall be determined by each as a fair charge according to their technical know-how, etc. This can and should be accomplished by mass consumer education (locally and nationally), he says.

"This should be undertaken by groups in other sections of the country. With some concentrated publicity, *this business might be placed on the higher plane where it belongs*," he says.

FORM COUNCIL

A new group, the Washington State Electronic Council, has been formed by delegates from several sections of the state, according to *TSA Service News*.

Mr. Verne Slichter was elected chairman; Dean Thompson, vice chairman; and Ansel Heckman, secretary-treasurer.

The bylaws call for semi-annual meetings with other meetings as necessary.

Each local association will have two delegates to the council (two votes). Where no local associations exist, individual council members, one from each area, will have one vote.

Reports given by delegates at the first meeting indicated that all areas in the state [And most of the country. —*Editor*] are bothered by the same problems:

Retailing "distributors" who sell to everybody; illegal operators who pay no taxes; do-it-yourself tube testers (sometimes stocked with used or reject tubes); captive service, and the price-cutting untrained opportunist.

As one of its final acts at the meeting, the council adopted a resolution to introduce a licensing bill into the State Legislature in January.

APPLIANCE TECHS ALSO

The TV technician has long believed that he has been singled out from all the repair fraternity to bear the brunt of the customer's complaints of bad service, incompetence and sharp business practises. He is apparently not entirely alone. A group of appliance service dealers in the Long Island (N. Y.) area have formed the Association of Home Appliance Service Companies.

Mr. Jack Averbuch, head of the association, says the group was formed to combat the bad image the public has of technicians and eliminate petty bickering among the firms.

While most of the shops handle appliances only, one or two of them do some TV service work. According to Mr. Averbuch, the association and the Radio-TV Guild of Long Island may get together for cooperative advertising to try to improve public opinion of technicians in general.

The association also hopes to set up a service training school, get manufacturers to hold clinics in the area and set up a consumer charge plan. They are negotiating with a local bank to handle the plan at a cost of 1½% of the total charge. The group represents

SOUND OFF!

Since August, 1959, RADIO-ELECTRONICS has been publishing a list of technician's service associations. The areas covered so far (in the order they appeared) are: Pennsylvania, New York, Ohio, Iowa, North Carolina, Kansas, Arizona, Michigan, California, Ontario (Canada), Massachusetts, Missouri, Minnesota, Florida, Montana, Oregon and Texas. Sometime in the near future, depending on when we complete the individual area lists, we will reprint the entire list in one issue. **Will those associations whose officers are no longer as listed, please give us the names of the new secretary and president, and any changes of address or other useful information?**

We cannot list a state (or area) unless the associations in the area make their presence known. If your group has not yet been listed, *please send us the names and addresses of the officers and the association*. Please indicate which officer is to be contacted by potential members.

To list an association or to find out the name of the one nearest you, write to: Associations Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

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Will A. Shaw, executive secretary
1513 W. 7 St.
Fort Worth 3

ABILENE CHAPTER
W. O. Arnold, secretary
2417 S. 7 St.
Abilene

AUSTIN CHAPTER
Bond's Television Service
1014 W. Lynn St.
Austin 3

BEAUMONT CHAPTER
CERTIFIED ELECTRONIC RADIO & TV ASSOCIATION, INC.
W. E. Johnson, secretary
P. O. Box 2603
Beaumont

BIG SPRING CHAPTER
John Stanley, secretary
609 Gregg St.
Big Spring

CONROE CHAPTER
P. O. Box 1125
Cleveland

CORPUS CHRISTI CHAPTER
J. R. Williams, president
Box 3013
Corpus Christi

DALLAS CHAPTER
D. F. Comer, secretary
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J. B. Penny, secretary
PO Box 8725
Houston

LA MARQUE CHAPTER
MAINLAND ELECTRONICS & TELEVISION ASSOCIATION
Ray Peterson, secretary
PO Box 691
La Marque

LONGVIEW CHAPTER
W. L. Beasley, secretary
504 E. Methvin
Longview

MIDLAND CHAPTER
MIDLAND ASSOCIATION OF RADIO & TV SERVICE, INC.
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311 E. Dodson
Midland

OAK CLIFF CHAPTER
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SABINE AREA TV & RADIO ASSOCIATION
Grady Jackson, secretary
711 Stadium Rd.
Port Arthur

SAN ANTONIO CHAPTER
Ralph McCoy, president
2225 Blanco Rd.
San Antonio

TESA-BORGER
Ray Samberson, NATESA director
214 N. Hedgecoke St.
Borger

TESA-HOUSTON
F. B. Koepnick, secretary
1822 Berry Rd.
Houston

TESA-TEXARKANA
Ward Brackeen, NATESA, director
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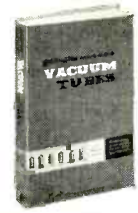

The author of the CBS "Tech Tip" series has come up with a "must" book for every technician, designer and engineer. Vacuum tubes account for nearly 80% of equipment failures—yet according to Bud Tomer this doesn't have to be! He explains why tubes fail and what can be done to obtain maximum tube life and usage. Covers characteristic variables and how to predict them; selected and premium tubes; why so many tube types; predicting performance; special-purpose tubes; tube testing; methods for lengthening tube life, etc. 160 p., 5½x8½", hardbound. *Only* $3.50

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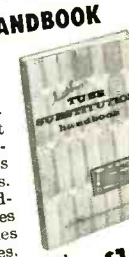

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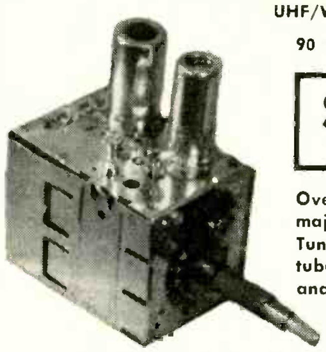

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about 14 companies or about 100 technicians.

One idea used by association members might be adaptable by TV service associations. If a technician needs a replacement part and is quite a distance from his shop, he can pick up the part at the nearest member shop and charge it to his shop.

FIRST LADY

The Radio Television Technicians Association of California, Inc., Pasadena Chapter, now has its first lady member, Mrs. Frances Sheppard of Sheppcraft Electronics. She is one of the several technicians who have joined up since the start of RTTA's membership drive, "60 in 60."

WARNING

NATESA Scope warns that it is possible for a customer to get a dangerous shock when using a transistor-radio battery charger. When selling one of these units, be sure to instruct the customer to insert the line plug *after* the battery is in place and remove the plug *before* removing the battery.

HELD COURSE

Tired of sitting around, complaining about their problems and doing nothing, Dayton Area TESA (Ohio) organized a course on business management, says *TESA News* (Dayton Area). The course was conducted by Dr. John K. Pfaul, associate professor of business administration at Ohio State University. Dr. Pfaul prepared the General Electric Co.'s profitable service management course.

The course was sponsored jointly by Dayton Area TESA and SREPCO, a local distributor. It was held in four parts, one each Wednesday evening in July.

CHECK THOSE LEAD-INS

A live cabinet or lead-in *can* be dangerous. Edgar G. Shelton Jr., an ABC vice president, received a full-line-voltage shock while cleaning leaves out of a copper rain gutter on his house. A short in his TV had applied line voltage to the antenna lead-in which apparently shorted to the gutter.

Always use a meter or neon tester to check for a live cabinet or lead-in as the last step before handing the customer your bill. A set that is "cold" at the shop may be "hot" when plugged in at the customer's house (insulators have been known to break and tuners to shift).

It takes only a few seconds to make this check and it may uncover a dangerous situation. As a final precaution on ac-dc sets, make sure the line plug is in the socket in such a way as to keep the chassis at ground potential.

CHAPTER OFFICERS

The San Fernando Valley Chapter of California State Electronics Association (CSEA) has elected Ernest C. Larsen, president; Conrad Breil, vice president, and Ed Stevens, secretary-treasurer. END

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Technotes

SYLVANIA PHONO MODEL 4312

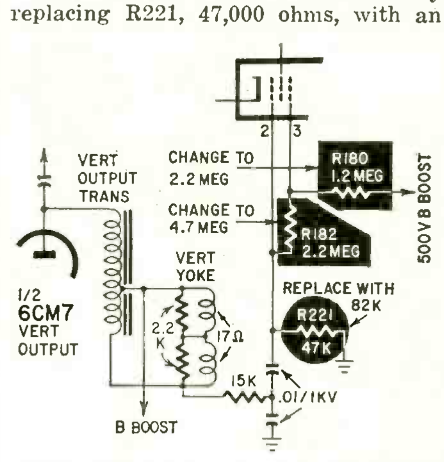
A couple of these sets came into the shop with the same complaint—they wouldn't work. In each set one of the series-string heaters was open. Upon replacing the bad tube, the sets still wouldn't work. A check showed burnt-out silicon rectifiers, no B-plus. Replacing the rectifier with a 150-ma selenium unit put the phonos back into operation.

What had been happening was described in a Sylvania *Service Digest.* If the receiver was on when the tube burned out and was then turned off, the collapsing field produced by the phono motor would kick back across the rectifier, shorting it out. Ordinarily, the load of the heater string damps the kickback but, when one tube's heater is open, there is no longer any such protection. The 150-ma selenium rectifier used as a replacement has a higher inverse voltage rating and is not damaged by such a kickback.—*C. S. Lawrence*

G-E 17P1330

Complaint: Poor vertical blanking. Shows up as faint white retrace lines in the picture.

This trouble can be corrected by replacing R221, 47,000 ohms, with an



82,000-ohm resistor. As changing R221's value results in a dc voltage change in the circuit, resistors R182 must be changed from 2.2 to 4.7 megohms and R180 should be changed from 1.2 to 2.2 megohms.—*Al Black*

TAPE-RECORDER WOW

I have found that tape-recorder wow problems are often caused by power-consuming appliances such as electric toasters, irons, refrigerators and stoves. The heavy current drawn by them causes the line voltage to fluctuate. This in turn makes the recorder motor wow.

Since it is virtually impossible to

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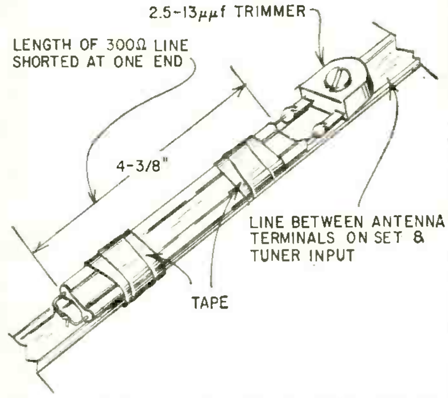
predict when such appliances in the neighborhood are going to be turned on or off, I find that countermeasures must be taken at the recorder to minimize or eliminate the trouble. Connecting a constant-voltage transformer or voltage regulator between the power line and the recorder input will often correct or minimize the distortion.—*John A. Comstock*

FM INTERFERENCE

Frequency-modulation interference shows up as diagonal bars or a herringbone pattern on the picture tube. A direct FM signal overloads the TV set's tuner, creating cross-modulation which can fall on any TV channel.



A second harmonic of an FM signal falling on a high-band TV channel can do the same thing. It is also caused by an FM station on an image frequency of a low-channel TV station.

To stop this type of interference, carefully adjust the FM trap in the receiver to attenuate the interfering signal. In severe cases, an additional trap may be needed. Details of such a trap—designed for installation in the transmission line—are shown in the diagram. The trap should be tuned to the interfering signal and installed at the antenna input.—*C. S. Lawrence*

CORONA CURE

Several TV receivers have insufficient clearance between the 1B3-GT high-voltage rectifier cap and the top of the high-voltage cage. Corona or arcing results (especially in damp weather) which is hard to cure with corona dope. A sure cure for this condition is to replace the 1B3-GT with a 1G3-GT. The 1G3 is electrically identical to the 1B3 but more than ½ inch shorter. This additional clearance will completely eliminate any corona or arcing from the high-voltage rectifier plate cap.—*Albert J. Krukowski*

PHILCO P5703

This hybrid auto radio came into the shop with a complaint of no sound. A burned-out fixed bias resistor (0.27 ohm) in the audio output stage pointed to the trouble. An ohmmeter check showed that the AR-6 transistor used in this stage had failed. (Forward and reverse resistances were approximately the same.)

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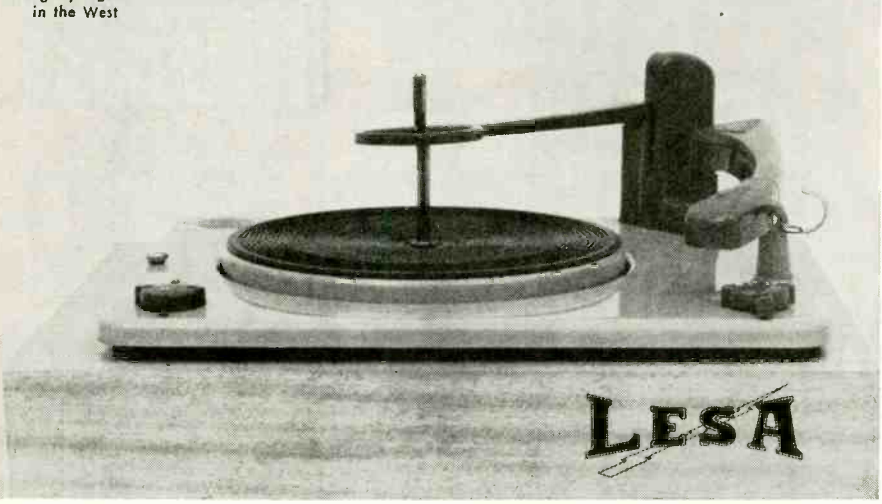

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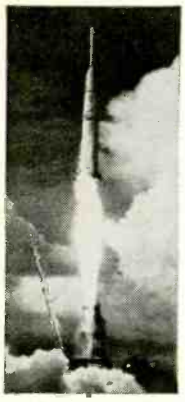

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did not have an AR-6. The AR-8A he substituted was the pin type; the original has coded, flexible leads. Fortunately, the heat sink had been drilled to take either type, so mounting was no problem. Some clips that came with a phono cartridge fit snugly on the transistor pins and made good connectors. I cut the leads close to the original transistor and removed and discarded it. Then I soldered one clip to the yellow (emitter) lead and one to the black (base) lead. The red (collector) lead I eliminated as the case of the pin type transistor is the collector and is automatically connected to the heat sink when mounted. (The heat sink on this model is isolated from chassis ground.)

After replacing the 0.27-ohm fixed bias resistor, I mounted the new transistor, first noting carefully which pin was marked B (base) on the case. To this pin I connected the black lead. The yellow lead I connected to the remaining (emitter) pin. Be careful not to push the clips so far down on the pins that they short to the heat sink and ruin the transistor.

Collector current should be adjusted for 750 ma. Connect a voltmeter between the heat sink and chassis and adjust collector current for a 0.75-volt drop across the output transformer primary with no signal and 14.0 volts input.—*Chase Bass* END

CORRECTIONS

There are two errors in the article on the subminiature tape recorder beginning on page 76 of the July issue. The diagram of the record amplifier at the bottom of page 77 is Fig. 4, not Fig. 5 as indicated in the caption. On page 78, fifth line of the third column, change C10 to C11.

Our thanks to N. M. Haynes, Amplifier Corp. of America, New York, N. Y., for calling these errors to our attention.

The transformers are labeled incorrectly in the photo of the Super Eight radio on page 44 of the August issue and do not agree with the schematic and parts list. To correct the photo callouts, change L1 to T1, L2 to T2, T1 to T3, T2 to T4, T3 to T5, T4 to T6 and T5 to T7.

We thank Mr. William J. Studlez, of Milwaukee, Wis., for this correction.

"Just a few changes I made in my radio pill."

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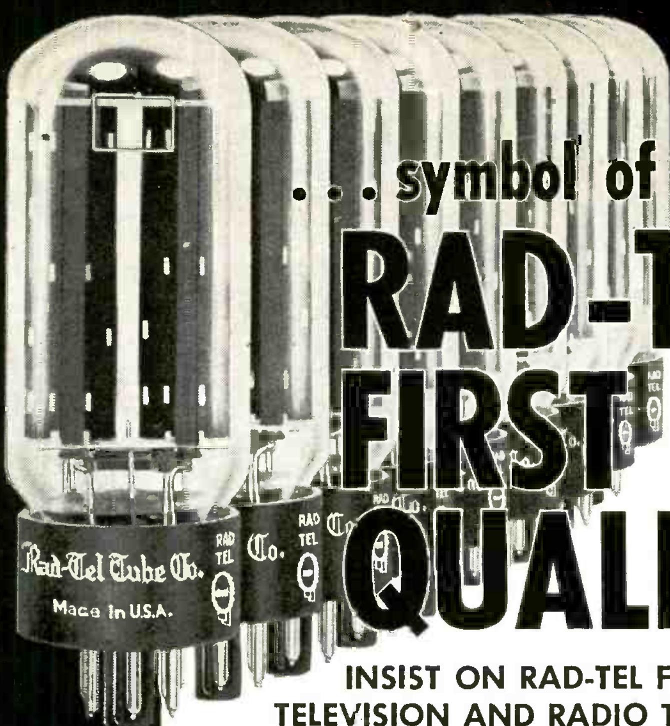

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___	1J3	.73
___	1K3	.73
___	1L6	1.05
___	1LN5	.59
___	1R5	.62
___	1S5	.51
___	1T4	.58
___	1U4	.57
___	1U5	.50
___	1X2B	.82
___	2AF4	.96
___	3AL5	.42
___	3AU6	.51
___	3AV6	.41
___	3BA6	.51
___	3BC5	.54
___	3BE6	.52
___	3BN6	.76
___	3BU8	.78
___	3BY6	.55
___	3BZ6	.55
___	3CB6	.54
___	3CF6	.60
___	3CS6	.52
___	3CY5	.71
___	3DK6	.60

Qty.	Type	Price
___	3DT6	.50
___	3Q5	.80
___	3S4	.61
___	3V4	.58
___	4BC5	.56
___	4BC8	.96
___	4BN6	.75
___	4BQ7	.96
___	4BS8	.98
___	4BU8	.71
___	4BZ6	.58
___	4BZ7	.96
___	4CS6	.61
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___	4DT6	.55
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___	5AT8	.80
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___	5BQ7	.97
___	5BR8	.79
___	5CG8	.76
___	5CL8	.76
___	5EA8	.80
___	5EU8	.80
___	5J6	.68
___	5T8	.81
___	5U4	.60
___	5U8	.81
___	5V6	.56
___	5X8	.78
___	5Y3	.46

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___	6AT8	.79
___	6AU4	.82
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___	6AU7	.61
___	6AU8	.87
___	6AV6	.40
___	6AW8	.89
___	6AX4	.65
___	6AX7	.64
___	6BA6	.49
___	6BC5	.54
___	6BC7	.94
___	6BC8	.97
___	6BD6	.58
___	6BE6	.55
___	6BF6	.44
___	6BG6	1.66
___	6BH6	.65
___	6BH8	.87

Qty.	Type	Price
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___	6BK7	.85
___	6BL7	1.00
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___	6BN6	.74
___	6BQ5	.65
___	6BQ6GT	1.05
___	6BQ7	.95
___	6BR8	.78
___	6BU8	.70
___	6BY6	.54
___	6BZ6	.54
___	6BZ7	.97
___	6C4	.43
___	6CB6	.54
___	6CD6	1.42
___	6CF6	.64
___	6CG7	.60
___	6CG8	.77
___	6CM7	.66
___	6CN7	.65
___	6CR6	.51
___	6CS6	.57
___	6CU5	.58
___	6CU6	1.08
___	6CY5	.70
___	6CY7	.71
___	6DA4	.68
___	6DB5	.69
___	6DE6	.58
___	6DG6	.59
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___	6DT5	.66
___	6DT6	.53

Qty.	Type	Price
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___	6J6	.67
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___	6V6GT	.54
___	6W4	.57
___	6W6	.69
___	6X4	.39
___	6X5GT	.53
___	6X8	.77
___	7AU7	.61
___	7A8	.68
___	7B6	.69
___	7Y4	.69
___	8AU8	.83
___	8AW8	.93
___	8BQ5	.60
___	8CG7	.62
___	8CM7	.68
___	8CN7	.97
___	8CX8	.93
___	8EB8	.94
___	10DA7	.71
___	11CY7	.75

Qty.	Type	Price
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___	12AC6	.49
___	12AD6	.57
___	12AE6	.43
___	12AF3	.73
___	12AF6	.49
___	12AJ6	.46
___	12AL5	.45
___	12AL8	.95
___	12AQ5	.52
___	12AT6	.43
___	12AT7	.76
___	12AU6	.50
___	12AU7	.60
___	12AV5	.97
___	12AV6	.41
___	12AV7	.75
___	12AX4	.67
___	12AX7	.63
___	12AZ7	.86
___	12B4	.63
___	12BA6	.50

Qty.	Type	Price
___	12BD6	.50
___	12BE6	.53
___	12BF6	.44
___	12BH7	.73
___	12BL6	.56
___	12BQ6	1.06
___	12BY7	.74
___	12BZ7	.75
___	12C5	.56
___	12CA5	.59
___	12CN5	.56
___	12CR6	.54
___	12CU5	.58
___	12CU6	1.06
___	12CX6	.54
___	12DB5	.69
___	12DE8	.75
___	12DL8	.85
___	12DM7	.67
___	12DQ6	1.04
___	12DS7	.79
___	12DZ6	.56
___	12EL6	.50

Qty.	Type	Price
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___	12EZ6	.53
___	12F5	.66
___	12F8	.66
___	12FM6	.45
___	12K5	.65
___	12SA7M	.86
___	12SN7GT	.74
___	12SN7	.67
___	12SQ7M	.73
___	12U7	.62
___	12V6GT	.53
___	12W6	.69
___	12X4	.38
___	17AX4	.67
___	17BQ6	1.09
___	17C5	.58
___	17CA5	.62
___	17D4	.69
___	17DQ6	1.06
___	17L6	.58
___	17W6	.70
___	19AU4	.83

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___	19T8	.80
___	21EX6	1.49
___	25BQ6	1.11
___	25C5	.53
___	25CA5	.59
___	25CD6	1.44
___	25CU6	1.11
___	25DN6	1.42
___	25EH5	.55
___	25L6	.57
___	25W4	.68
___	25Z6	.66
___	35C5	.51
___	35L6	.57
___	35W4	.52
___	35Z5GT	.60
___	50B5	.60
___	50C5	.53
___	50DC4	.37
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new PATENTS

ALERTNESS INDICATOR

Patent No. 2,902,030

John L. Kennedy, Santa Monica, and Roland C. Travis, Highland, Calif., and Bertram Wellman, Lincoln, Mass.

Alertness can be measured by checking the time lag between a given stimulus and the corresponding response from an individual. It is an important factor for airplane pilots or persons doing monotonous or fatiguing work. A definite relation between alertness and certain bioelectric potentials within the body has been found by the inventors. These occur at frequencies above 40 cycles and can be measured through metallic contacts placed on the forehead.

Fig. 1 shows how muscle potentials vary with alertness. When alertness is low (when a person is tired or drowsy), there is considerable time delay between stimulus and response. The energy generated at certain muscles is very weak. When the individual is alert, the energy pulses are much stronger.

A block diagram of this invention appears in Fig. 2. The muscle signals are amplified, filtered to remove frequencies below 40 cycles (which

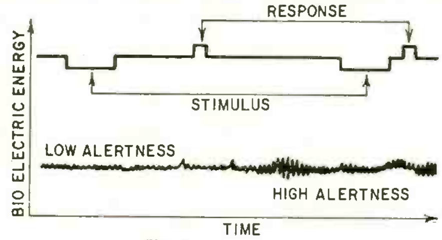


Fig. 1

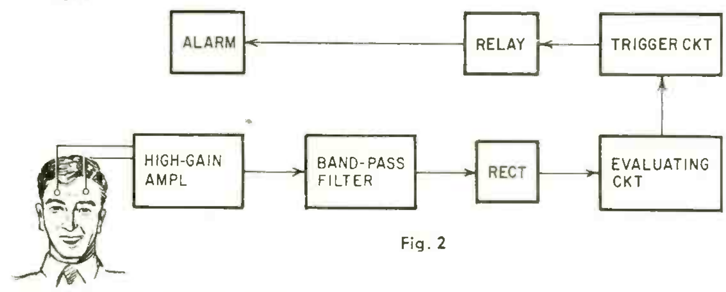
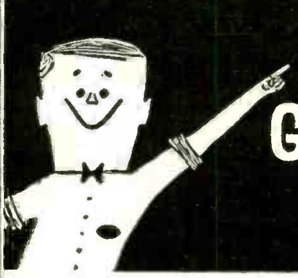


Fig. 2



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are mainly brain waves) and rectified. An evaluating network integrates the pulsed energy to measure the average alertness over a predetermined period. When alertness falls below a critical point, trigger pulses are generated to operate a relay and sound an alarm.

ULTRASONIC SYSTEM FOR MOTION STUDY

Patent No. 2,914,730

Gerald N. Nadler, Olivette, and Jay N. Goldman, Richmond Heights, Mo.

Doppler effect is the shift in frequency when a signal source moves toward or away from an observer. For example, the sound of a fire engine seems higher when it is approaching than when receding.

The effect is used here for time and motion study. A tiny untrasonic sound source is attached to the hand of a worker to analyze his motion. This sound is received by three microphones along perpendicular axes. The sound is converted to voltage and recorded. From the change in pitch, it is possible to determine instantaneous hand velocity.

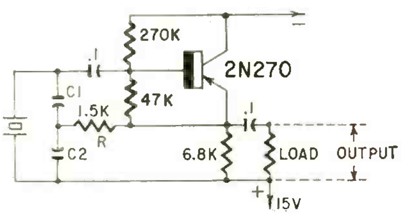
Actually, the ultrasonic frequency (20 kc) is mixed with a local frequency (21 kc) before it is analyzed. Thus the shift is relatively large compared with the beat (1 kc). A Doppler change of 186 cycles is observed for a velocity of 10 feet a second.

STABLE OSCILLATOR

Patent No. 2,930,002

Norman E. Edwards and Anthony W. Muoio Haddonfield, N. J. (Assigned to Radio Corp. of America)

This circuit is so stable that it shows less than 1-cycle variation when various transistors are used. Also no frequency change occurs when voltage is varied over a wide range.



The following table shows suggested values for C1 and C2:

	below 75 kc	*above 75 kc*
C1	940 $\mu\mu f$	470 $\mu\mu f$
C2	.00147 μf	470 $\mu\mu f$

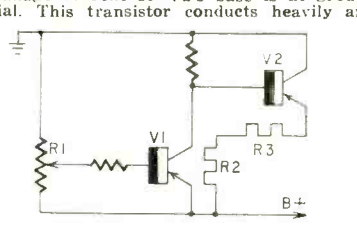
TRANSISTORIZED THERMOSTAT

Patent No. 2,932,714

John B. Merrill, Rochester, N. Y. (Assigned to General Dynamics Corp., Rochester, N. Y.)

This heat regulator uses a pair of transistors. V2 should be a high-power transistor.

At low ambient temperatures, V1 has nearly zero leakage current so V2's base is at ground potential. This transistor conducts heavily and



considerable current passes through heater coils R2 and R3. At higher ambient, V1's greater leakage current biases V2 to lower its conduction. Thus R1, R2 temperatures are lower to compensate for the higher ambient.

When R1 is properly adjusted, the heater coils are maintained at nearly constant temperature. They may be used to regulate the temperature of a transistor (see R2 alongside V1) or any other device. END

HONEST—I'M HONEST!

By Phyllis Barlow

She said she wouldn't pay her bill.
Her reason had me floored!
She said she heard me plainly say,
I'd used a "cheater cord"!

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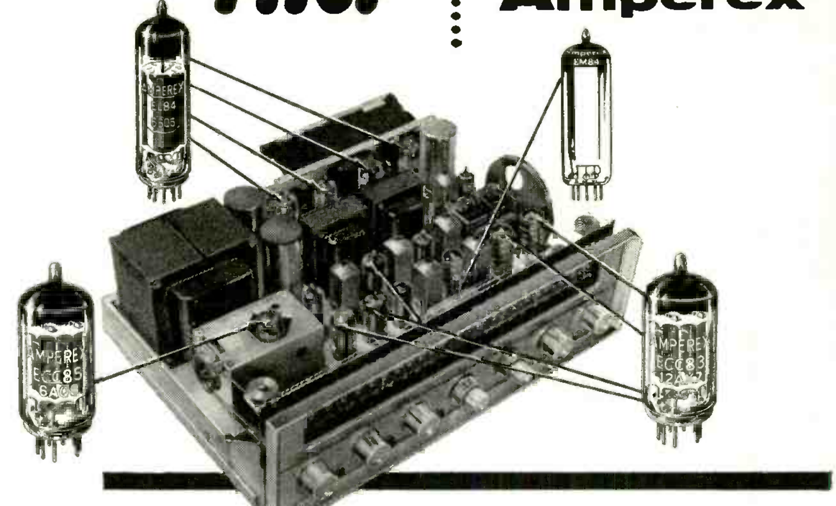

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- 7189: 20 w., push-pull
- 6BQ5/EL84: 17 w., push-pull
- 6CW5/EL86: 25 w., high current, low voltage
- 6BM8/ECL82: Triode-pentode, 8 w., push-pull

VOLTAGE AMPLIFIERS
- 6267/EF86: Pentode for pre-amps
- 12AT7/ECC81:, 12AU7/ECC82:, 12AX7/ECC83: Twin triodes, low hum, noise and microphonics
- 6BL8/ECF80: High gain, triode-pentode, low hum, noise and microphonics

RF AMPLIFIERS
- 6ES8: Frame grid twin triode
- 6ER5: Frame grid shielded triode
- 6EH7/EF183: Frame grid pentode for IF, remote cut-off
- 6EJ7/EF184: Frame grid pentode for IF, sharp cut-off
- 6AQ8/ECC85: Dual triode for FM tuners
- 6DC8/EBF89: Duo-diode pentode

RECTIFIERS
- 6V4/EZ80: Indirectly heated, 90 mA
- 6CA4/EZ81: Indirectly heated, 150 mA
- 5AR4/GZ34: Indirectly heated, 250 mA

INDICATORS
- 6FG6/EM84: Bar pattern
- IM3/DM70: Subminiature "exclamation" pattern

SEMICONDUCTORS
- 2N1517: RF transistor, 70 mc
- 2N1516: RF transistor, 70 mc
- 2N1515: RF transistor, 70 mc
- IN542: Matched pair discriminator diodes
- IN87A: AM detector diode, subminiature

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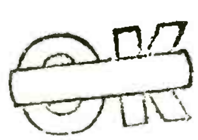

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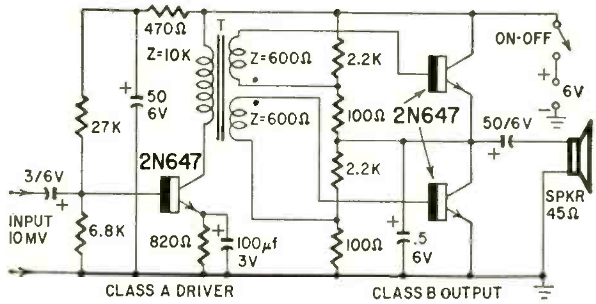
The compact amplifier delivers 100 mw with a 10-mv input. Maximum harmonic distortion at this output is 10%.—*RCA Transistor Data Sheet*



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But for a successful service job, the customer's cost must also be kept in mind. If reception (noise-free) is too expensive, a lot of people just won't use their radios, and others may decide to endure the noise. This definitely means the simplest and lowest-cost filter circuits should be the ones that you try first.

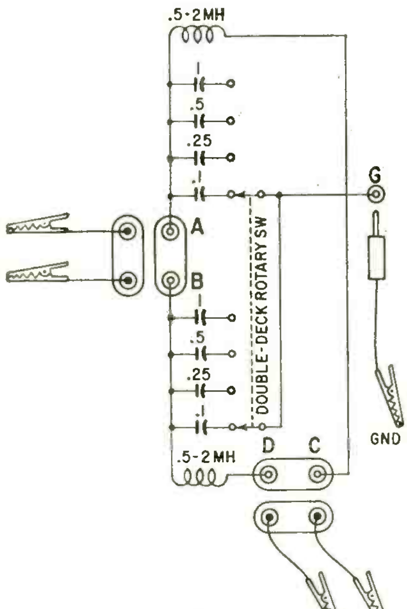

Fig.1

Fig. 1 shows a variable filter system used with a rotary double-deck switch. By changing the setting of the switch and connections, six types of filters can be used (Fig. 2) to find which is the

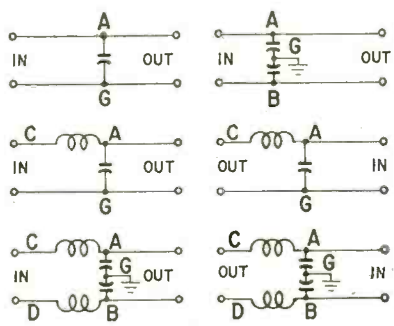

Fig.2

best cure for the interference present. The components for this variable filter unit can be bought at your local electronic parts distributor. All the capacitors in the circuit should be rated at not less than 600 volts. The choke coils should be able to handle at least 6 amperes. This unit is connected to the ac line. Use an insulated case and make sure the switch shaft is not hot. The alligator clips must be insulated and handled with care.

I mounted this simple circuit in a small wooden box with a clear plastic top. Single chokes, capacitors and filters can be obtained by using one lead at A and one at C or G. When using capacitors alone, always start with the lowest capacitance. Increase the capacitance to 1 μf before using the chokes.
—*George E. Lytle* END

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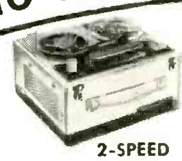

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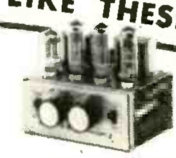

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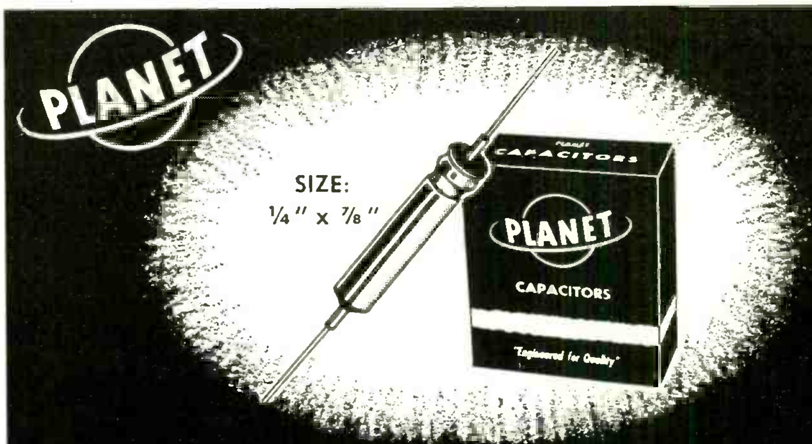

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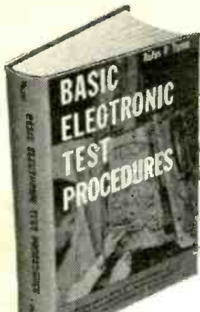

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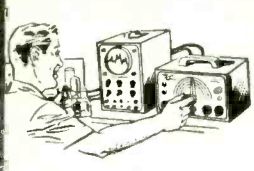

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TEST-LEAD EXTENSIONS

Here are three wire extensions that are useful with phone-tip type test prods. I formed the ones I made from plastic-covered bell wire but any insulated No. 20 or No. 22 solid-copper wire may be used. Bend a hook on the end of one (Fig. 1) and it can be hung on leads and socket lugs. Leave 1/64 inch of bare wire extending beyond the spaghetti (Fig. 2) and it is handy for taking readings down under a jumble of wires in some "New York Subway"

Fig.1

Fig.2

Fig.3

chassis. Fig. 3 shows an extender that has its end bent into a clip.

The prod tip against the spaghetti of the extender holds the extension firmly in place but it's better to put a rubber band over the prod tip and pigtail of the extender to be sure.—*Frank W. Dresser.*

HOME-MADE CABLE CONNECTORS

When a plug and socket connector of the seven- or nine-pin variety is not readily available . . . you can make one out of two miniature sockets and an ordinary paper clip. Cut the clip into ½-inch lengths, insert in the tube end of one socket and solder in place. This makes the male plug. The other socket of course is the female connector.—*J. Simrin*

DOUBLE CLIPS ARE USEFUL

I have found that, by fastening two ordinary test clips together, they can be made into "twin-clips" and their usefulness around the shop greatly improved. They can be used for making fast temporary connections, for increasing or decreasing the value of components by connecting them in series or parallel, or for clipping a test prod to a wire or terminal. I often use the clips to hold a part reminder or note to a chassis.

To fasten two clips together, simply cut off the wire supports at the rear of each clip, remove the screws and use

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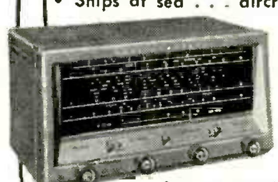

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just one screw to fasten both clips together. Twin clips are also sold commercially, but are not always obtainable.—*Albert Mason*

(Try connecting them with about an inch of flexible wire between clips—much more versatile.—*Editor*)

LIQUID METAL ANCHORS WIRE

When you need some sort of clamp to keep a long insulated wire positioned correctly, Duro plastic aluminum or

steel can be used as liquid metal for making wire anchors. Apply the liquid to the wire and to a spot on the chassis as shown. The liquid will dry metal-hard and hold the wire securely in place. —*James C. Conrad*

CRT CLEANING AID

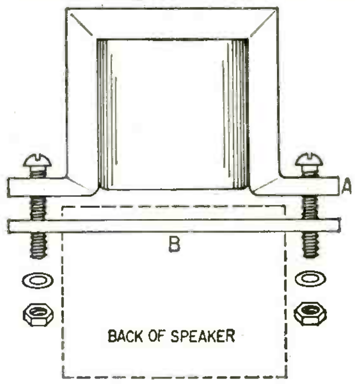
Many TV house calls are for a familiar trouble—a dim picture due to a heavy coating of dirt on the CRT and safety glass. Most technicians rely on the customer to provide the cleaning materials for this job, but all too often none are readily available.

I solved this problem by equipping my tube caddie with a plastic spray bottle, such as used for deodorants, filled with a 10% solution of ammonia and water. The tops of most spray bottles are easily removed for quick filling.

This handy applicator makes the job of cleaning CRT's and safety glass an easy job.—*A. J. Krukowski*

MOUNTING SPEAKER TRANSFORMERS

When you fit a new output transformer onto an old speaker, the mounting holes are rarely in the same place and, if you are not careful, you can spend a lot of time getting it on firmly. Stop fiddling around with it. Cut a narrow strip of metal just long enough and wide enough to cover the trans-



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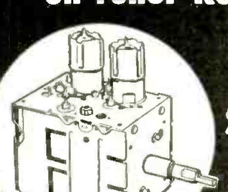

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Tarzian-made tuners are easily identified by this stamping on the unit. When inquiring about service or replacements for other than Tarzian-made tuners, always give tube complement . . . shaft length . . . filament voltage . . . series or shunt heater . . . IF frequency, chassis identification and allow a little more time for service. Use this address for fast, 48-hour service:

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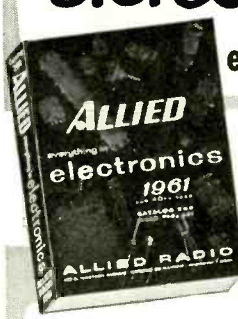

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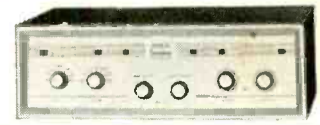

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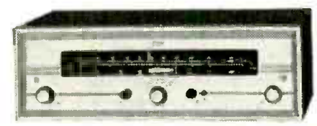

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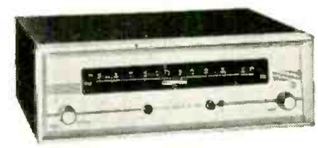

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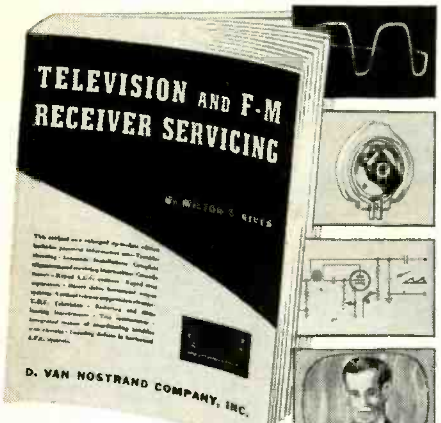

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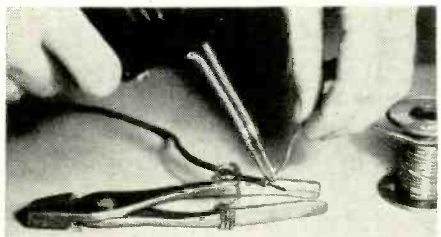
former mounting lugs. Drill two holes to match those on the replacement transformer. Now slip the metal strip through the square mount at the back of the speaker and mount the transformer on top, securing it with two small nuts and bolts. The sketch is easy to follow.—*Thomas Crowe*

SOLDERING AID

You can hold a wire still while you tin its tip by using a spiral of solder



wrapped around a heavy tool such as a pair of pliers. Small parts can be held the same way. Try this "second-hand" idea sometime.—*Joe C. Allen*

PARTS SUBSTITUTION IN DOGS

When working on an exceptionally tough "dog" where the only recourse is to change parts one after another until the bad one is tagged, I use a simple method to keep track of what's going on. On a blank piece of paper I sketch in the base diagram of the tube in the circuit in question and then draw each component as it is checked. In this way I know that each part that has been drawn in is known good and all missing components are still in doubt.—*Frank A. Salerno*

END

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

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

In September, 1910, *Modern Electrics*

Wireless and Automobiles, by René Homer.
A Unique Method to Transmit Pictures.
Condenser Radiophone.
Wireless in Watch.
Why Do Wireless Waves Travel Farther By Night Than by Day?, by George F. Worts.
A Good Transmitting Condenser, by Richard U. Clark.
How to Make a Bicycle Wireless Outfit, by William Dettmer.
A Very Efficient Perikon Detector, by H. A. Lake.
A Break-In Key, by M. H. Hammerly.
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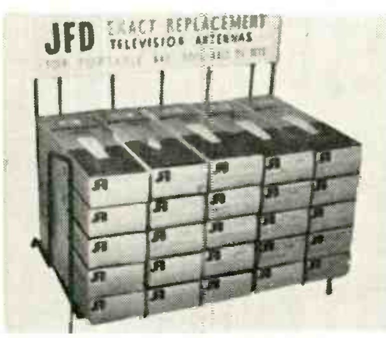
Cornell-Dubilier Electronics Div. announced another in its series of special 50th anniversary dealer–service-technician capacitor promotions—the CDE Sweet Deal kit made up of 45 minia-

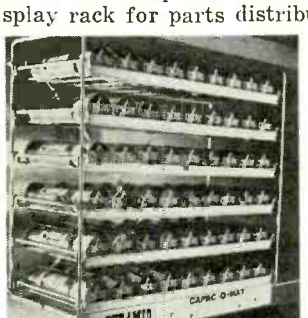
turized dipped silver-mica capacitors housed in a clear plastic compartmented dispenser. Dave Prepon (behind counter) of Aaron Lippman & Co., Newark, N. J., explains the Sweet Deal offer.

JFD Electronics, Brooklyn, N. Y., is offering dealers a new wrought-iron



merchandiser for its exact replacement TV antennas for portable and tote-able receivers.

Pyramid Electric Co., Darlington, S. C., designed a new Capac-o-mat storage and display rack for parts distributors.



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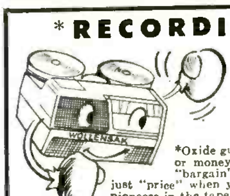

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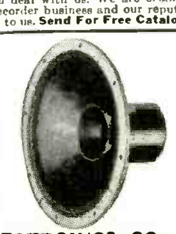

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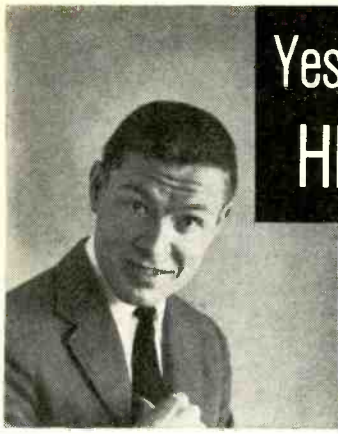

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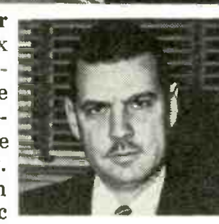

Edward E. Bauer joined Aerovox Corp., New Bedford, Mass., as vice president and general manager of the New Bedford Div. He comes from General Electric where he was general manager of the Irmo, S. C., capacitor plant.

Harold A. Goldsmith, co-founder of Magnetic Amplifiers, Inc. recently merged with Siegler Corp., was appointed president of Bogen-Presto Div. of Siegler Corp., Paramus, N. J.

Ray D. Barr joined Globe Electronics, a division of Textron Electronics, Council Bluffs, Iowa, as vice president and controller. He had been with Carpenter Paper Co.

Albert Coumont was appointed sales manager of Sprague Products Co., North Adams, Mass. He joined the company in 1956 as assistant to the president. He will

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be responsible for management of field sales. **Harry Kalker**, president, will continue as chief executive officer with responsibilities for setting corporate policies and internal management.

R. R. Forbes was appointed manager of the Semiconductor Dept. of P. R. Mallory & Co., Elkon Div., Du Quoin, Ill. He had been sales manager of the division.

Donald Gorham joined Vocaline Co. of America, Old Saybrook, Conn., in a technical position in the Electronics Products Div. He had been senior calibration technician with Avco Lycoming Missile Div.

Rene Snepvangers joined Electrosonic Laboratories, Inc., Long Island City, N. Y., as director of Engineering. An audio pioneer instrumental in the development of the LP record, he was most recently with Fairchild Recording Equipment Corp.

EIA PRODUCTION AND SALES

(First 5 months)	*1960*	*1959*
TV production	2,444,174	2,211,712
Radio production	6,973,069	5,677,421
FM radio production	295,297	172,640
TV retail sales	2,285,866	1,919,162
Radio retail sales*	3,175,469	2,480,686
TV picture-tube factory sales	3,697, 969	3,603,969
TV receiving-tube factory sales	160,574,000	164,558,000

*Excluding auto radios.

END

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- ☐ **TRANSMITTER**, Code #925327, 100 milliwatt, 27 mc., crystal controlled, citizens band, completely transistorized. Shirt pocket size. $18.99 ea. 2 for $19.99.
- ☐ **CONVERTER**, Code #260270, adapts any broadcast radio to 27 mc. citizens band. Tunes all 22 channels. $14.99 ea. 2 for $15.99.
- ☐ **CONVERTER**, Code #926027, similar to above except uses 3 high frequency transistors. Operates on 6 or 12 volts. $24.99 ea. 2 for $25.99.
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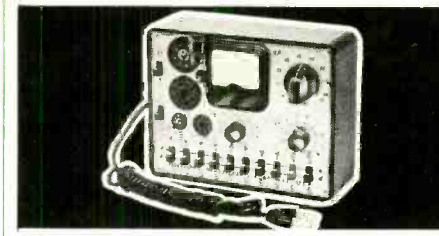

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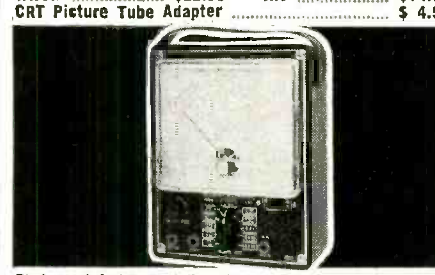

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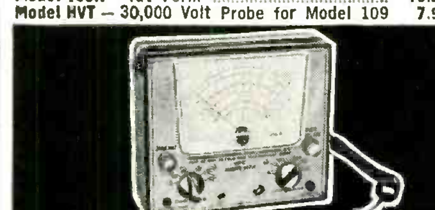

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INDEX lists most radio and TV sets and the corresponding Supreme repair manual. TV manuals cover sets back to 1948 while radio manuals go back to 1926.—**Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill.

CATALOG *No. 60 (Microwave Rf–If Equipment)* has 32 pages of information on microwave-receiver front ends, miniature and subminiature preamplifiers, mixer–preamplifier assemblies, aircraft-crash locator beacons and afc units.—**LEL, Inc.,** 380 Oak St., Copiague, N. Y.

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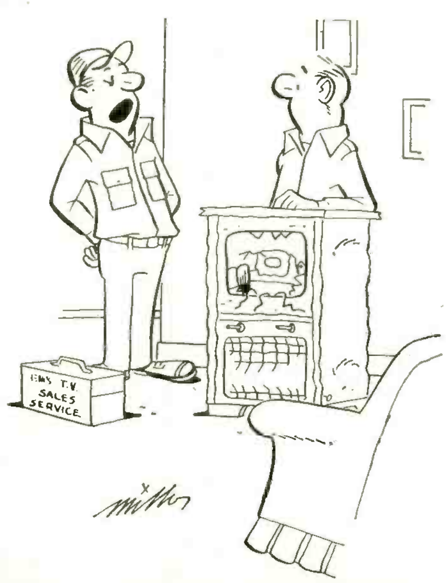

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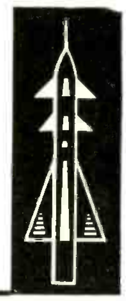

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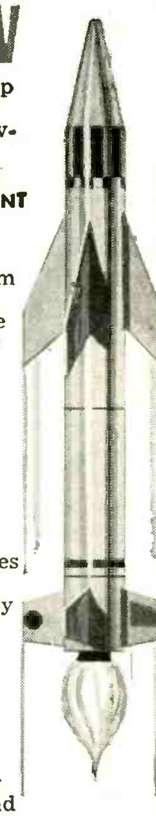

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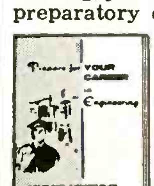

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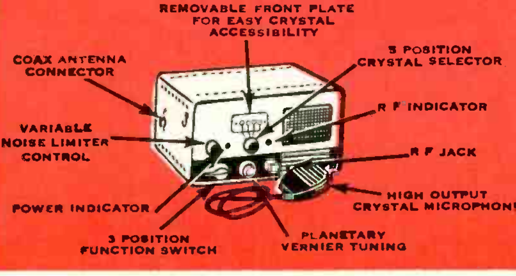

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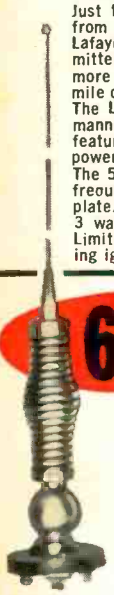

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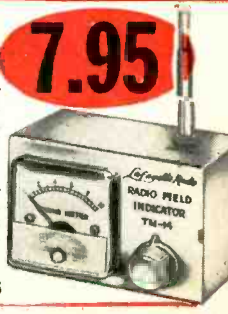

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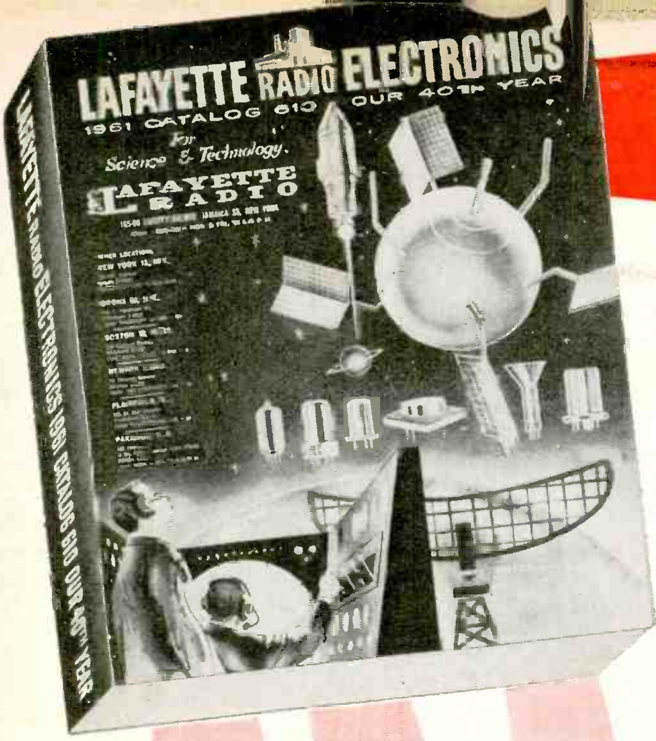

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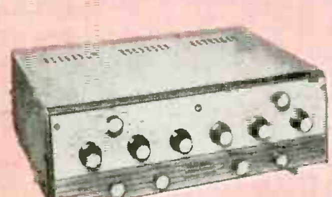

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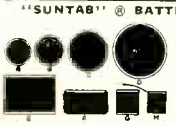

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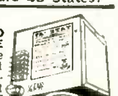

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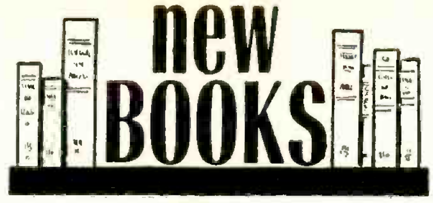

FUNDAMENTALS OF ELECTRONICS, by E. Normal Lurch. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. 5 3/4 x 9 in. 631 pp. $8.25.

The reader will find here an excellent introduction to communications, microwaves, TV and other branches of electronics.

Its analyses are both thorough and logical, and the reader should acquire basic know-how in amplifiers, oscillators and other circuits. Transistors and tubes receive equal attention. A very understandable text, just below the engineering level, if the reader knows something of elementary algebra and trigonometry.—*IQ*

CONTROLLED RECTIFIER MANUAL. Semiconductor Products Dept., General Electric Co., Electronics Park, Syracuse 1, N. Y. 5 1/2 x 8 1/2 in. 255 pp. $1.

The silicon controlled rectifier is only a few years old, but it has replaced many other types of electronic switches. It is highly efficient, small, powerful and fast-acting. This manual describes the theory, ratings and applications of these units.

Typical schematics show how it is used in servo controls, choppers, inverters, power supplies, etc. Cooling, overload, paralleling and test methods are considered too.

RADIO RECEIVER SERVICING. (Second Edition), by John T. Frye. Howard W. Sams & Co. Inc., Indianapolis, Ind. Bobbs-Merrill Co., Inc., New York, N. Y. 5 1/2 x 8 1/2 in. 222 pp. $2.95.

This is a practical book on servicing all types of sets: ac–dc, all-wave, FM, transistor, printed-circuit. Each chapter is devoted to a specific complaint such as hum, noise, dead set. From his own practical experience, the author tells how to locate the defect and make the repair. Chapters end with review questions. The answers are at the back of the book.—*IQ*

TUBE CADDY TUBE SUBSTITUTION GUIDEBOOK, by H. A. Middleton. John F. Rider Publisher Inc., 116 W. 14 St., New York 11, N. Y. 4 1/8 x 6 in. 53 pp. 90¢.

A handy little guide for the TV technician's tube caddy. It lists direct substitutions for commonly used tubes in its four sections—1819 receiving tubes; 219 European-to-American substitutions; 297 American-to-European substitutions; 75 ruggedized tubes.—*LS*

MATHEMATICS FOR ENGINEERS (2 volumes) by W. N. Rose. John F. Rider, Publisher, Inc., 116 W. 14 St., New York, N. Y. 5 1/2 x 8 1/2 in., $6.60 each vol.

Vol. I, 9th edition, has 527 pages. It begins with basic rules and methods of algebra, trig and geometry, progresses gradually to the binomial theorem, exponents and logs. Many worked-out examples are given to help the reader.

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These volumes are well prepared for self-study and strike a happy medium between theory and practice.

CLASSIFICATION OF ELECTRON TUBES, by J. Haantjes and H. Carter. Macmillan Co., 60 Fifth Avenue, New York 11, N. Y. 8 x 11 1/2 in. 96 pp. $3.50.

An interesting, well illustrated (in color) text that is intended to give the student a brief and simple description of how electron tubes work and present a system for classifying them. The illustrations are beautiful and give excellent cutaway views of vacuum-tube interiors. The text has a British slant. —*LS*

THE ATOM AND THE ENERGY REVOLUTION, by Norman Lansdell. Philosophical Library, Inc., 15 E. 40 St., New York 16, N. Y. 6 x 9 in., 200 pp. $6.

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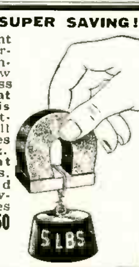

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HANDBOOK OF ELECTRONIC TABLES AND FORMULAS (First Edition). Howard W. Sams & Co., Inc., 1720 E. 38 St., Indianapolis, Ind. 5¼ x 8½ in. 128 pp. $2.95.

A lot of information is packed between the covers of this book. Numerous charts, nomograms, formulas and tables are here to help the engineer, technician and student save time and energy. The text's contents include: codes, TV data, formulas, weights and measures, FCC allocations, conversion factors, service data, screw and wire tables, WWV schedule, logs and trig functions, etc.

This volume can well be one of the most useful in your library.—*IQ*

NAB ENGINEERING HANDBOOK (5th Edition). Editor-in-chief, A. Prose Walker. McGraw-Hill Book Co., 327 W. 41 St., New York 36, N. Y. 6 x 9 in. 1,664 pp. $27.50.

This book covers all phases of radio and TV broadcasting from FCC rules through color TV, antennas, towers and studio facilities and finishes up with 61 pages of charts and graphs. It is intended for the broadcast engineer, but many others will find much useful data between its covers.—*LS*

BASICS OF MISSILE GUIDANCE AND SPACE TECHNIQUES (2 volumes), by Marvin Hobbs. John F. Rider Publisher Inc., 116 W. 14th St., N.Y. 11, N.Y. 6 x 9 in. 304 pp. total. $3.90 each.

This two-volume set tells the missile-guidance story to the electronics man and shows him how electronics is a vital part of missile and space techniques. The first volume covers guidance techniques; guide-beam, doppler and homing techniques; internal and celestial navigation; computer applications and other related topics.

Vol. 2 goes into more elaborate practices such as testing and telemetering, satellite theory and practice, electronic components and power sources, and satellite monitoring and tracking.—*LS*

FUNDAMENTALS OF ELECTRONICS, by Matthew Mandl. Prentice-Hall, Inc., Englewood Cliffs, N. J. 6 x 9 in. 574 pp. $10.60.

This clear, modern text offers an excellent start to a career in electronics. It presents the basic facts of atomic structure, circuits, magnetism and receivers. Transistor circuits are shown and described alongside tube circuits of the same type. The text ends with special circuits like flip-flops and magnetic amplifiers, and a chapter on test instruments.

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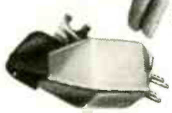

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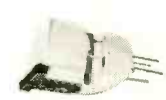

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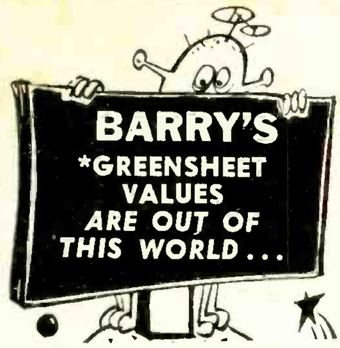

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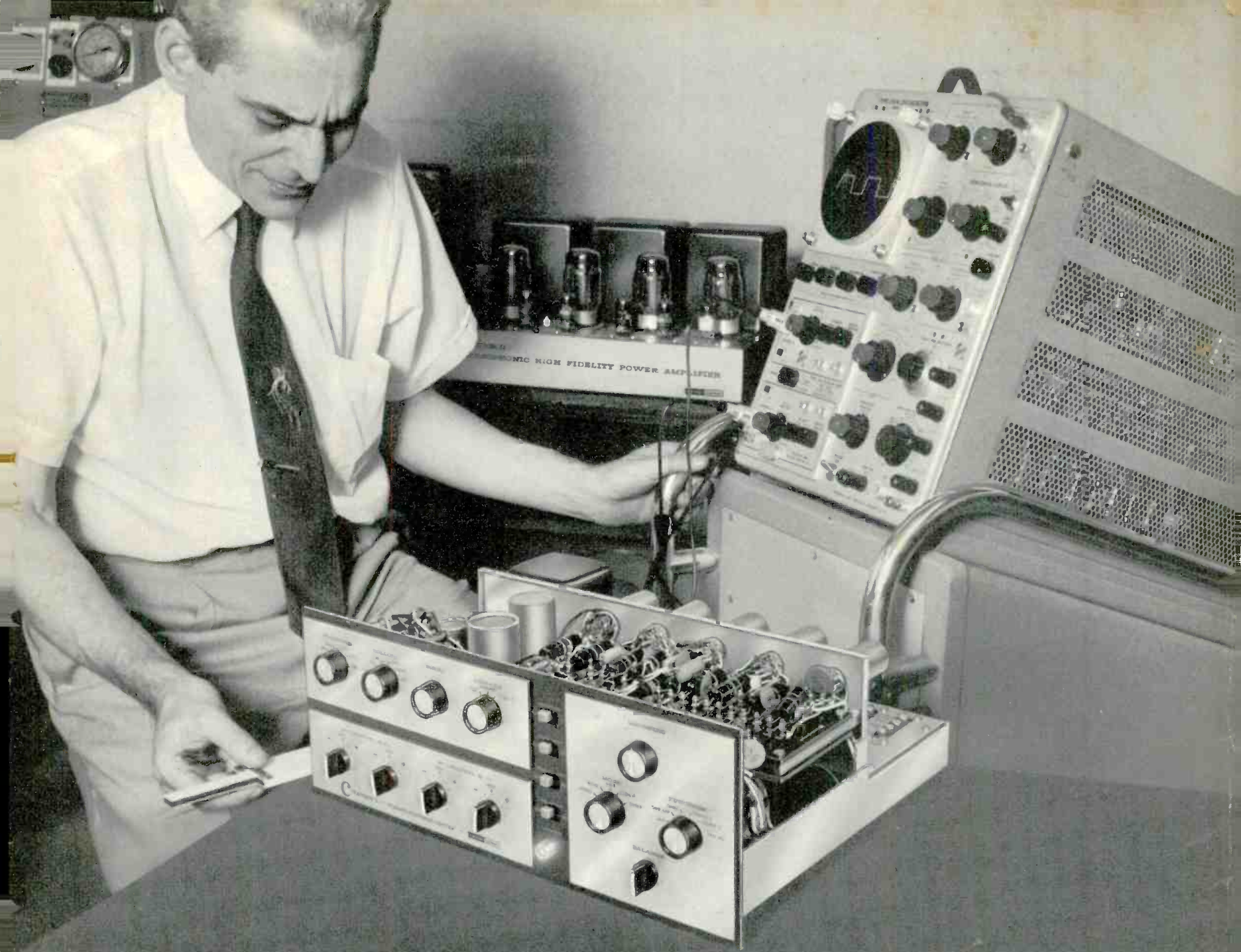

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