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OCTOBER 1959

Radio-Electronics

HUGO GERNSBACK, Editor

35c

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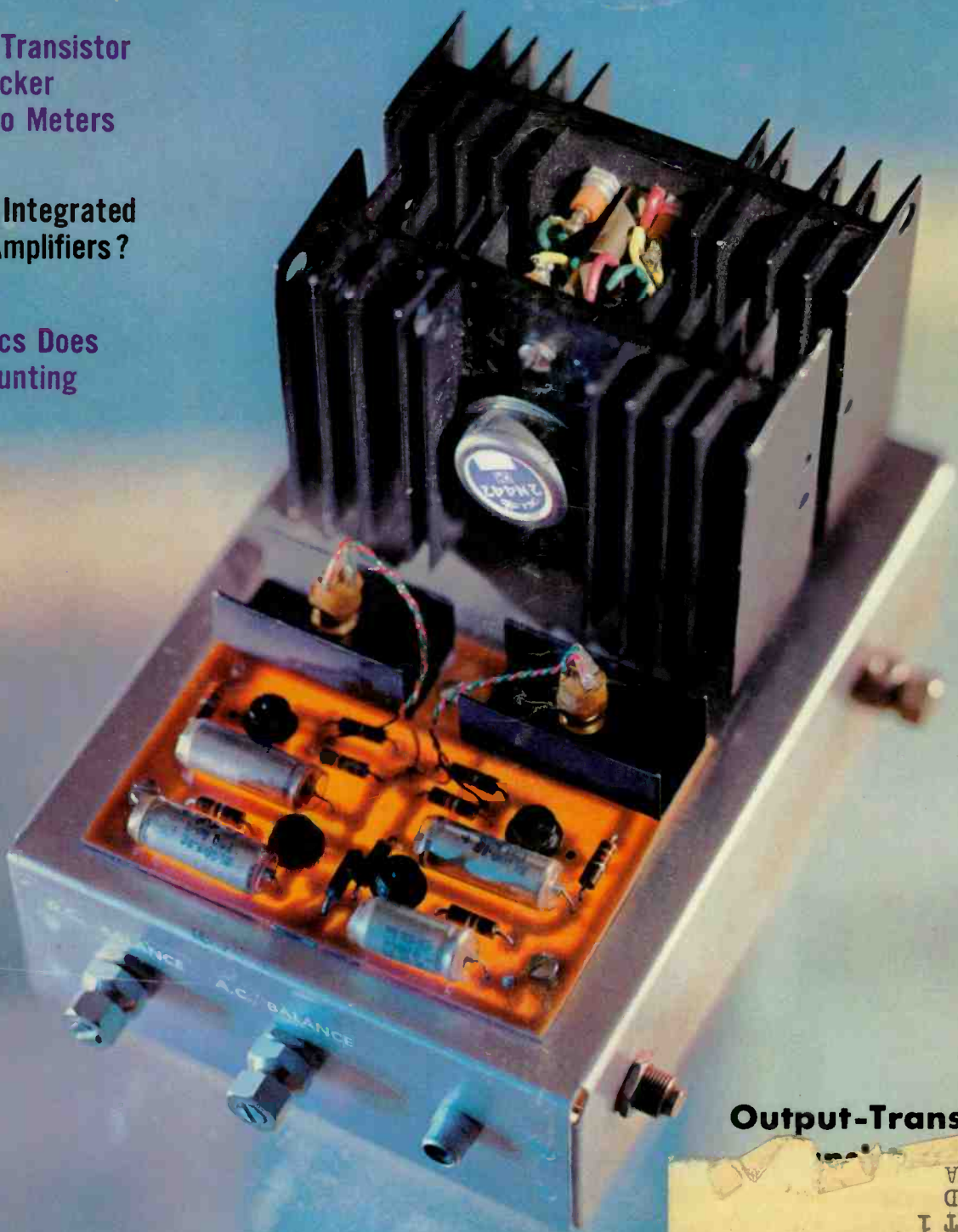

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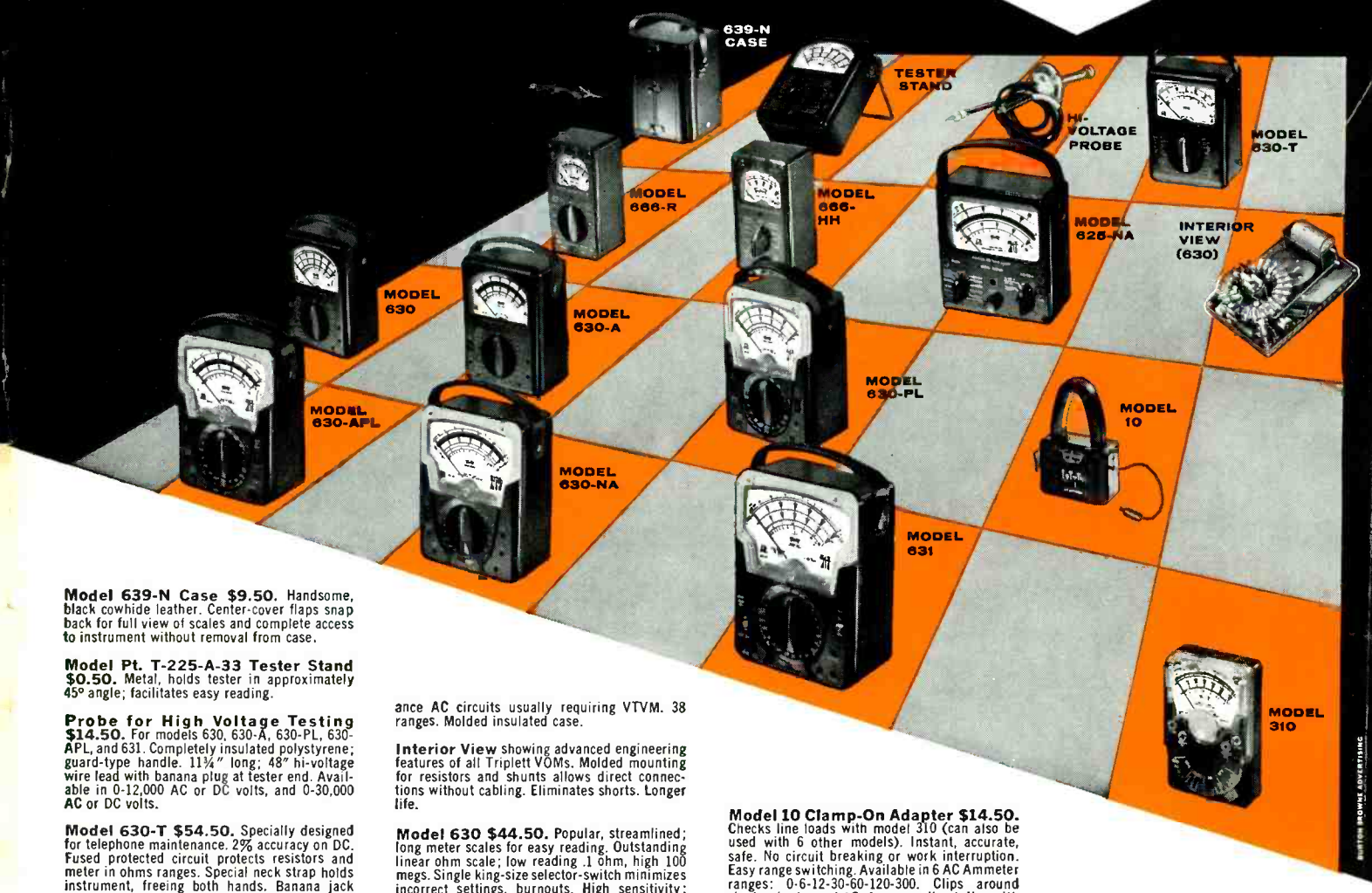

Model 639-N Case $9.50. Handsome, black cowhide leather. Center-cover flaps snap back for full view of scales and complete access to instrument without removal from case.

Model Pt. T-225-A-33 Tester Stand $0.50. Metal, holds tester in approximately 45° angle; facilitates easy reading.

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Model 630-T $54.50. Specially designed for telephone maintenance. 2% accuracy on DC. Fused protected circuit protects resistors and meter in ohms ranges. Special neck strap holds instrument, freeing both hands. Banana jack connectors eliminate all shock hazard. Completely insulated case protects from ground.

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Model 666-HH Pocket VOM $27.50. Compact, hand-size; 3" meter integral with panel, adjusted to 400 microamperes at 250 millivolts. Only 3 jacks necessary for all ranges. 19 ranges.

Model 625-NA $54.50. Dual sensitivity for extra ranges; large mirror scale for super readability. 3-color meter scale 5" long. 6" instrument, 0-50 microamp. AC volts at 10,000 Ω/V for checking many audio and high impedance AC circuits usually requiring VTVM. 38 ranges. Molded insulated case.

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Model 630-A $54.50. Laboratory type; ½% resistors for greater accuracy. Long mirrored scale eliminates parallax. Banana jacks, low resistance connections; high flux magnet increases ruggedness. Single king-size selector switch minimizes incorrect settings, burnouts. Molded fully insulated case.

Model 630-PL $44.50. Instant-vision, wider spread scales; streamlined case; handsome modern design. Unbreakable window. Outstanding linear ohm scale; low reading .1 ohm; high to 100 megs. Single king-size selector switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch. High sensitivity: 5,000 ohms per volt AC; 20,000 ohms per volt DC.

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Model 630-APL $54.50. Laboratory type with ½% resistors, more accurate movement. Long mirrored scales eliminate parallax. Unbreakable window. Single king-size switch minimizes incorrect settings, burnouts. 5 to 500,000 cps frequency response in AC measurements. DC Polarity Reversing switch. High sensitivity: 5000 ohms per volt AC; 20,000 ohms per volt DC. Molded case fully insulated.

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ON THE COVER

(Story on page 34)

This all-transistor 8-watt amplifier is designed as a companion unit for stereo.

Color original by Habershaw Studios, New York, N. Y.

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NEWS BRIEFS

SOUND CONTROL OF ROCKETS may be in the offing if present investigations using high-intensity (176-db) high-frequency sound to control the burning rate of solid rocket fuel pay off. At present, it is impossible to control the burning of solid propellants so they burn at an uneven rate, slowly at first and more rapidly as burning continues.

The intense sound will aid in mixing the components of the solid fuel, with lower intensity producing a lower combustion rate. Thus by using the ultrasonic "blast" at full power first, then reducing the intensity, the burning rate can be evened out. Simpler rocket engines and higher power-to-weight ratios will result if this idea, advanced by Acoustica Associates of Plainview, N. Y., and now being underwritten by a Government contract, proves correct.

MISSILE FIRINGS and bomb blasts anywhere can be detected with a new high-frequency back-scatter scheme revealed by the Office of Naval Research. The ONR has run tests to prove its theory for over 20 months, monitoring nuclear blasts, missile firings and satellite launchings. Making use of ionospheric reflection, the results are similar to radar, but work over thousands of miles.

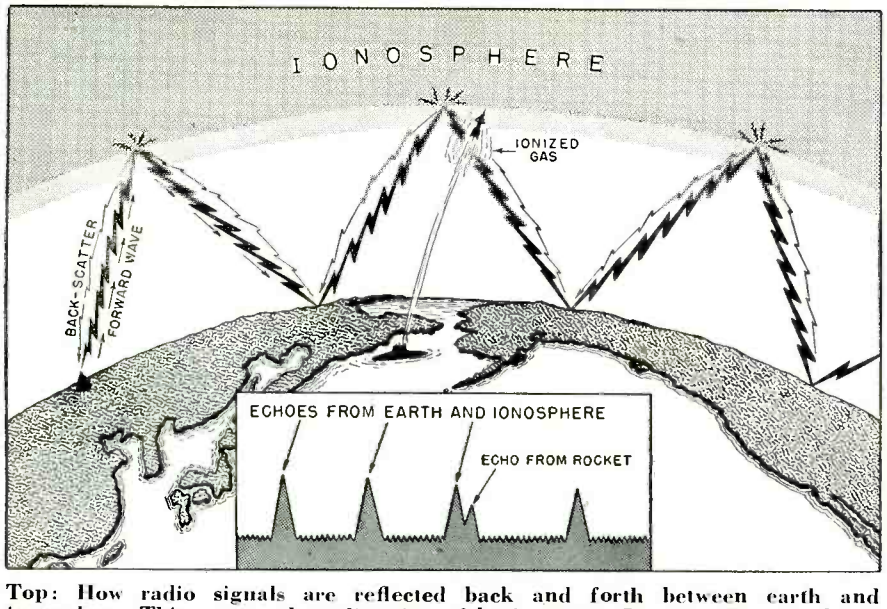
Project Teepee is a radio monitoring system using transmitters of 15 to 50 kw, as opposed to the BMEWS (Ballistic Missile Early Warning System) radars which emit millions of watts. Teepee bounces electromagnetic waves off the ionized blast cloud of a nuclear bomb or a climbing rocket's ionized exhaust. These large clouds of ions reflect high-frequency waves in much the same way that solid objects reflect radar pulses.

Ordinarily, ionospheric back-scatter would appear on a scope as a regular succession of blips. When the receiver gets back a little energy from a cloud of ionized gas, there is an extra little blip displayed. Prior calculations of the radio propagation path can use the shape and location of the blip to locate the disturbance responsible for it.

Whereas BMEWS affords 15 minutes' warning when a hostile missile is launched overseas, Teepee should provide 30 minutes' notice when a intercontinental ballistic missile is fired.

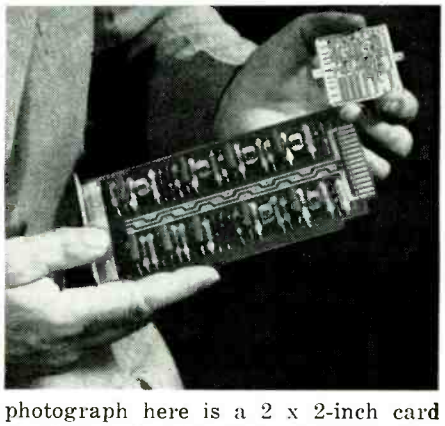
Teepee will ultimately lessen the need for some radar and other warning systems such as DEW line, BMEWS and Project Midas, the infra-red detecting system which would use satellites with infra-red sensors.

Although Teepee has monitored hundreds of missile and satellite firings and bomb tests as far back as the launching of Sputnik I near the end of 1957, it is still in the experimental stage. The head of the project, Dr. W. J. Thaler, who was senior scientist of Project Argus (RADIO-ELECTRONICS, page 49, May, "A-Bomb Proves Earth's Magnetic Field") said, "We are confident a reliable system capable of reliable detection over intercontinental ranges is feasible and can be developed within a few years. . . . The same basic system could also be used to monitor a nuclear test ban because it has already detected atom-bomb explosions at thousands of miles."



Top: How radio signals are reflected back and forth between earth and ionosphere. Thin arrows show direction of back scatter. Bottom: How the back-scatter reflections appear on a scope. Ionized gas from a rocket firing produces blip where it would not normally be expected.

MICROMINIATURE RESISTORS as well as capacitors and interconnections can now be sputtered onto very thin ceramic cards in one operation. Resistors as thin as 1 mil can be made in the process, developed by D. A. McLean of Bell Telephone Laboratories. Shown in the



photograph here is a 2 x 2-inch card containing a three-stage multivibrator which previously required 7 x 3½ inch in standard printed circuitry. The sputtered technique placed 24 resistors on the card, plus 9 capacitors and plug-ins for 6 transistors and 9 diodes. Reliability of these units will be very high due to formation of resistors, capacitors and interconnections all of from one metal, tantalum in this case, and all at the same time.

HIGHWAY HI-FI is expected to come in strong with the 1960 Plymouth and DeSoto cars. RCA is supplying special 45-rpm players to the Chyrsler Corp. RCA officials said they have units available but couldn't show them ahead of Chrysler's car previews.

WOMAN-SPOTTING RADAR developed for the Army works on pulse Doppler techniques and is so sensitive that an experienced operator can hear and see whether a moving object thousands of yards away is a man, a group of soldiers, a jeep or a woman. The radar

Men 17-55

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2060

transmits pulses into a 30° sector, then receives reflected pulse energy from stationary terrain as well as from moving targets.

The portion of the reflected-signal energy coming back from the moving object is shifted in frequency continuously (Doppler shift). That signal is converted in the set to an audio tone equivalent to 30 cycles a second for each mile-per-hour motion. If an object is moving at a steady 3 miles an hour, the operator hears a 180-cycle sound. A man swinging his arms would produce other, more complex sounds fluctuating, say, between 120 and 240 cycles, if close enough (perhaps a mile) to reflect enough energy for that detail.

A vehicle produces a higher tone because it moves faster, and a woman's shorter, peppier walk has an identifiable sound. The four photo tracks shown here are made by a train, an auto, a man and a woman walking. The radar has spotted a single man at 15 miles under ideal conditions. It's a highly mobile set which includes a 5-foot plastic radome set on a 25-foot pole. It was developed by the Army and Hazeltine Corp.

CLOSED-CIRCUIT TV was used in a novel combination of applications when the nuclear-powered merchant ship Savannah was christened by Mrs. Dwight Eisenhower. CCTV cameras picked up the working of the reactor below decks. It was displayed for the guests on a 6 by 8-foot TV screen upstairs, which also serves for movies and standard TV programs. This programming can be viewed in other lounges in addition to the main lounge, crew quarters and 37 staterooms, over the RCA-equipped system.

FM IS GROWING AGAIN, according to latest FCC figures. There were 79 FM transmitters authorized during early 1959, 7 more than on AM. FM grew rapidly during the years just after WW II, then shrank after 1949. The low point was reached in 1955 when there were only 557 valid station grants. Today there are 620 FM stations on the air, with over 765 active authorizations. As FM receivers continue spreading into every household, FM stations will keep increasing in importance and number. Several manufacturers are readying auto sets with FM, too.

Hundreds of thousands of people living in New York and New England know that FM is really growing because they listen to fine music FM network QXR. This largest FM net has just added WTAG-FM in Worcester, Mass. with 10 kw. WTAG-FM is the 14th QXR affiliate; other stations range from 5 to 40 kw.

(A man called RADIO-ELECTRONICS the other day for information. Said he knew that FM meant frequency modulation, "But what does AM mean?"—*Editor*)

ONE NEW TV STATION has begun programming since we last reported:

WAFG, Huntsville, Ala.....31

The US total remains the same, however, as we lost:

KSPR-TV, Casper, Wyo. 6

WICC-TV, Bridgeport, Conn., channel 43, went dark for just one month from Aug. 12 to Sept. 13.

New call letters were made official by the following two stations:

WLUC-TV, Marquette, Mich.....6
(formerly WDMJ-TV)

WLUK-TV, Marinette-
Green Bay, Wis. 11
(formerly WMBV-TV)

The US operating station total remains 558, but there are now 468 vhf and 90 uhf stations. The noncommercial group still numbers 42.

MONKEY BEHAVIOR, and presumably the behavior of man, can be changed temporarily by applying painless electrical pulses to various areas of the brain through surgically implanted hair-thin electrodes.

Under stimulation from a collar-carried transistor unit, the monkeys were made to eat up to seven times their normal intake, to suddenly seek out a mate, to lose their ferocity and ability to "boss" others around, or conversely to become menacing and fierce.

The current used, according to Dr. Jose Delgado of the Yale Medical School, research surgeon who is conducting the experiments, is so weak that it could probably not be felt by the tongue, which is more sensitive to an electrical charge than any other part of the body.

PLANE TABOO ON RADIOS is now in effect on overseas flights to protect cockpit receivers from radiation sent out by oscillators of passenger portables. The International Air Transport Association, including all major overseas airways, agreed to ban passenger use of radios and recorders. It was first considered that the plane's equipment might be shielded but this was ruled out because transistor portables radiate out the windows direct to plane antennas.

Tape recorders' bias oscillators are only 30 to 90 kc, but work at much higher power levels than most superhet oscillators. Thus those with bad bias waveforms can produce harmonics at communications or navigation frequencies.

STEREOCASTING situation may be cleared up before winter's end. The National Stereophonic Radio Committee (NRSC) is trying to reduce the many competing systems to three, then decide between them. The systems were placed

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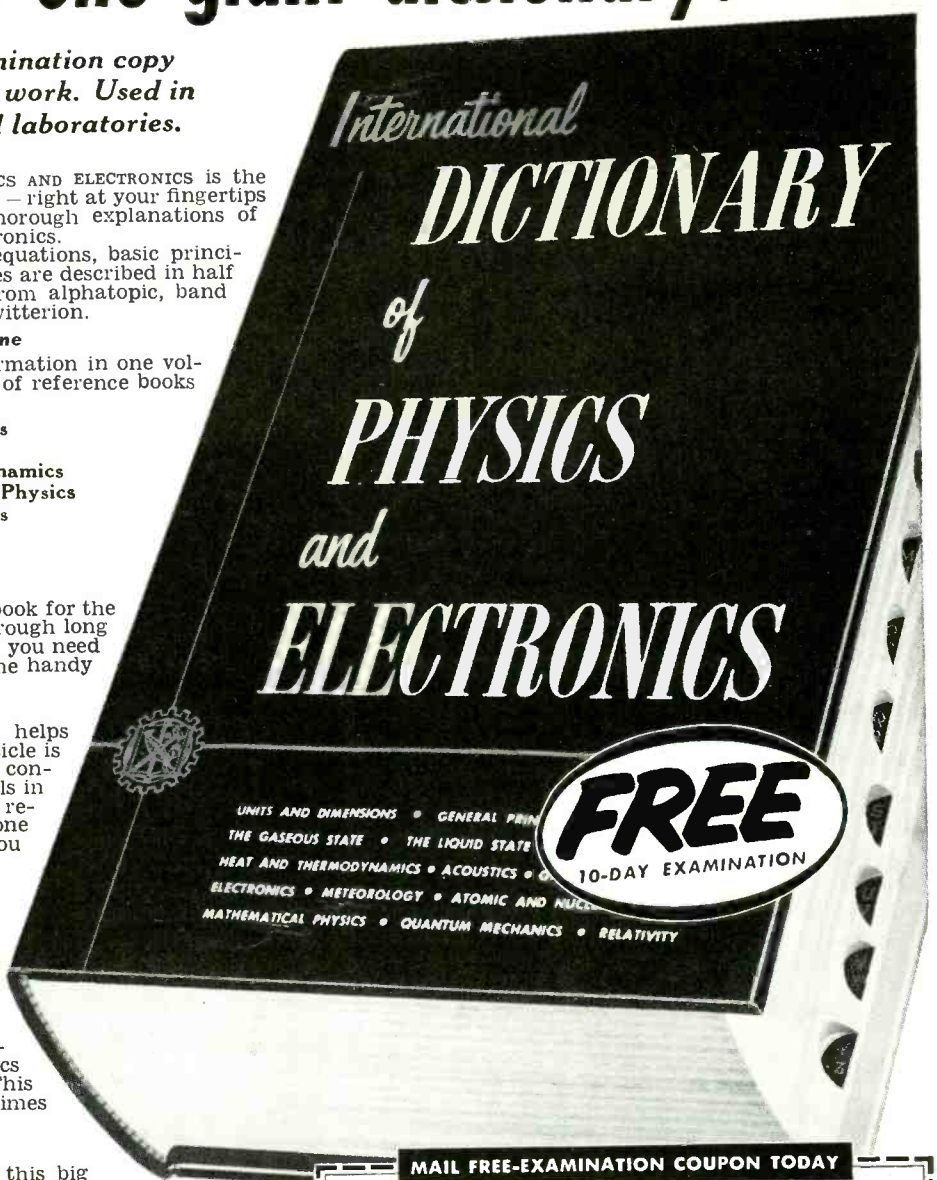

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on basis of family resemblance in an FM–AM group (GE, Philco, Zenith), the FM–FM group (Calbest, Crosby, Halstead) and the English Percival system. The FCC has set a deadline of Dec. 11 for filing proposals on stereocasting, and the NRSC may well come up with its recommendation by then.

Calendar of Events—October

Industrial Electronics Symposium, Sept. 30–Oct. 1, Mellon Institute, Pittsburgh, Pa.

Stereo and Hi-Fi Show, Oct. 2–4, Davenport Hotel, Spokane, Wash.

National Communications Symposium, Oct. 5–7, Hotel Utica, Utica, N.Y.

Motion Picture & Television Engineers Convention, Oct. 5–9, Statler-Hilton Hotel, New York.

Audio Engineering Society Convention and Equipment Exhibit, Oct. 5–9, Hotel New Yorker, New York, N.Y.

Institute of High Fidelity Manufacturers Hi-Fi Show, Oct. 5–10, New York Trade Show Building. (RADIO ELECTRONICS will exhibit in Room 525.)

EIA Value Engineering Symposium Oct. 6–7, University of Pennsylvania, Philadelphia, Pa.

Conference on Radio Interference Reduction, Oct. 6–8, Museum of Science & Industry, Chicago, Ill.

Canadian IRE Convention, Oct. 7–9, Exhibition Park, Toronto, Canada.

National Electronics Conference, Oct. 12–14, Hotel Sherman, Chicago, Ill.

Home Entertainment Show, Oct. 15–18, Rice Hotel, Houston, Tex.

Detroit High Fidelity Show, Oct. 16–18, Statler Hotel.

Portland (Ore.) Stereo & Hi-Fi Show, Oct. 16–18, Multnomah Hotel.

URSI Fall meeting, Oct. 19–21, El Cortez Hotel, Balboa Park, San Diego, Calif.

East Coast Conference for Aeronautical and Navigational Electronics, Oct. 26–28, Lord Baltimore Hotel, Baltimore, Md.

Michigan Industrial Electronics Exposition, Oct. 28–29, Detroit Artillery Armory, Oak Park, Mich.

Electron Devices Meeting, Oct. 29–30, Shoreham Hotel, Washington, D.C.

Buffalo (N.Y.) Hi-Fi Show, Oct. 30–Nov. 1, Statler Hotel.

SATELLITE USING SOLAR energy to power no less than three transmitters, two receivers and a simple TV scanning device is now in orbit. The new satellite is the paddle-wheeled, 142-lb Explorer VI. The "paddles" are actually four 20 x 20-inch vanes, with 1,000 solar cells on each of their surfaces.

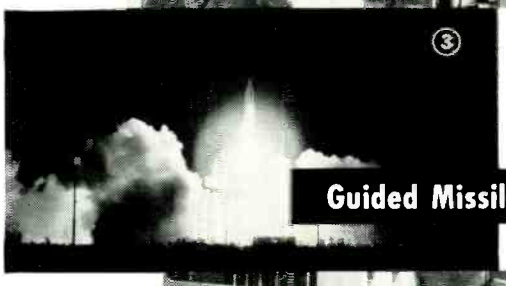
Travelling 22,000 miles an hour, the satellite moves in an eccentric 12½-hour orbit that takes it to 25,000 miles away from the earth at its farthest point, at its nearest within 150 miles.

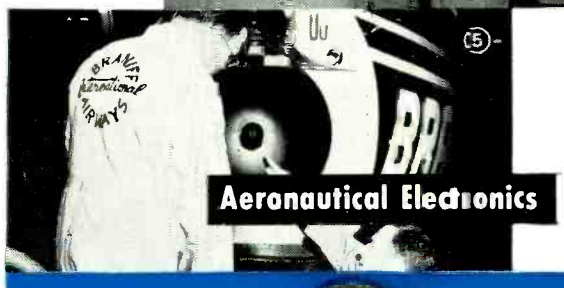
Two low-powered transmitters work on 108.06 and 108.09 mc for routine transmission of scientific information, and a higher powered (40-watt) transmitter operates intermittently—about 1½ hours out of every 6. The transmitter can be turned on and off by commands from the ground.

Fifteen major experiments are being conducted with electronic gear crammed into the 26 x 29-inch spheroid. Magnetometers will map the size, shape and

(*Continued on page* 18)

How to Get a Commercial FCC License





do you know what an FCC license really can do for you in Electronics?

1 More income for you every week

2 A more interesting job in electronics

The average person spends over 50% of his waking hours on the job (or going to and from the job). Therefore doesn't it make sense to have a job that is really interesting and also pays well?

The chances are very good that if you are reading this magazine you can qualify for the really good jobs in electronics like those shown in the pictures at the left . . . and it won't take long to do it. Your past training and experience in basic electronics (such as radio and TV repair, armed forces electronics, ham operators, etc.) can be the foundation for a profitable career as an "across-the-board" electronics technician.

Whether you run your own shop or work for someone else, the real money, the interesting work, is available to the man who can effectively handle the more complex electronic gear. Home receiver repair can provide a good living, but it can't match the opportunities open to a skilled electronics technician.

The Career Information Material shown below will show you how you can qualify for a government certificate of competency . . . a commercial FCC License . . . and acquire a really fine technical education. Find out how your success with the FCC examination is guaranteed . . . or your money back.

You will also find out which jobs require the FCC License . . . where technicians are needed . . . what a technician needs to know about electronics . . . and many other facts about opportunities for you in electronics.

It will cost you only the price of a postage stamp to get all the facts. If you are in any type of electronics work . . . or if you have had previous training or experience in electronics . . . you owe it to yourself to ask us to send you information on profitable careers in electronics.

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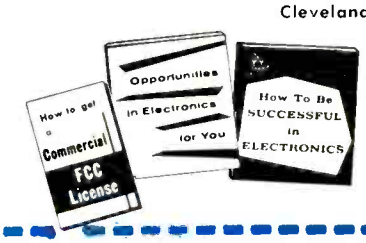
2. Radio Corporation of America
3. Jupiter IRBM, Army Ordnance Missile Command
4. Collins Radio Company
5. Radio Corporation of America



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- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
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- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other

In what kind of work are you now engaged? _____

In what branch of Electronics are you interested? _____

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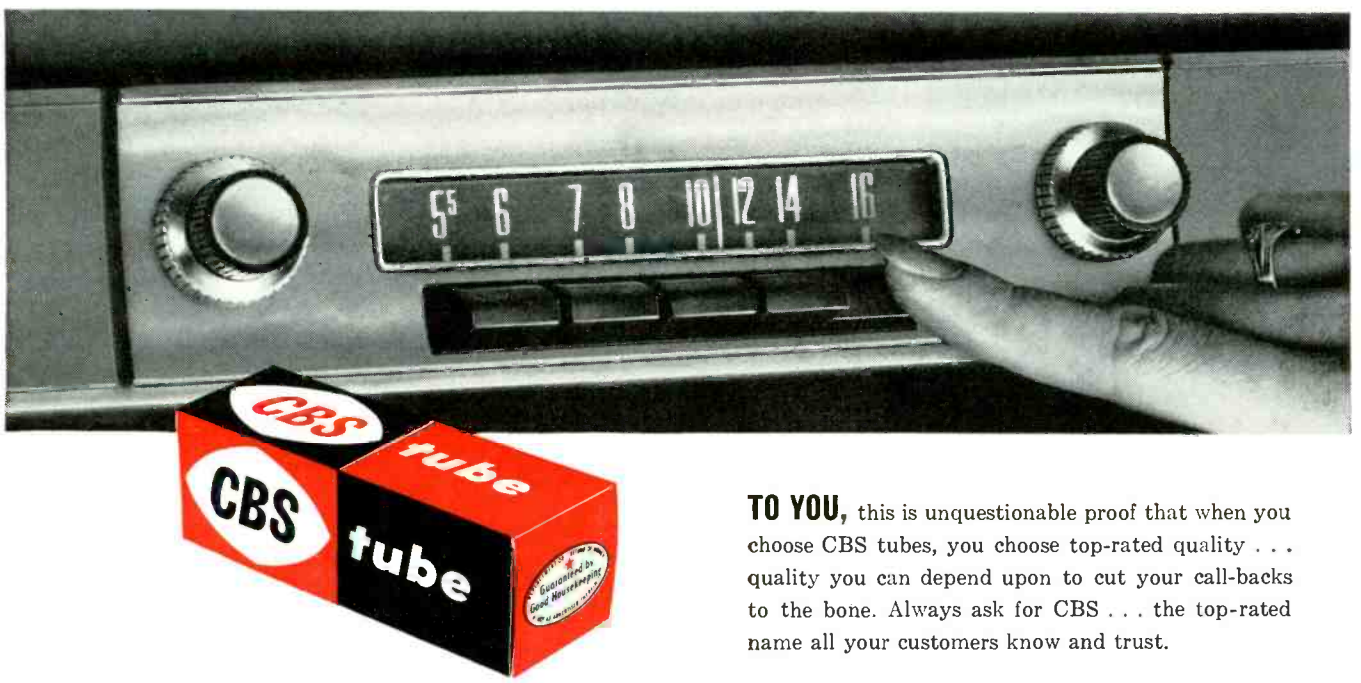

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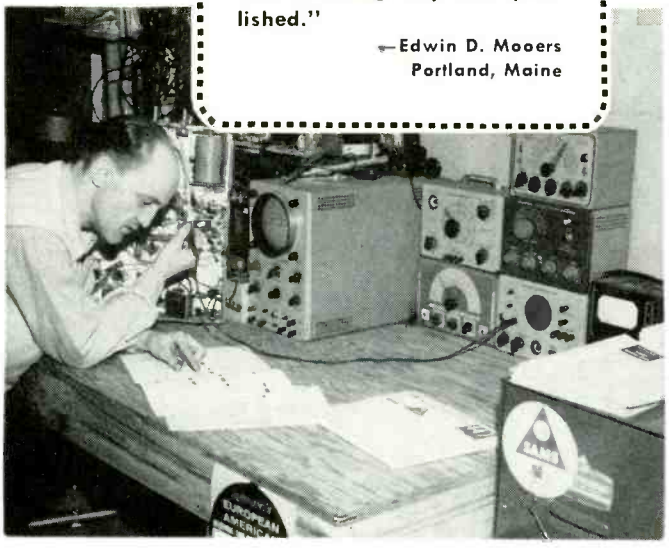

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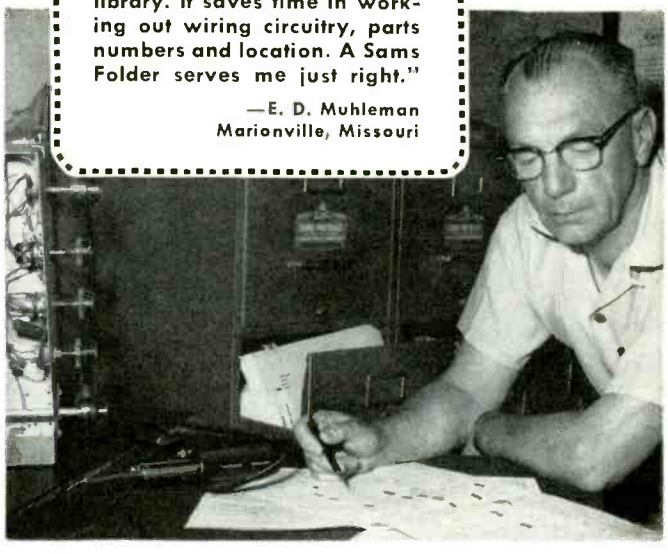

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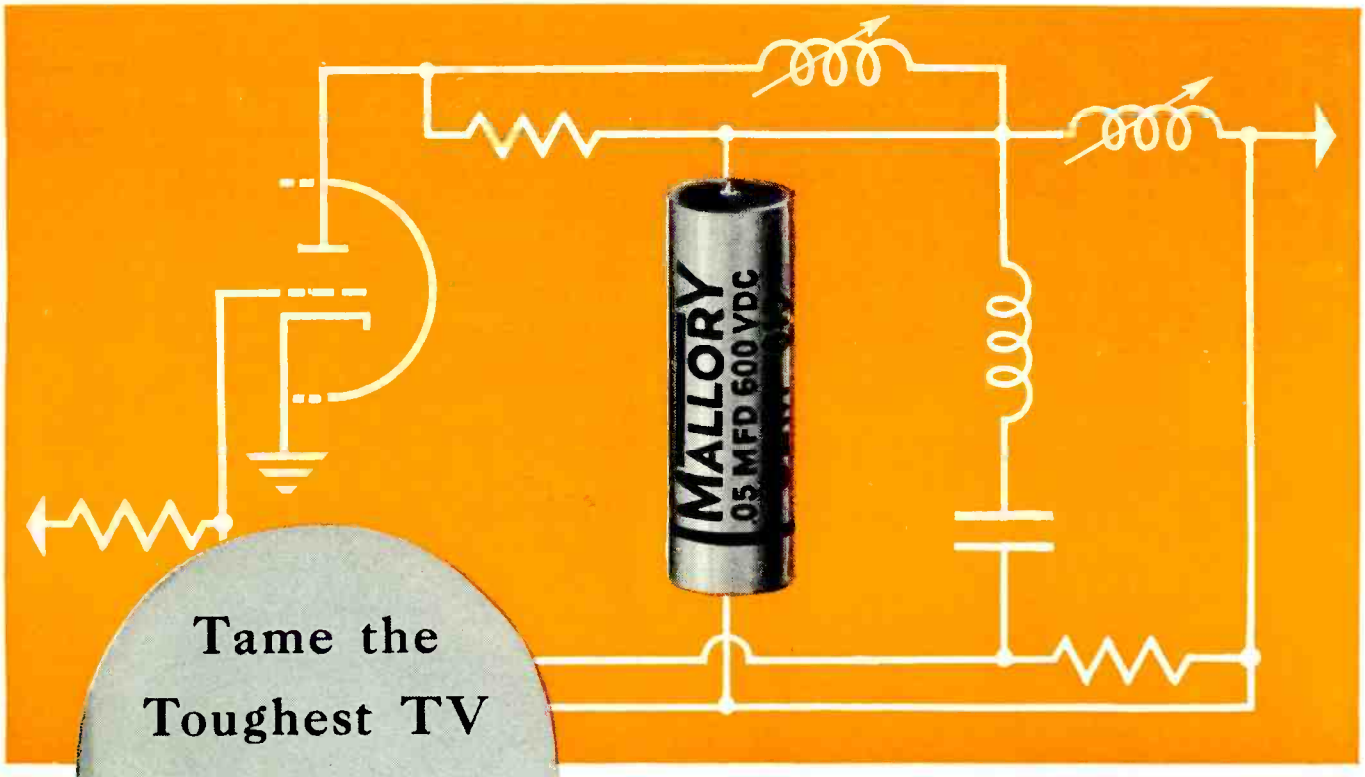

Tame the Toughest TV Replacement Spot with a . . . . Mallory Gem Capacitor

This circuit should be familiar—half of a 6SN7 serving as the horizontal oscillator in a typical TV receiver circuit. The marked spot in the diagram is a tough assignment for a capacitor. If it opens, you lose raster. If it changes capacity, or if the replacement is beyond tolerances, the horizontal sweep will not sync in.

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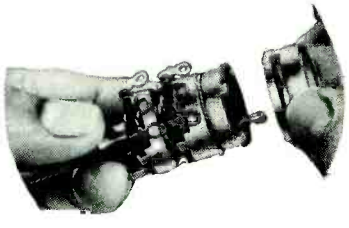

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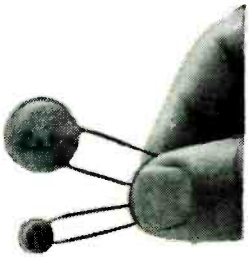

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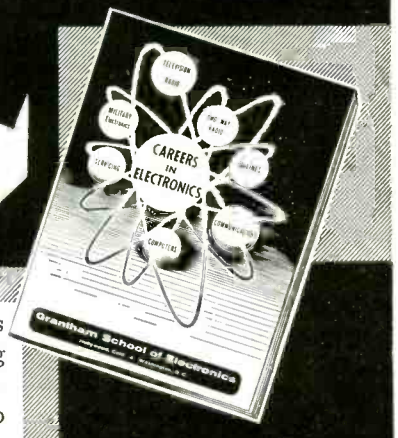

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Everett T. Bozard, 411 N. Wash. St., Alexandria, Va.	1st	12
Henry M. Best, 1003 Vermont St., Fremont, N. C.	1st	11
Harold V. Jones, P.O. Box 705, Alamogordo, N. M.	1st	13
Michael F. Aperio, 916 Townsend St., Chester, Pa.	1st	12
Earl A. Stewart, 3918 Modesto Dr., San Bernardino, Calif.	1st	14
Donald L. Leeburg, Box 1075, Anchorage, Alaska	1st	12
J. Milton Condit, 1312 N. 78th Street, Seattle, Wash.	1st	8
John R. Bahrs, 72 Hazelton St., Ridgefield Park, N. J.	1st	12
Richard Baden, 4226 - 37th St., N.W., Washington, D.C.	1st	12
James F. Stewart, 2618½ Prospect Ave., La Crescenta, Calif.	1st	12
Norman R. Cook, 130 Olive Street, Neodeska, Kans.	1st	12

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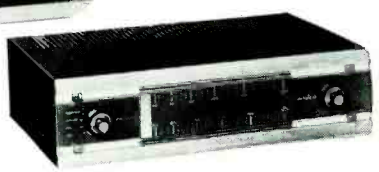

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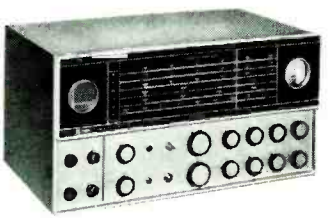

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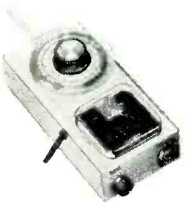

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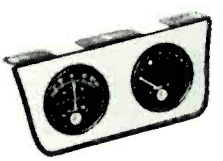

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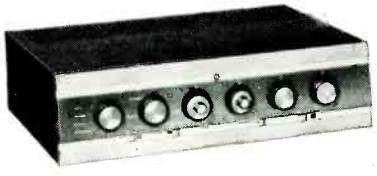

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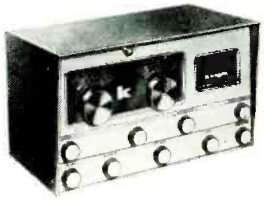

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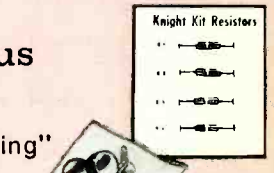

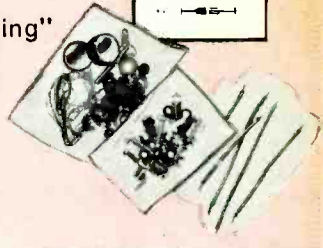

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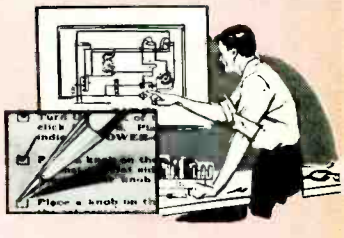

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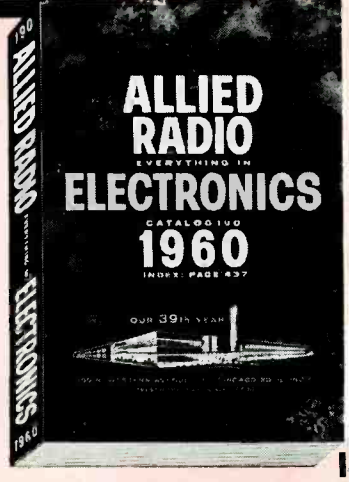

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direction of the earth's magnetic field. Information will be gathered on the electron density of the ionosphere and its effects on radio waves. The TV-like scanning device is hoped to produce rough pictures of the earth and its cloud cover. And information will be gathered on the size and speed of micrometeorites (cosmic dust).

Calendar of Events—November

Mid-America Electronics Conference, Nov. 3-5, Municipal Auditorium and Hotel Muehlebach, Kansas City, Mo.

National Automatic Control Conference, Nov. 4-6, Sheraton-Dallas Hotel, Dallas, Texas.

High-Fidelity Music Show, Nov. 6-8, New Washington Hotel, Seattle, Wash.

Radio Fall Meeting, Nov. 9-11, Syracuse Hotel, Syracuse, N. Y.

Instrumentation Conference, Nov. 9-11, Atlanta, Ga.

Annual Electrical Techniques in Medicine and Biology Conference, Nov. 10-12, Penn-Sheraton Hotel, Philadelphia, Pa.

High-Fidelity Music Show, Nov. 13-15, New Heathman Hotel, Portland, Ore.

Conference on Magnetism and Magnetic Materials, Nov. 16-19, Sheraton-Cadillac Hotel, Detroit, Mich.

New England Research and Engineering Meeting, Nov. 17-19, Boston Commonwealth Armory, Boston, Mass.

Nuclear Science National Meeting, Nov. 19-20, Commonwealth Armory, Boston, Mass.

High-Fidelity Music Show, Nov. 20-22, Benjamin Franklin Hotel, Philadelphia, Pa.

SILENT SATELLITES have been detected by three radio amateurs at G-E's Advanced Electronics Center. Theorizing that the ion cloud around a satellite would reflect high-frequency transmissions, they set up radio watch on the 5-, 10-, 15-, and 20-mc transmissions of the Bureau of Standards station WWV.

They made hundreds of observations and demonstrated conclusively that there were three types of disturbances to the usual WWV signals directly attributable to satellites. At 20 mc, there was a fast flutter, similar to the familiar TV "airplane flutter." At 10 and 15 mc, there were two effects, one called "Doppler" because it produced a changing audio tone, despite the fact that such modulation was not on the WWV carrier. This was presumably due to beats between the signal received direct from WWV and that received by reflection from the satellite. The second effect was always delayed by 8 to 10 minutes after each pass of a satellite. This "rumble" contained sound from 60 to 400 cycles which remained steady.

ELECTRONIC REFRIGERATORS reached the patent stage with applications by Philco and Westinghouse for patents on electronic units using the Peltier effect. This allows cooling when current passes through a junction of dissimilar materials, in this case germanium, indium and antimony.

Neither company would say when they expect to produce the electronic, no-moving-parts refrigerators. END

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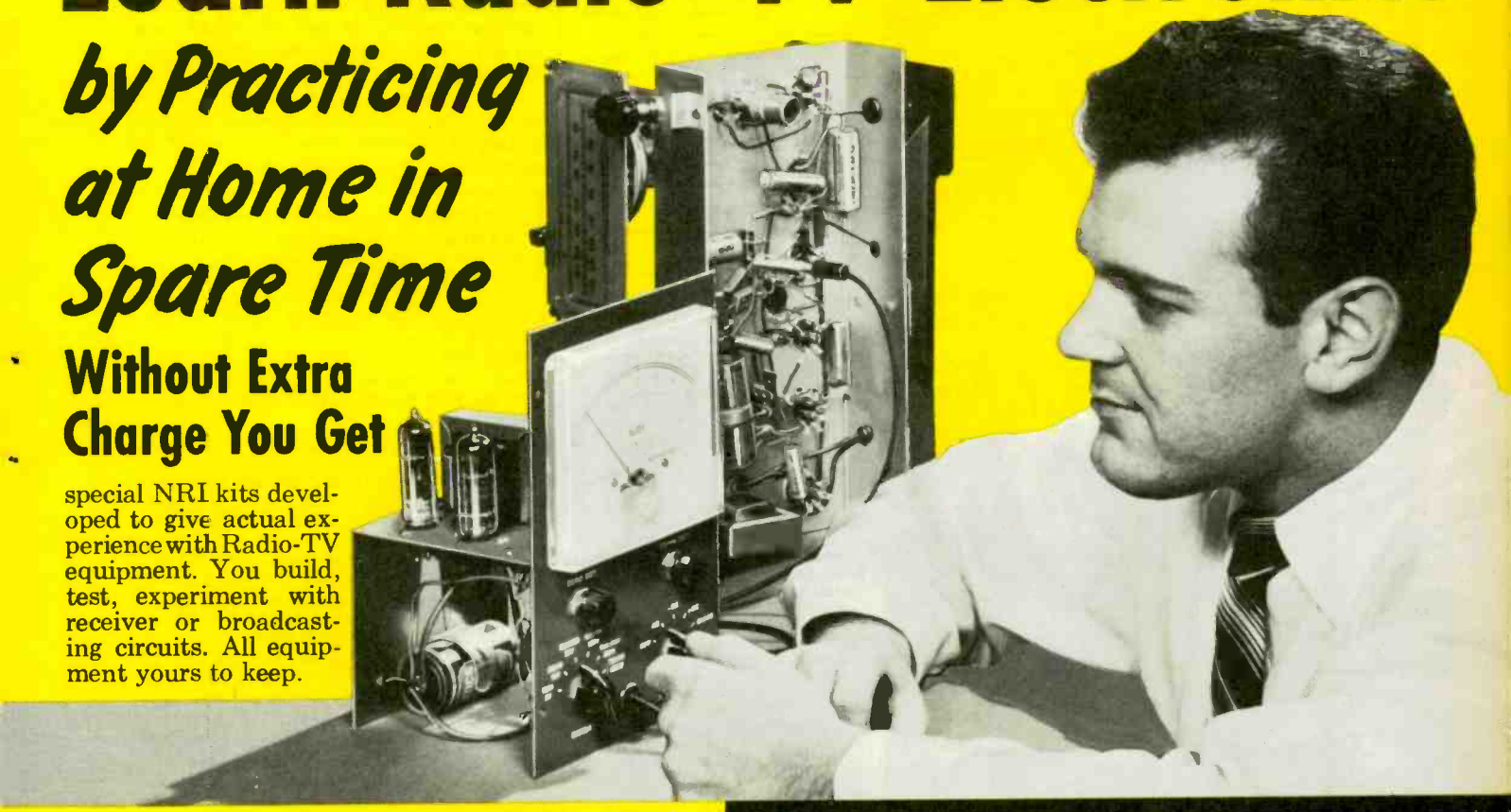

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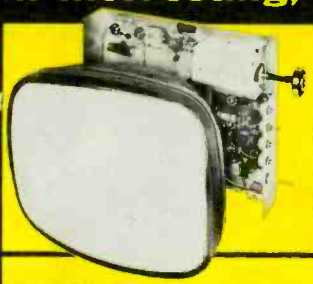

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SEE OTHER SIDE

NEW EXPERIMENT IN TELEPHONY

It could speed up "dialing." Bell Laboratories people created it—and now it's being tested.

The telephone you see above embodies an important new concept. It "dials" by means of push buttons—promises more convenient telephoning. Bell System engineers are currently testing it for public reaction. Bell Telephone Laboratories developed it.

The Laboratories' invention of the transistor makes it possible. For the transistor permits a new kind of calling signal generator, mounted within the instrument.

To insure ease of operation, psychologists studied human reactions to various finger pressures and sizes and arrangements of buttons. All factors affecting speed and accuracy were thoroughly evaluated. Electrical and mechanical engineers brought together the human and physical factors, created a practical piece of apparatus. Industrial designers worked out the functional shape.

The new instrument sends a calling signal quite different from that of your present telephone. This poses a problem. Complex automatic switching must be changed to handle the new signals as well as the old ones. Switching engineers must devise ways to make this change in *thousands* of central offices—economically.

Most of the challenges have been met. Final judgment on this new concept depends on the outcome of field tests. Meanwhile, Bell Laboratories continues in its task of originating and developing devices to improve your Bell System telephone service.

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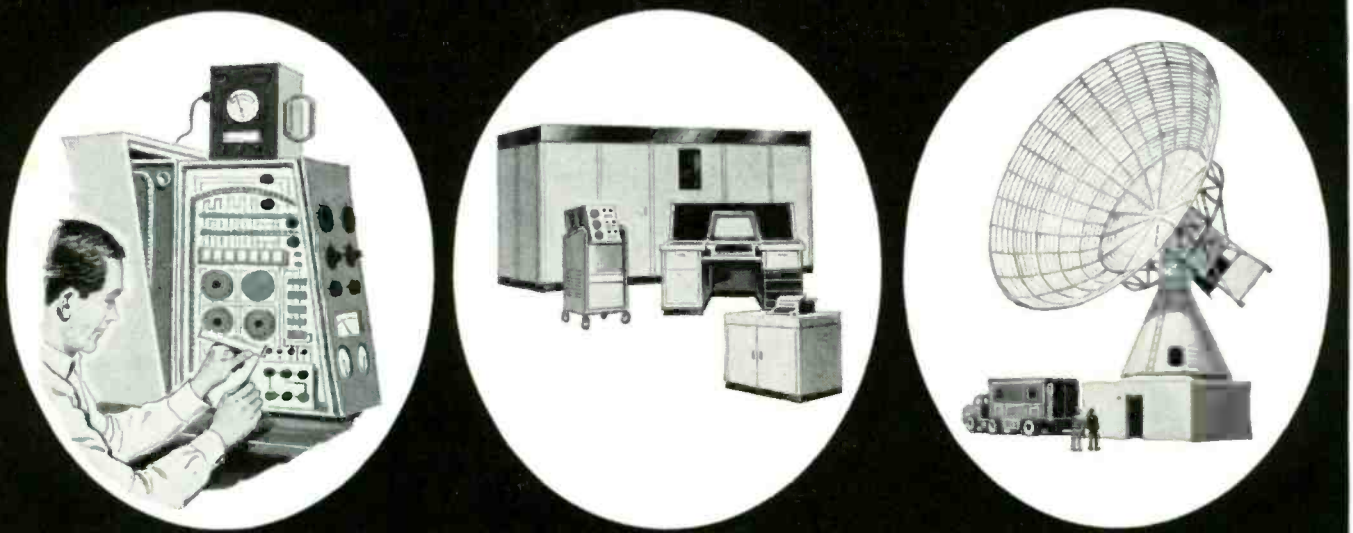

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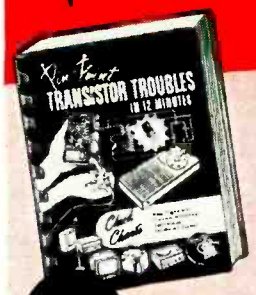

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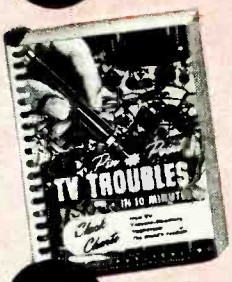

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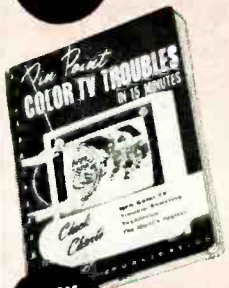

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Correspondence

STEREO MIKING

Dear Editor:

Chester Santon's preference for close-miking technique for stereo recording (page 41, August) compels me to disagree. . . . I don't challenge his right as a critic to approve it in print, but some voice (mine, in this case) must cry from deep in the wilderness, "It ain't right!"

For example, take Mr. Santon's comment on the Van Cliburn concert-recorded version of Rachmaninoff's *Third*. It's a fine performance, but the miking, at least in the copy I heard, gave the ridiculous impression that Van, his piano and the Symphony of the Air were all housed in a coat closet or a shoe-box. Not even the performers heard that performance with the lack of reverberation that we are expected to accept. I will not buy such a poor recording. I doubt that the miking was planned to be, "ideal for the small-scaled concept of the work."

A hall with "good" acoustics is not dead like radio studios of the 30's and 40's. It has a highly specific type of reverberation that lasts for 2 to 3 seconds. Exclude if you will 300 years of musical experience and say that now, with modern recording, we have a "new sound." Certainly recordings cannot re-create realism; they can only create the illusion of realism. But music recorded with the right reverberation will sound right and real.

E. D. HOAGLAN

Omaha, Neb.

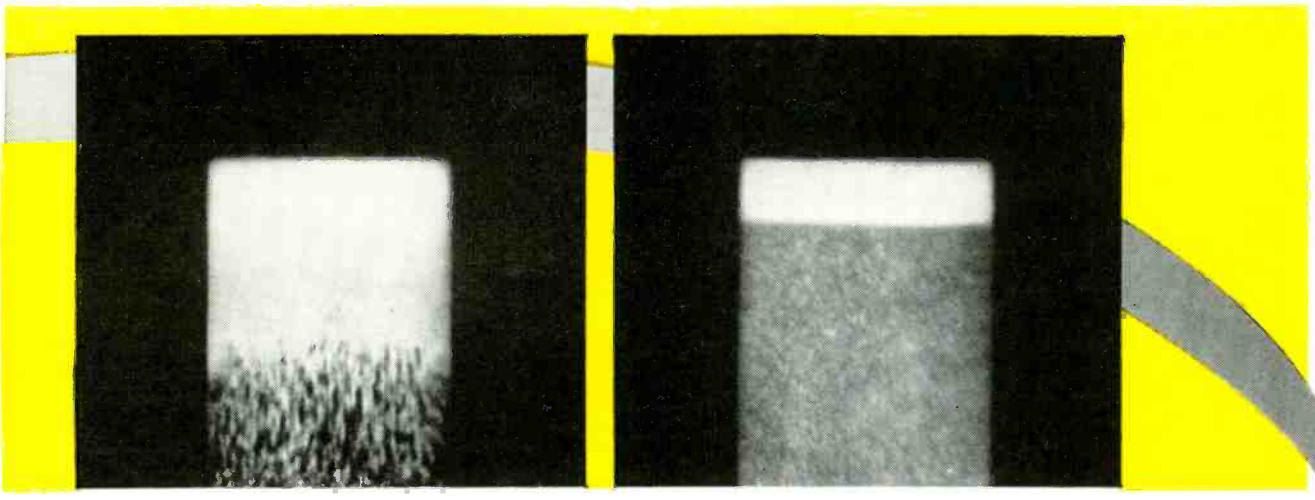
My general comments at the beginning of the August column were not an endorsement of the Van Cliburn miking. In that recording, the conductor holds the orchestra to a whisper in some passages. With a capacity crowd in the hall, normal mike placement was abandoned, not as part of any trend referred to in my preliminary remarks, but as a safeguard against excessive audience noise.

Even under normal recording conditions, further improvements in the stereo disc may provide greater latitude in mike placement.—*Chester Santon*

DISPUTES CROWHURST

Dear Editor:

Regarding Mr. Crowhurst's article on stereo broadcasting (July issue), I take exception to his statement that the Burden system does not and can-



Inherent physical superiority of Sylvania's exclusive Sarong cathode, right, over a conventional cathode, left, is evident in this photomicrograph comparison. The texture, thickness, sharp coating edges and overall uniformity of Sarong represent major improvements in the heart of the electron tube never before achieved in mass production.

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Fewer call-backs due to intermittents and shorts . . . reduced noise and less arcing...these are some of the benefits available to you *now* with this "can't be copied" Sylvania development.

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First tubes to incorporate Sarong are tv tuner types 6BZ7, 6BQ7A, 6BC8 and 6BS8. Eventually Sarong cathodes will be utilized in a full line of Sylvania receiving tubes.

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Sarong cathodes are now in use in four Sylvania tv tuner types. Eventually all Sylvania receiving tubes will contain Sarong cathodes.

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not work. I also question the mathematics in his article. These are not the figures published by Burden Associates.

I have personally heard the Burden Phantodyne system perform and I noticed no audible effect on the stereo signals. The listening quality for monophonic reception of a single stereo channel, too, was of excellent quality. Both the Burden and the Becker (Bell Telephone) systems are compatible with all forms of mono and stereo transmission including multiplexing, FM–AM, FM–FM and TV–FM–AM systems.

LAWRENCE S. SCHENCK
Station WVIP,
Mount Kisco, N. Y.

ORGAN TUNING

Dear Editor:

Mr. Jaski's article "Servicing Electronic Organs" (August RADIO-ELECTRONICS) was timely, and I enjoyed reading it until the paragraphs on organ tuning. To really make an organ sing, the following table should be employed. This uses the authentic equal-tempered scale in six places, and the beats are calculated in a circle of fifths based upon middle C:

Fifth	*Beats/sec*	*Beats/10 sec (all flat)*
C —G	0.888	9
C#—G#	0.953	10
D —A	0.995	10
D#—A#	1.053	10 or 11
E —B	1.118	11—12
F —C	1.142	12
F#—C#	1.252	13
G —D	1.325	14
G#—D#	1.407	14
A —E	1.490	15
A#—F	1.580	16
B —F#	1.671	17
C —G	(next octave higher)	18

If the fifths are tuned perfectly around the circle, you'll wind up with a horrible 7 cycles per second beat and have no place to squeeze it in. An organ tuned in this way is suitable only for boogie and picket-fence rhythm—harmony is not considered.

SEVERN GLADEM
Dayton, Ohio.

TRANSISTOR FICTION ?

Dear Editor:

In Mr. Louis Garner's "Transistors—Fact and Fiction" (p. 48, July) he neglects to tell us that one common circuit, the class-B output stage in the common-emitter configuration, is prone to damage by reversing of the battery.

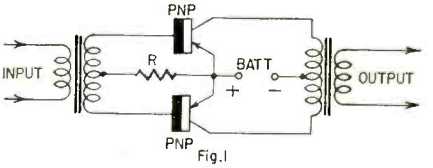

Fig. 1

He states, "with the common-emitter configuration, reversing battery polarity will not damage the transistor."

Looking at the circuit (Fig. 1), we

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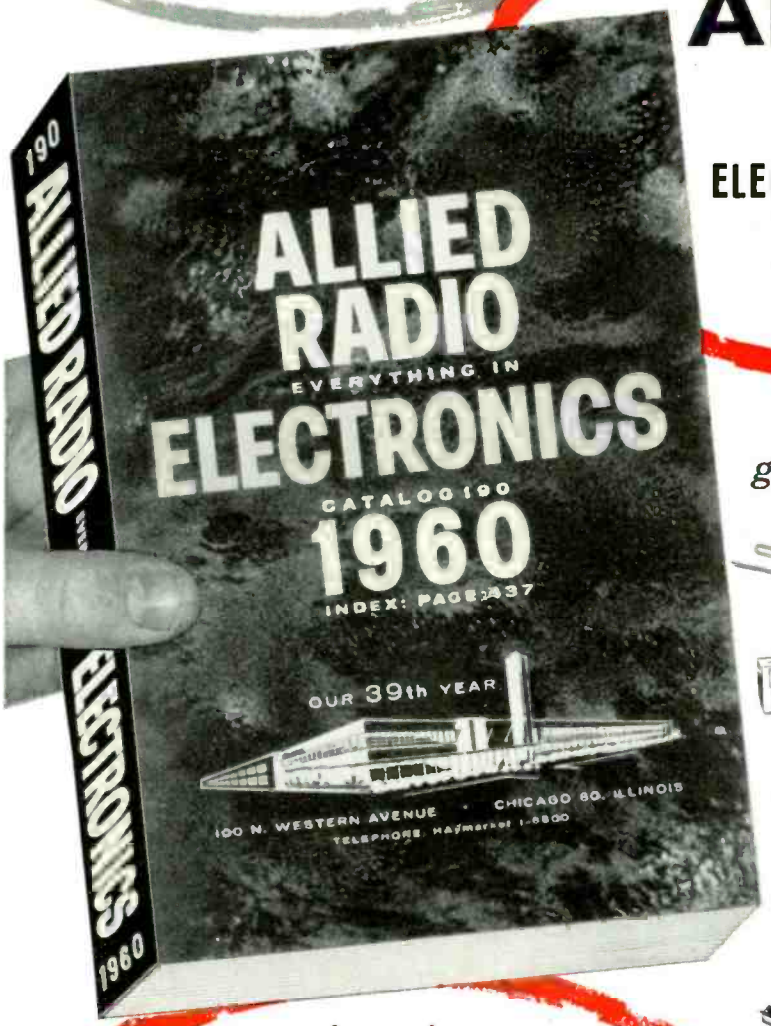

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see R, which is only a few ohms, and is often omitted entirely, as the only protection. It is usually too small to save the transistor. Redrawing the circuit (Fig. 2), shows the biasing for one side of the stage clearly.

Voltage is applied across the base-

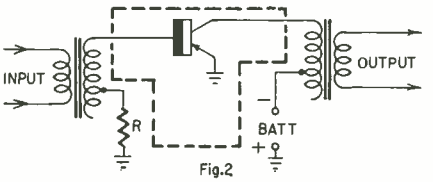

Fig.2

collector junction, as shown by the dotted line, in the reverse direction. If the battery polarity is reversed, the collector junction will conduct; both transistors will instantly burn out (some manufacturers, but not many, protect against this by inserting a small diode in series with R).

Whitehorse, Yukon, Canada — JIM BUTTERFIELD

I concede that—*using the circuit Mr. Butterfield has supplied*—reversing the battery polarity will generally blow the transistors. However, commercial circuits are almost always class AB, not B, as he suggests; they almost *always do* have the resistor R, which he says is often omitted; base bias is *almost always* supplied by a voltage divider, and the circuit example I used was a single-ended, not a push-pull, stage. I tried reversing battery polarity in about a dozen transistor sets. I didn't ruin a single transistor, although in three cases very close to overload current was drawn by the output stage.

Finally, I referred to the statement "Reversing polarity will ruin transistors" as a *half-truth*—I didn't say it was always wrong.

As I also said in the sentence Mr. Butterfield has taken me to task for, "It is still a good idea to observe battery polarity."—*Lou Garner*

A CORRECTION

Dear Editor:

I have just received my August RADIO-ELECTRONICS and I fear that if your readers go by the drawing only, some of them may get the wrong notion about how to make the test I described in the last paragraph on page 39, as by some accident the drawing does not convey exactly what I meant.

When I said, "Stretch a single layer of cotton handkerchief across your mouth," I meant stretched *across* (not away from) the mouth. Imagine you are gagging yourself, or that you are a nurse wearing a microbe filter. The test material must be stretched across the mouth so tightly that no air can escape *except* through the sample. You can then feel by the differences in back pressure just how some materials resist the flow of air while others offer negligible resistance.

P. G. A. H. VOIGT

Toronto, Canada

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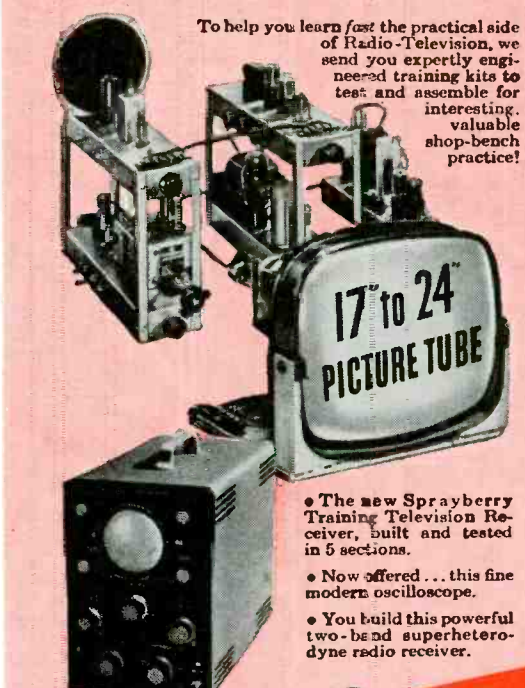

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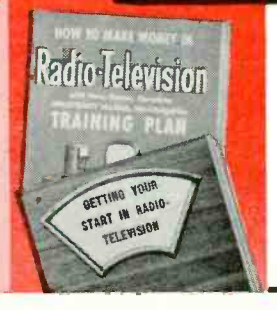

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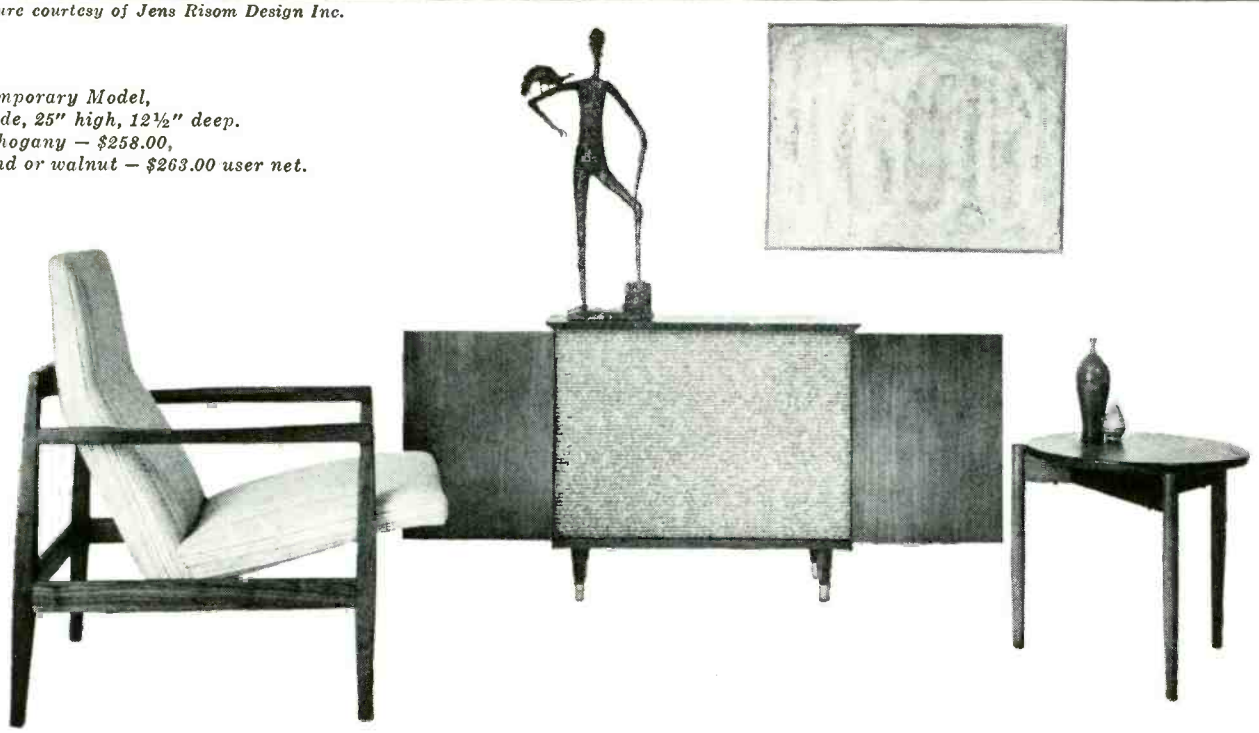

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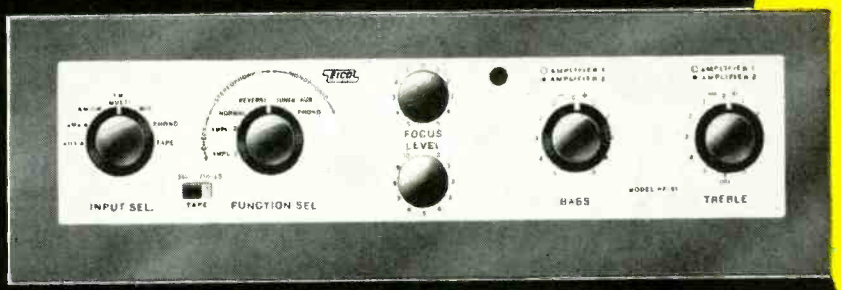

Stereo Amplifier-Preamplifier HF81

Stereo Preamplifier HF85

70W Stereo Power Amplifier HF87
28W Stereo Power Amplifier HF86

FM Tuner HFT90
AM Tuner HFT94

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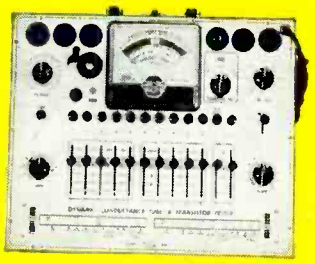

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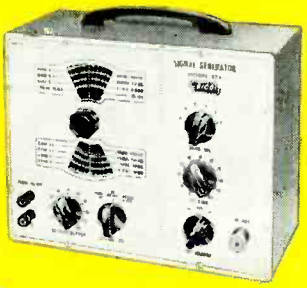

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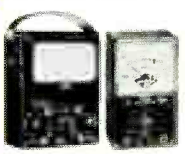

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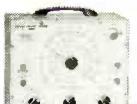

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FUTURE AUDIO GOALS

. . . The Great Audio Inventions Are Still to Come . . .

THE birth of audio undoubtedly dates back to the invention of the Bell telephone in 1876. Electronic sound has come a long way during these 83 years, yet the most important audio progress still lies in the future.

We have pointed out repeatedly on this page that recording sound (and video) by mechanical means is but a stopgap;* it is certain not to prevail in the future. Registering sound on record and tape will be considered a crudity in the future—it will give way to pure electronic, nonmechanical recording in which nothing moves except electrons. Such a method would not be noisy, would require no stylus, give no extraneous track sounds. It will store the audio impulses just as a capacitor or an electret stores electricity. The electronic recorder will store the impulses for years, to play them back at will hundreds of times as wanted.

We need not overstress the obvious fact that such sophisticated recording of the future will vastly improve audio and stereo quality. We can also foresee that the physical size and weight of our future sound "records" will be but a small fraction of our present ones. And the price should be lower, too.

One of the most urgently pressing inventions doubtless is *inaudible sound.* Today families are disrupted, neighbors disturbed and estranged by our audio buffs and enthusiasts, as well as over the more common raucous television receiver. Hardly a day passes that the press does not report some unpleasantness on account of excessive sound in somebody's home. Nonmusical and sound-hypersensitive wives, older people, the sick, invalids and others are constantly up in arms over excessive sound sessions that often run into long hours. The esthetics of music when it explodes into high decibels can indeed wreak havoc.

Such a state of affairs is unnecessary, nor will it be tolerated, in the near future. In the electronic age, audio enthusiasts no longer need make enemies or create annoyance to others. Here is one solution—there are a number of other and perhaps better ones.

Let us call the future development *ultra-music.* It uses ultrasonic sound, whose lowest frequency is over 20,000 cycles per second. Humans cannot hear it at all, but canaries and other birds, as well as certain mammals, can hear it readily.

What is required is a simple *electronic ultrasonic converter,* smaller than a thimble.† It will be fully transistorized and easily fits in one's ear. It will not be a difficult electronic engineering task to devise an ultrasonic transmitter that attaches directly to the audio output of a radio, TV, high-fidelity or stereo set. The transmitter can be concealed near the ceiling so that the ultrasonic waves will not be interfered with by furniture, moving human heads, etc. Thus the music will permeate the entire room, *but no one will hear a sound* unless he wears the thimble-sized converter.

Stereo? Just wear *two* converters, one in each ear (and of course have stereo transmitters). Yes, total audio peace *is* possible.

High-fidelity for whom? We hear sounds best between 1,000 and 4,000 vibrations a second.‡ Unfortunately, human hearing deteriorates steadily after age 25. Above this age, persons no longer can hear the true higher sounds of any instrument. Thus a young boy, under the best conditions and with perfect hearing, may hear sounds of from 20 to 30,000** vibrations (cycles) a second; but by the time he is 50, he may hear up to only 10,000 cycles, thus missing practically all the higher overtones of the musical instruments. Cats and other animals, for example, hear sounds very much higher in pitch.

By the time humans get to an age when they are most keen to listen to the world's best musical recording or to live music, nature has stepped in and robbed them of nearly half the sound range by impairing their hearing sense. Of course, they still hear the fundamental tones, but not the higher harmonics. Thus they hear "flat," not brilliant music.

Curiously—and fortunately for humans—we can still enjoy music that we cannot hear with our ears, even if both of our auditory nerves have been destroyed and we are stone deaf. How is this possible? Beethoven was deaf for many years before he died. *This did not prevent him from composing the beautiful music he never heard himself.*

We humans can *think music;* we can carry a tune in our head that is never audible, not even to ourselves. We never have any difficulty reaching very high notes in our mind *as long as we remember such notes from the time when we could still hear.*

How do we hear? Audible sounds are conducted via the ear canal through a complex mechanism involving three bones in the middle ear, the ear drum, and a liquid that fills the inner ear. The ear's diaphragm connects with the auditory nerves which are stimulated by the fibers of Corti. The resulting sensations are then communicated to the brain in a complex and not-too-well understood manner.

For many decades, physicist–scientists have tried to reach certain brain centers of humans who were either blind or deaf and bring light or sound to their consciousness. In this they have partly succeeded: when certain parts of their brains—the visual centers—were touched with probes carrying weak electric currents, flashes of light were distinctly "seen" by blind people. Similar probing of the auditory center of the brain, brought (confused) "sound" to the consciousness of deaf people. Neither experiments brought about true seeing or hearing; they produced only a *simulation* of these senses. But it was a beginning.

We can imagine a future means of bringing actual sound to the consciousness, not only of the totally deaf, but of those who cannot hear the higher register of sound, due to age or partial progressive deafness. We may call it *molecular bioacoustics.*

We can imagine an electronic molecular microwave generator, which gives out subatomic vibrations. When such a generator is connected to a standard high-fidelity or other electronic music source, molecular vibrations are set up in the room. These vibrations are not audible, but convey full and true sounds to the consciousness *by oscillating the hearing centers of the brain.*

By this method, the full range of music from 20 to 30,000 vibrations (cycles) can be heard, no matter what the age or state of hearing of the individual.

NOTE: The suggestions and ideas in this article are from the author's forthcoming book *Ultimate World.*—*H.G.*

*See "Stored Television Reception," RADIO-ELECTRONICS, January, 1959.
†Such a device has already been patented by Dr. Harry F. Olson of RCA (Pat. No. 2,461,344).
‡Encyclopaedia Britannica

**Encyclopaedia Britannica

COVER FEATURE

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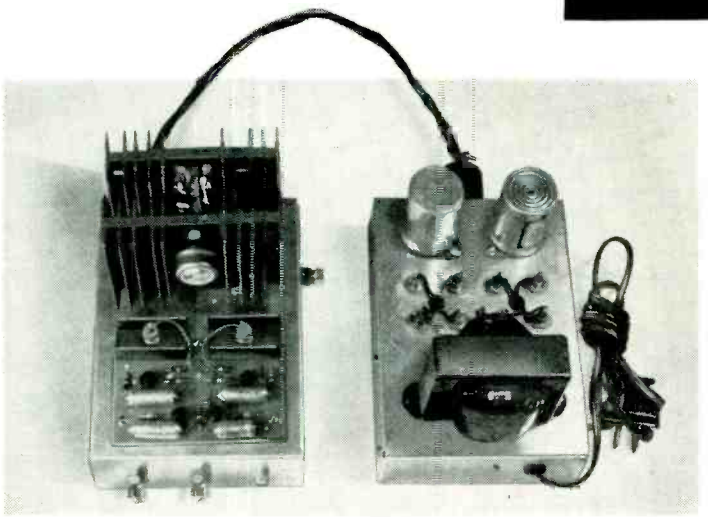
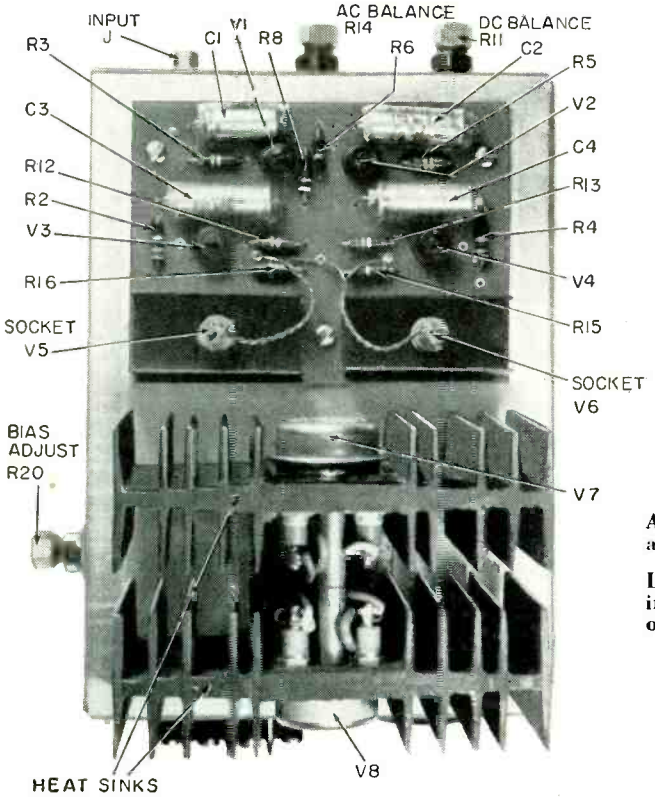
By DANIEL MEYER*





Above, the amplifier and power supply.

Left, top view, showing placement of parts.

THIS amplifier was designed for the second channel of a stereo high-fidelity system. Transistors are not as yet common in such applications, but they have advantages over vacuum tubes in power amplifier use, just as they do in preamps. They generate much less heat and are quieter than vacuum tubes. Distortion and frequency-response characteristics can be made comparible to vaccum-tube amplifiers if the power requirements are not too high. In view of its intended use, the following requirements were decided upon as the minimum acceptable characteristics for the amplifier:

- At least 8 watts output.
- Harmonic distortion below 2%.
- Response flat within ±0.5 db from 20 to 20,000 cycles.

As in vacuum-tube amplifiers, class-A operation is necessary if distortion is to be as low as possible. Several types of distortion are unique to class-B transistor amplifiers.[1] Possibly the hardest to correct is the variation in current-gain factor (beta) over the range of applied signal swing. This variation can differ from one transistor to the next, as can the value of beta at any given amount of collector current. This means matched transistors must be used to get a reasonable distortion level from a class-B amplifier. Even if this is done, there is no guarantee that the transistors will stay matched. (A 30% change in current gain in the first 1,000 hours of operation is not unusual.) In view of this, and since the higher efficiency possible with class-B operation is not an important factor in most high-fidelity applications, this amplifier was designed to use class-A circuitry throughout. It is still considerably more efficient than a vacuum-tube amplifier, since no filament supply is needed.

The circuit

The first thing to be considered was

The equipment matches or exceeds the author's claims and his frequency response and harmonic distortion curves are entirely accurate. Intermodulation tests showed no significant IM distortion over the usable range. Square-wave tests showed no appreciable distortion of square waves from 20 cycles to 6,500 cycles. From 6,500 cycles to 10,000 cycles only the higher harmonics were attenuated.

The amplifier has sufficient gain to be driven to a full 8 watts with the output of a 300-mv ceramic phono cartridge. Hum and noise level are down more than 48 db at 8 watts.

*Research engineer, Southwest Research Institute.

[1]Jones and Hilbourne, *Transistor A. F. Amplifiers*, Philosophical Library, Inc.

the output stage. Several available output transformers will give 8 to 10 watts output, but they are not high-fidelity type units. This meant that either a transformer would have to be designed and wound or an OTL design used. Transformerless operation eliminates a possible source of distortion, and also reduces the weight and cost. With transistors, this type of operation is especially attractive since a match to standard 4-, 8- or 16-ohm speakers is possible.

Investigation into OTL designs showed that some were undesirable. About the most attractive possibility has complementary transistors in the output stage. This was ruled out because there are no complementary power transistors available that will handle the desired output power. The amplifier must be compatible with presently available speakers, so circuits calling for a center-tapped speaker could not be used. Designs using capacitor coupling to the voice coil were also ruled out. An unreasonably large capacitor would be needed if an amplifier of this power rating were to be flat down to 20 cycles. All things considered, a bridge type output circuit seems to be the most desirable for an amplifier of this sort.

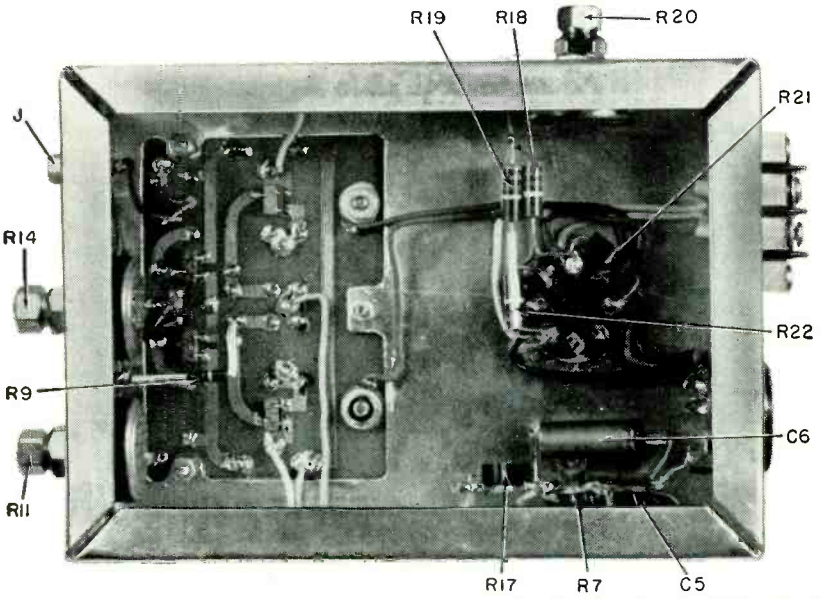
Fig. 1 shows the basic bridge arrangement. The bridge is balanced when the direct-voltage drops across circuit elements 1, 2, 3 and 4 are such that the dc potential across the speaker terminals C–D is zero, regardless of the dc potential across points A and B. In practice, the four elements may be transistors, batteries or other elements. An impedance change in one or more of them will make current flow in the speaker. Transistors may be used to effect such changes and deliver power to the speaker. Since no dc flows in the speaker, and a center tap is not required, conventional speakers can be used.

The amplifier's output stage is much like the bridge circuit used in the output stages of the power amplifiers formerly manufactured by Electro-Voice.[2] A simplified diagram of the output stage of this amplifier is shown in Fig. 2. For either transistor, half the load impedance is in the collector circuit and half in the emitter circuit. However, the collector load for one is the emitter load for the other. This type of operation provides a low output impedance and a large amount of degenerative feedback. The output signal is independent of power supply ripple to the extent that load-voltage excursions remain below the minimum instantaneous supply voltage. The peak-to-peak output voltage across the load can approach BATT1 plus BATT2. The maximum voltage across either transistor is, however, only half this voltage. The amount of zero-signal current in the output stage is determined by the amount of base current in the series combination of the base–emitter resistance of the transistor (V7 or V8), and the resistor from emitter to ground (R7 or R8 in Fig. 2). Since the resistors from emitter to ground are by far the larger of the two resistances, the output is supplied with an essentially constant current bias. This, plus the thermistor in the emitter circuits of V3 and V4, prevents a thermal-runaway condition from developing in the output stage under high ambient temperature.

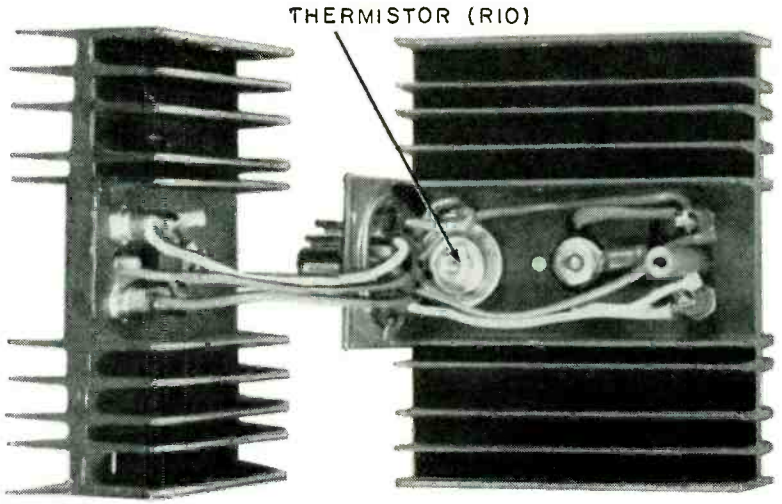
The voltage-amplifying portion of this amplifier (see Fig. 3) consists of a phase inverter, two push-pull voltage amplifiers and two emitter followers. The phase inverter is a transistor version of the long-tailed-pair phase inverter used in vacuum-tube circuits. It provides a reasonably high input impedance for the amplifier because of the large resistance common to the emitters of the first two transistors.

The push-pull signal from the phase inverter is coupled to the two push-pull voltage amplifiers. The voltage amplifiers are needed to get the voltage to

[2]Tomcik and Wiggins, "New Amplifier Has Bridge Circuit Output," *Audio*, November, 1954.



Under the chassis. Printed circuit board makes it neat and uncluttered.



Detail of output transistor plug-in unit. Disassembled, the position of the Thermistor is revealed.

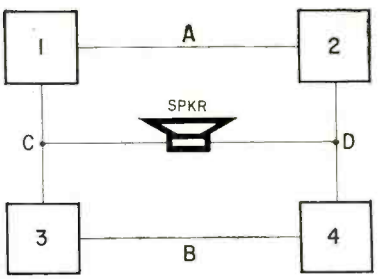


Fig. 1—Basic arrangement of the bridge output circuit.

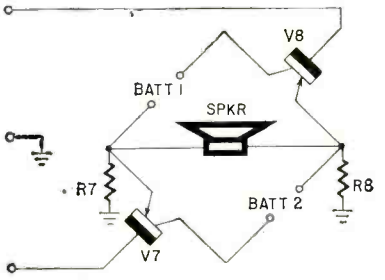
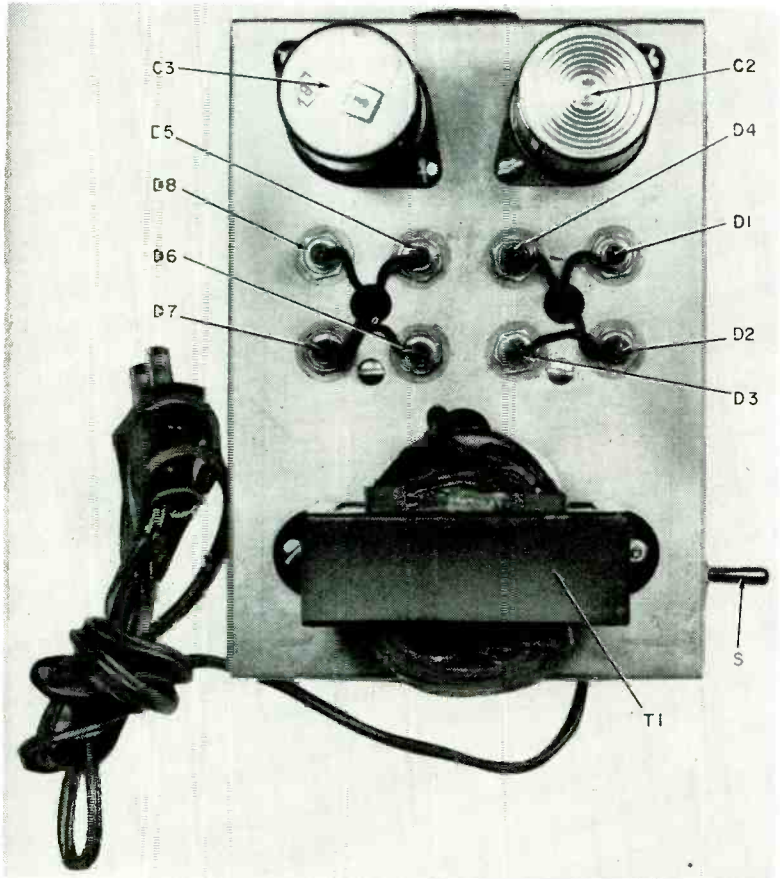


Fig. 2 — Output circuit used in the amplifier.

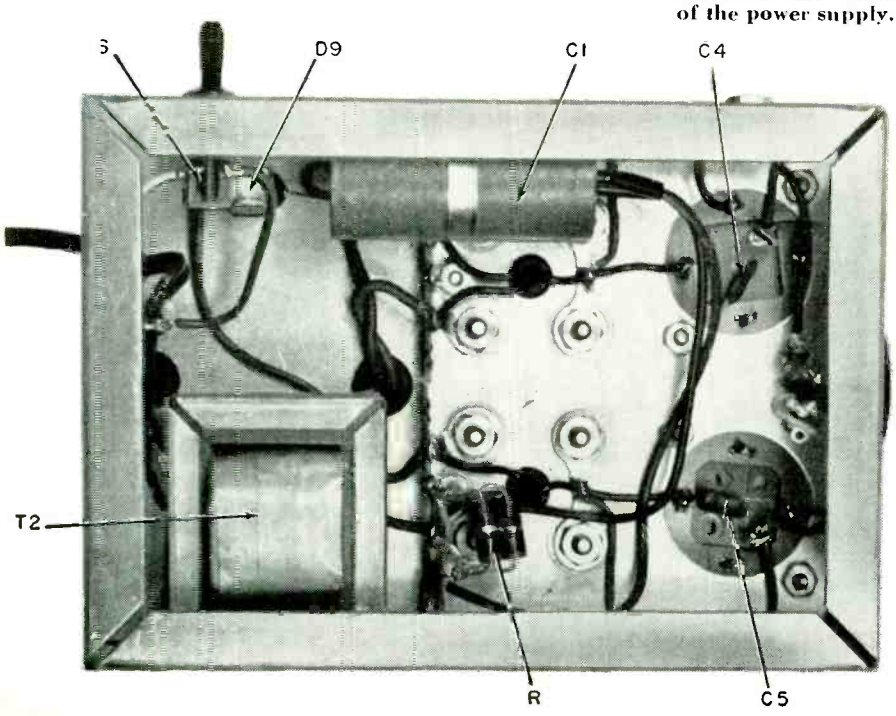
drive the output transistors. Each output transistor needs a peak-to-peak driving voltage equal to half the desired peak-to-peak output in the load.

The voltage amplifiers are direct-coupled to the two emitter followers, which in turn are direct-coupled to the output transistors. This provides a low-impedance constant-voltage driving source for the output stage. It is the most desirable type source for low distortion, because the input-voltage vs output-current transfer characteristics of power transistors are more linear than the input-current vs output-current characteristics, for the mode of operation used here.



Top view of the power supply. Diode rectifiers are stud-mounted units.

A look at the bottom of the power supply.



Construction

Parts layout is not critical. The pattern for the printed-circuit board used in the voltage amplifier section is shown for those who like to use this type of construction (see Fig. 4). If you use the printed-circuit board, it should be completely assembled before mounting on the chassis. Mount the board with fiber washers between it and the metal chassis. This prevents the creation of any accidental ground loops. The circuit should be grounded to the chassis only at the input jack.

The two output transistors and their heat sinks were made a plug-in unit in the original amplifier. This is easily done by bolting the two heat sinks together and mounting an octal plug on the bottom. The heat sinks used in the original amplifier are available from most Delco distributors as part No. 1221119. The small heat sinks on the emitter-follower transistors (V5 and V6) are 1¾-inch square pieces of 1/16-inch thick aluminum. These pieces are simply bent into a U around the transistors. **Do not skimp on any of the heat sinks.** Skimping can result in a runaway condition at high ambient temperatures.

The thermistor is bolted to the inside of one of the output transistor heat sinks. Insulate the thermistor washer from the bolt and the heat sink with mica washers. The thermistor specified is a washer type and has no leads. Contact should be made to each side with solder lugs cut to fit the washer. These can be made of shim brass or thin copper sheet.

The original amplifier used 2N107's for V1, V2, V3 and V4. But these were selected units, and not all transistors of this type would work well in the circuit. The 2N241's specified in the parts list are recommended. There are no direct replacements for V5 and V6. Do not attempt to use a different type transistor here.

The output transistors were chosen for their flat current-gain characteristics over the range of 0 to 2 amperes. Almost any of the large family of Delco power transistors available in the same style case could be used. I used 2N441's and 2N442's in my unit. However, these are not readily available. They can be replaced with the Delco DS-501, stocked by the Electronics Division of United Motors or Delco distributors. This is a higher-gain version of the 2N441 and 2N442. Be sure and use the mica insulating washer supplied with the transistors to insulate their cases from the heat sinks.

The power supply is the best that could be made with available transformers (see Fig. 5). If it were possible to buy a transformer that would allow full-wave rectification, instead of the two full-wave bridges used here, the number of rectifiers needed could be

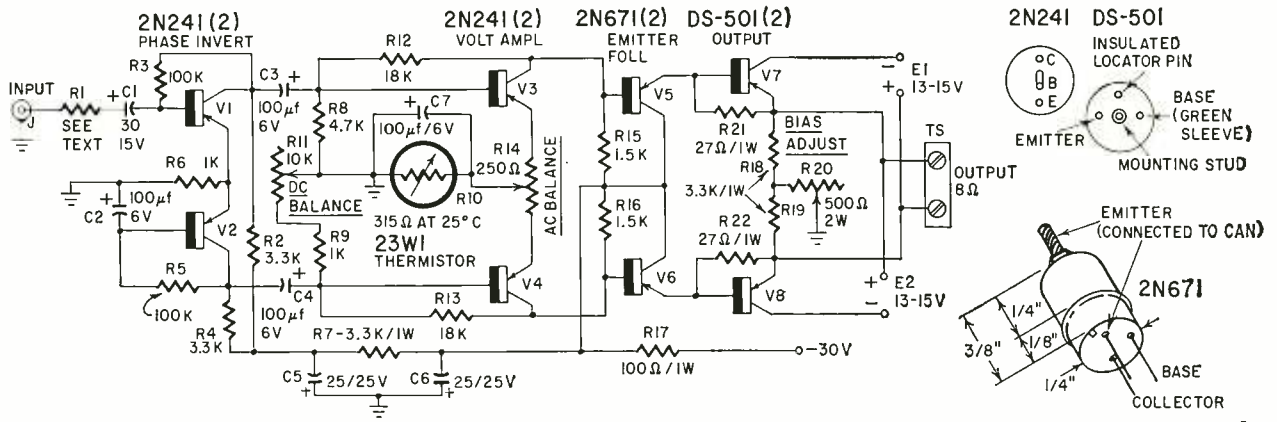


Fig. 3—It takes 8 transistors to make this quality audio amplifier.

R1—see text
R2, 4—3,300 ohms
R3, 5—100,000 ohms
R6, 9—1,000 ohms
R7—3,300 ohms, 1 watt
R8—4,700 ohms
R10—thermistor, 315 ohms @ 25°C, VECO type 23WI or equivalent
R11—pot, 10,000 ohms, linear taper
R12, 13—18,000 ohms
R14—pot, 250 ohms, linear taper
R15, 16—1,500 ohms
R17—100 ohms, 1 watt
R18, 19—3,300 ohms, 1 watt
R20—pot, 500 ohms, linear taper
R21, 22—27 ohms, 1 watt
All resistors ½-watt 10% unless noted
C1—30 μf, 15 volts, electrolytic
C2, 3, 4, 7—100 μf, 6 volts, electrolytic
C5, 6—25 μf, 25 volts, electrolytic
J—phono jack
TS—2-terminal barrier type terminal strip
V1, 2, 3, 4—2N241
V5, 6—2N671
V7, 8—DS-501
Octal sockets (2)
Octal plugs (2)
Chassis—to suit
Miscellaneous hardware
Heat sinks for V5 and V6 (see text)
Heat sinks for V7 and V8 (Delco 1221119 heat radiator package or equivalent) (Available from United Motors, Delco distributors or Delco Radio Div., General Motors Corp., Kokomo, Ind.)

cut in half. The transformer that supplies the −30 volts to operate the voltage-amplifying stages is a rewound Stancor PS-8416. The filament and high-voltage windings were removed, and 500 turns of No. 34 magnet wire wound on top of the original primary. If you would like to wind one transformer for all the needed supplies, the necessary secondary voltages are: two 32-volt ct at 1 amp, and one 50-volt 75-ma. Such a transformer would make a much neater and simpler power supply than the one shown. The rectifier for the −30-volt supply is mounted with a capacitor clip in the original unit. The rectifiers in the two bridges were mounted on the chassis. The instructions for mounting given with these rectifiers should be followed.

Adjust before using

Turn the bias adjustment control to its maximum-resistance position, and center the ac and dc balance controls. With the amplifier turned on, adjust the dc balance control for zero voltage—measured from V3's collector to that of V5. Do this with a dc meter set on its lowest range. Bias control R20 should now be set to give an 800-ma zero-signal current in the output transistors. This measurement can be made by temporarily putting an ammeter in series with one of the output stage power supplies (E1 or E2). A switch type jack for this purpose may be in-

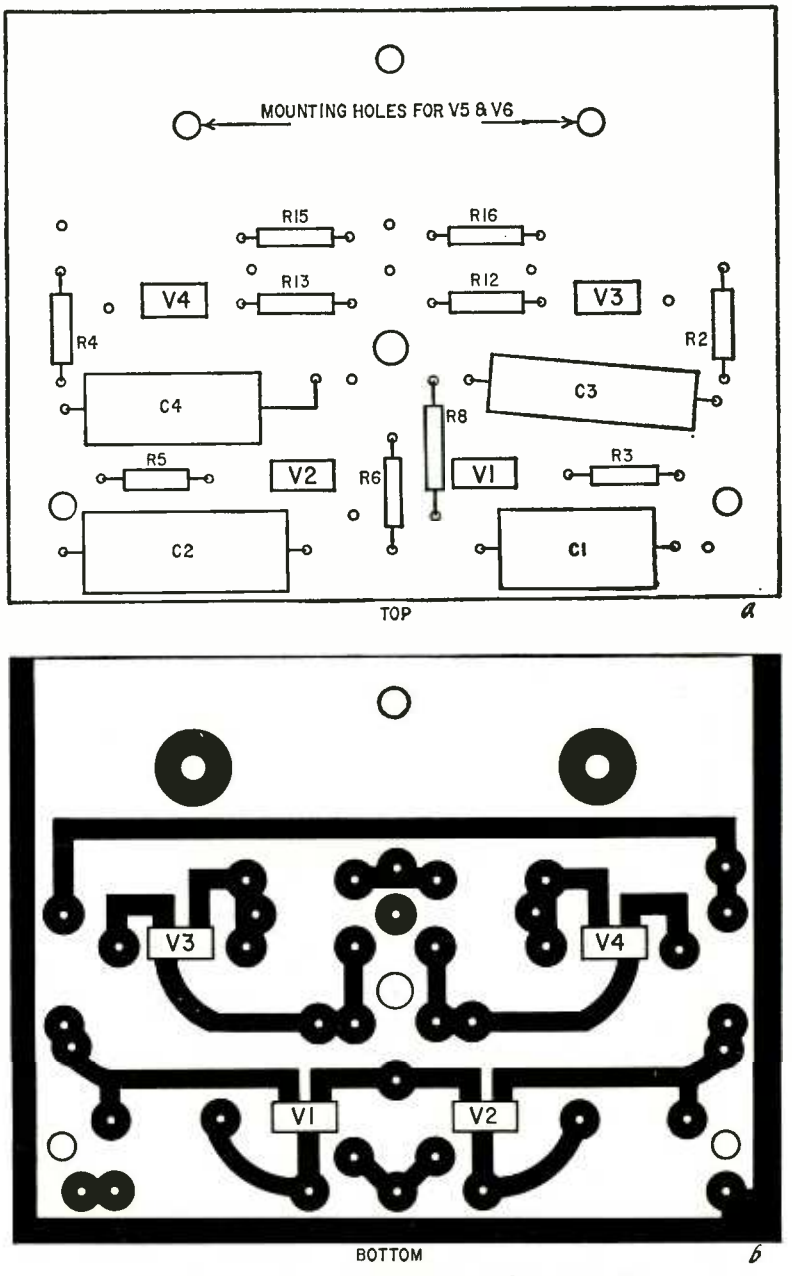
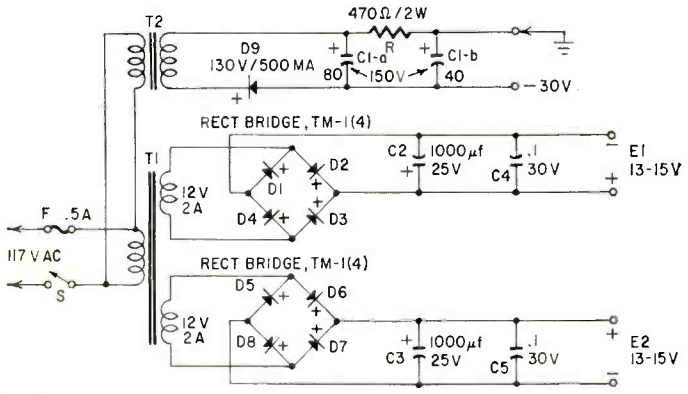


Fig. 4—Actual-size printed-circuit board for the voltage amplifier section of the unit. Of course, point-to-point wiring can also be used.



R—470 ohms, 2 watts
C1—80-40 μf, 150 volts
C2, 3—1,000 μf, 25 volts, electrolytic
C4, 5—0.1 μf, 30 volts, ceramic
D1, 2, 3, 4, 5, 6, 7, 8—1 amp, 50 volts (Transitron TM-1, GE IN1115, International Rectifier 3ATI)
D9—silicon rectifier, 500 ma, 130 volts
F—0.5 amp
S—spst toggle
T1—power transformer: primary, 117 volts; secondary 12 volts, 2 amps; 12 volts, 2 amps (UTC FT-10 or equivalent)
T2—power transformer rewound as per text (Stancor PS-8416)
Chassis—to suit
Miscellaneous hardware

Fig. 5—Two-transformer 9-diode supply delivers operating power to the amplifier.

cluded in the power supply if desired. The adjustment should be checked after about ½ hour of operation and reset if necessary. Adjust the ac balance control for a null at the junction of resistors R18, R19 and R20. This may be measured with either an ac voltmeter or an oscilloscope while feeding a signal into the amplifier with an audio oscillator. Check the dc balance again after adjusting the ac balance. The two controls interact to some extent. This completes the adjustment procedure and the amplifier is ready for use or testing.

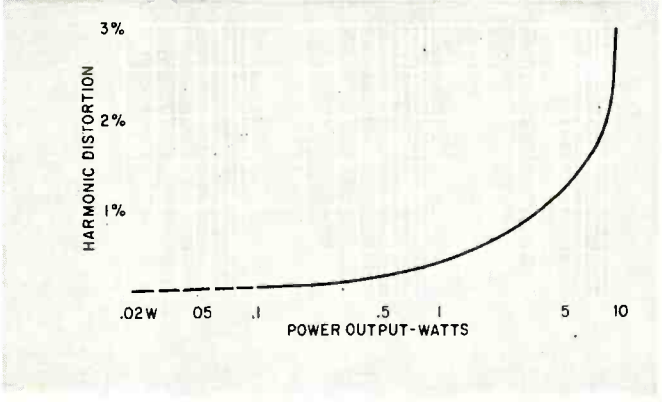


Fig. 6—Harmonic distortion vs. power output measured at 1,000 cycles.

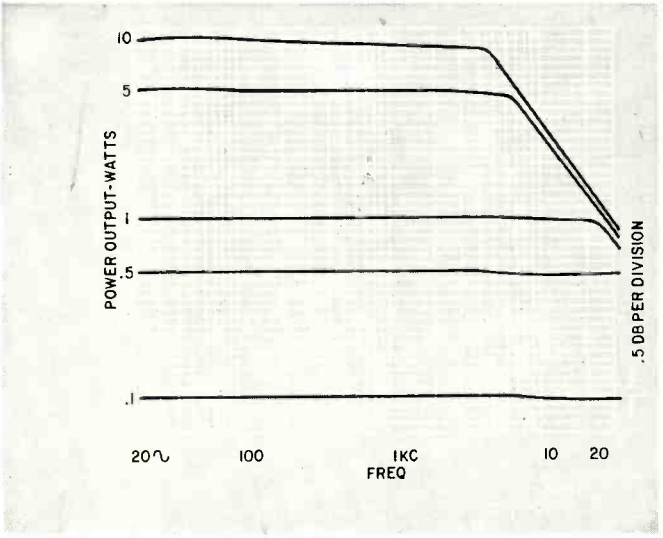


Fig. 7—Curves showing relation between power output and frequency.

Test results

The distortion vs output-power curve shown in Fig. 6 was plotted with a Hewlett Packard model 201B audio oscillator and a Donner model 21 wave analyzer. The frequency-response curves in Fig. 7 were plotted with a Mosley X-Y recorder and a Hewlett Packard model 207A sweep type audio oscillator. All tests were made with an 8-ohm resistive load on the output. OTL operation makes it necessary to design for a specific value of output load. This amplifier was designed to work into an 8-ohm load. A different voice-coil impedance will result in less available output power. It would be necessary to redesign the output stage to get full output with other than an 8-ohm load.

Resistor R1 is put in the input of the first stage to provide it with a current source. This resistor should be about 4,700 ohms. With this value of resistance, the original amplifier had a sensitivity of 0.4 volt for full output. Slight changes in the value of this resistance to adjust the sensitivity of the amplifier are OK. A pot is used as an input level control on a later version.

When working with this amplifier, do not short the case of V5, V6, V7 or V8 to any other part of the amplifier while it is on. The cases are internally connected to the elements inside the transistors, and shorting them could seriously damage the transistors.

Neither side of the output on this amplifier should be grounded. Its output is balanced to ground and half of the output signal appears between each side of the output and ground.

You will note that Fig. 7 shows a reduction in output power at higher frequencies. This is due to the low beta cutoff frequency of the power transistors. Actual performance of the amplifier on program material does not suffer since the power level in music and speech tends to decrease as frequency increases.

Warning: do not test this amplifier for maximum power output at higher frequencies for any great length of time. The drop in beta in the power transistors is accompanied by a phase shift and a reduction in transistor efficiency. Prolonged testing at high frequencies can cause a rapid rise in junction temperature and possibly ruin the transistor. If such tests are made, an ammeter should be used in series with the output transistor power supply. The meter will give a quick visual indication if a runaway condition develops.

The amplifier meets or exceeds the requirements set for it. A listening test will verify this. The low distortion level and almost complete absence of any hum will make this amplifier a pleasure to hear.

The author wishes to thank John M. Prucha of Southwest Research Institute for his many valuable suggestions on the design of this amplifier, and also Southwest Research Institute, whose instruments were used in testing the completed amplifier. END

Stereo on tape is not new, but the machines used to record and reproduce stereo sound are

TAPE MACHINES for STEREO

By CHARLES B. GRAHAM

A FEW years ago it was difficult to find a tape recorder that could be easily connected into a hi-fi system. Either it didn't have an output jack or the one it had wasn't connected to the output of a cathode follower so the connecting cable had to be kept short. Usually the output stage had little feedback and a miniature transformer to get the most sound, however distorted it might be, from the playback.

Today, all that has changed. Almost every recorder we looked at had been engineered with the hi-fi enthusiast—the lover of the recorded sound—in mind.

Looking over the recorders available today, we found a strong trend in home and semiprofessional machines toward units that play back *and record* both two- and four-track stereo and mono tapes. Of the over 35 widely sold tape recorders which play stereo tapes, at least 20 can also record in stereo. And most of these can record *either two or four* tracks.

To assist the prospective purchaser, RADIO-ELECTRONICS contacted every known manufacturer of tape recorders. We compiled a chart that shows many of the facilities of machines now on the market. The chart is divided into two major sections, the first dealing with over 25 of the most popular tape recorders, most priced below $500. The second section deals with machines costing between $500 and $1,000. Recorders selling for more than $1,000 are for professional use only, and run as high as $5,000.

Recorders which cannot play stereo tapes (with the exception of a few high-quality miniature-portable units) are excluded because there are so many such machines. The miniature recorders listed represent another new trend, with their surprisingly good recording characteristics despite their extreme portability.

A few of the least expensive record–playback tape units, along with some intended primarily for dictation, remote-broadcast (spring-wound) pickup and other special purposes are also excluded.

There is a growing number of tape *decks* with heads set up for both two and four tracks. A tape deck is the easy way to add tape to an existing system, since today's stereo preamp–control units and stereo amplifiers all have tape-head inputs and preamplifiers. All the hi-fi man has to do is buy a tape deck for only $100 to $200 and add it to the stereo electronics already on hand, providing stereo tape playback. Later the stereo recording amplifiers can be bought or put together from one of the several kits now on the market.

About the chart

This is not intended as a directory of every model made by every manufacturer of tape recorders. Instead it is a listing of representative machines, describing numerous features and indicating trends. It can be useful to those considering buying a stereo tape recorder, **but should not be the basis for purchasing.** Rather it may serve to indicate whether a particular machine has or does not have certain specific features. After studying the chart, the prospective purchaser can examine the machine(s) he has found most interesting.

Features which all machines have are not included on the chart. For example, all recorders now have a safety interlock arrangement for Record. That is, a separate lever or button must be depressed with one hand *while* the *other* hand turns the selector to Record. The features which are listed are new or vary from one maker to another.

The number of recorders already equipped for four tracks, together with those whose manufacturers will soon join in, along with the long-heralded appearance of four-track tape cartridge-playing machines, indicate that four-track tapes may soon become the standard for all but professional recording. Prerecorded stereo tapes now available include reel-to-reel 7½-ips 2-track, reel-to-reel 7½-ips 4-track, and cartridge loading 3¾-ips 4-track. These last can be played on reel-to-reel 4-track machines by reloading the tape onto 5-inch reels. Most four-track machines not only record stereo both two- and four-track, but can record four individual monophonic tracks as well. This provides such extended recording time on most machines, even with full-thickness 1½-mil tape, that increasing numbers of people are likely to take to using 5-, 4- and even 3-inch tape reels.

Without exception, every stereo tape machine runs at both 7½ and 3¾ ips. In addition, a few include 1⅞ ips, and more will add this speed in the future as head designs continue to improve. Present recording–playback heads with best high-frequency response have a gap width of 90 microns, although the majority of the under-$500 units have heads with 120-micron gaps.

Most machines have cathode-follower outputs (or heavy feedbacks) to facilitate the use of external amplifiers and high-fidelity systems. And all the recorders surveyed were found to have provision for such connection, though the less expensive ones didn't have low-impedance outputs. Instead, they usually came right off the output transformer's secondary, thus keeping the

STEREO TAPE MACHINES

	Model	Playback (Tracks)	Stereo Record (Tracks)	Speed Besides 3¾, 7½	Hys Sync Motor	Chan 1 Amp	Chan 1 Spkr (in.)	Chan 2 Amp.	Tone Cont.	LO-Z Out	Monitor Head	Record Indicator	Index Counter	2–4-Track Switch	Price (incl.case)†	Case Extra
AMPEX	902	2, 4	—	—	—	PRE	—	PRE	—	2	YES	METER	YES	MECHAN	$449.50	$45
BELL	T-228	2, 4	2	—	—	PRE	—	PRE	—	2	—	EYE	YES	SEP HDS	$329.95	$34.95[2]
CROWN	GCSP	2[1]	—	15	YES	PRE	—	PRE	—	2	AVAIL	2 METERS	—	—	$505.00	$50–60
HEATH	TR10	2	—	—	—	PRE (KIT)	—	PRE (KIT)	—	2	—	METER	YES	—	$169.50	NO CASE
MAGNECORD	102	2	—	—	—	PRE	—	PRE	—	2	AVAIL	2 METERS	—	SEP HDS	$449.95	$30
NORELCO	CONTINENTAL	2, 4	4	1⅞	—	5 W	5	PRE	1	—	—	METER	YES	NO SWITCH	$299.50	—
	STEREO-400	2, 4	2, 4	1⅞	—	5 W	4 x 6	5 W	1	—	—	EYE	YES	NI	$399.50	—
PENTRON	NL-4	2, 4	2, 4	—	—	P.P. 10 W	4 x 6 (2)	P.P. 10 W	2	—	—	2 EYES	YES	MECHAN	$375.00	—
	XP-605	2, 4	—	—	—	P.P. 10 W	TWO	PRE	1	—	—	EYE	YES	MECHAN	$199.50	—
	TR20	2, 4	—	—	—	10 W	—	10 W	1	—	—	METER	YES	MECHAN	$269.00	—
RECORDIO	592	2	—	—	—	3 W	5 x 7 (2)	3 W	1	—	—	EYE	YES	—	$219.50	—
REVOX	D36ST	2, 4	2	—	YES	6 W	8	6 W	1	2	YES	EYE	YES	SEP HDS	$429.00	—
ROBERTS	90C	2 4	2, 4	—	YES	6 W	5 x 7	PRE	1	2	—	METER	YES	NI	$349.50	—
SONY	DK55A	2	2	—	YES	6 W	—	6 W	1	2	—	2 METERS	YES	—	$465.00	—
TANDBERG	5	2, 4	—	1⅞	—	3 W	5½ x 8	3 W	—	—	—	EYE	YES	NO SWITCH	$399.50	$22 [3,4]
	5-2	2, 4	2 4	1⅞	—	3 W	5½ x 8	3 W	—	—	—	EYE	YES	NO SWITCH	$469.50	$20 [3,4]
TAPESONIC	70CBL	2[1]	—	15	YES	P.P. 10 W	8	—	2	1	YES	METER	YES	—	$446.75	—
TELECTRO	400	2. 4	2, 4	1⅞	—	8 W	TWO	8 W	1	—	—	2 NEONS	YES	NO SWITCH	$289.95	—
TRUVOX	360-62	2	2	—	—	4 W	6 x 10	4 W	—	2	—	EYE	—	—	$495.00	—
V-M	720	2, 4	2	—	—	8 W	6 x 9, 3.5 (2)	PRE	2	—	—	EYE	YES	—	—	—
WEBCOR	2008	2, 4	—	1⅞	—	8 W	TWO	8 W	1	—	—	EYE	YES	MECHAN	—	—
	2007	2 4	2, 4	1⅞	—	8 W	TWO	8 W	2	—	—	METER	YES	MECHAN	—	—
WEBSTER ELEC	350	2, 4	—	—	—	12 W	6 x 9	12 W	1	2	—	METER	—	MECHAN	$455.50*	—
WOLLENSAK	T-1616[5]	—	—	—	—	P.P. 10 W	4 x 6	PRE	—	—	—	EYE	YES	MECHAN	$279.50	—

CARTRIDGE (RCA-TYPE) MACHINES

BELL	402	4	—	3¾ only	—	PRE	—	PRE	—	2	—	—	—	—	$129.95	—
	403	4	4		—	PRE	—	PRE	—	2	—	2 METERS	—	—	$199.95	—
	404	4	4		—	7 W	—	7 W	—	2	—	2 METERS	—	—	$229.95	—
RCA	SCP-2[4]	4	4		—	4 W	6½, 3½, (2)	4 W	2	—	—	2 NEONS	—	—	$299.95*	—
ROBERTS	ADAPTER[6]	4	—		—	(See Mdl. 90C)	—	—	—	—	—	METER	—	—	$75.00	—

HIGHER-PRICED MACHINES

AMPEX	952	2, 4	2	—	—	PRE	—	PRE	—	2	YES	METER	YES	MECHAN	$595.00	$55
	676	2	2	7½ or 3¾	YES	PRE	—	PRE	—	2	—	METER	YES	—	$950.00	$45
CONCERTONE	33	2	2	7½; 3¾ or 15	YES	PRE	—	PRE	—	2	YES	METER	—	—	$995.00	$60
	MARK VII[6]	2, 4	2, 4	7½; 3¾ or 15	YES	PRE	—	PRE	—	2	YES	2 METERS	—	SEP HDS	$995.00	$45
CROWN	GC5X-4	4	4	15	YES	PRE	—	PRE	—	2	YES	2 METERS	—	—	$710.00	$50–60
FERROGRAPH	808/2 or /4	2 or 4	2 or 4	7½, 15	YES	PWR AMP	YES	PRE	—	2	YES	METER	YES	—	$595.00	—
MAGNECORD	728-4X	2, 4	2 4	—	YES	PRE	—	PRE	—	2	YES	2 METERS	YES	SEP HDS	$759.00	$50
NEWCOMB	SM310	2, 4	2, 4	—	YES	PRE	—	PRE	—	2	YES	2 METERS	YES	SEP HDS	$595.00	—
SONY	DK55A4	2, 4	2	—	YES	6 W	—	6 W	1	2	—	2 METERS	YES	SEP HDS	$540.00	—

[1]4-track head on special order.
[2]Price for carrying case.
[3]Foot-control models available.
[4]In portable case; other models soon.
[5]For Roberts 90-C & similar machines.
[6]Remote control $52.50.
†Audiophile prices net, except where followed by asterisk, indicating list price. May vary with time and geographical location.
*List price.

TAPE DECKS

Make	Model	Speed Besides 3¾ & 7½	Hys Sync Motor	Stereo Play Electronics	Stereo Rec/Play Electronics	Price (Deck only)	Price Incl. Rec/Play Elec
ARKAY	MS-5	—	—	KIT	KIT	$125.95	(NOT AVAIL)
BELL	T-223	—	—	$40 (×2)	$60 (×2)	$169.95	$269.95
	401	3¾ ONLY	—†	$40 (×2)	$60 (×2)	$99.95	$199.95
CROWN	ECT	15	YES	$57 (×2)	$190 (×2)	$270.00	$650.00
HEATH	TRIAQ	—	—	KIT (INCL.)	KIT (INCL.)	$149.95	$149.95
PENTRON	TM4X	—	—	$18 (×2)	$100	$109.95	$189.00
ROBERTS	190-D-4	—	YES	—	$119.50	$189.95	—
TELECTRO	900-5	1⅞	—	$27.50 (×2)	$65.00 (×2)	$126.25	$250.25
TRUVOX	MK IV	—	—	—	$99.50 (×2)	$215.00	$414.00
VIKING	85ES	—	—	$28.50 (×2)	$77.50 (×2)	$147.00	$234.00
	85ESQ	—	—	$29.50 (×2)	$118.00 (×2)	$172.00	$286.00
WEBSTER ELEC.*	360	—	—	$70.00	$199.00	$124.00	$313.00

*Webster Electric prices are list. †RCA type cartridge machine.

transformer and power output tube(s) in the circuit. A number of recorders included two power amplifiers for stereo playback.

Without exception, they all have jacks for connecting larger external speakers to replace the necessarily small speakers in the machines.

Accessory speakers

Most manufacturers of home machines offer companion speaker–amplifier units, either with speaker, amplifier and case closely matching those of the recorder, or with larger speakers and case with a 10-watt push-pull amplifier for the second stereo channel. These units run from $60 to $200. Of course, almost any of these companion units may be used with any recorder preamp regardless of make. About the best reason for using both recorder and supplementary amplifier–speaker of the same manufacture is so they'll look alike and will be about equally efficient, an important factor in left-right switching.

Extra features

Every tape recorder we've come across today has both a high-gain microphone input and a medium-gain input for a crystal phonograph or tuner.

With the exception of some machines costing over $400, today's tape recorders use standard phono or phone plugs for all input and output connections. Some of the more expensive models still use broadcast type connectors.

A great many machines, including the less costly ones, have tape-lifting fingers or other means for keeping the tape away from the heads during high-speed forward or rewind. Surprisingly, some of the very finest mechanisms do *not* have this provision. It is advisable when using such a recorder, to slip the tape out of the head assembly and let it run free during high-speed rewind or forward if the whole reel is to be wound.

Many units, including V-M, Pentron and Webcor models, allow automatic cutoff at the end of tape travel. This is done by running the tape against a microswitch in series with the main on–off switch, in such a way that the switch opens when the tape runs out. The V-M 720, for example, even has an ac utility outlet at its rear which is controlled by the auto-trip switch.

Another desirable feature which is beginning to make its appearance is the speaker disabling switch. In the early days, the use of the microphone position automatically cut out the loudspeaker, to prevent acoustic feedback. This was carried even further in recent years, with most tape recorders having the switching so set that any recording position automatically kills the audio. Now a number of makers are giving the recordist the option of leaving the speaker either on or off during recording, to enable him to monitor the program material. This is not *monitoring the recording*, however. Many people have confused these two types of monitoring and may be misled by the word "monitor" on some low- or medium-priced machines. In those cases there is no separate playback head and preamplifier, both of which are required for instantaneous monitoring of the actual recording, *after* it has passed the recording head.

Some medium-price recorders have a magnetic phonograph preamplifier in addition to the tape-head preamp(s). This permits playing LP's directly into the tape recorder, without intervening amplifiers, and can be a very convenient feature in some special situations.

The neon record indicator which was almost universal a few years ago is now almost entirely replaced by the electron-ray "eye" tube, which in most cases is quite satisfactory. And there are now almost as many models using meters for riding gain as those still using the green electron-ray tubes.

A number of machines have automatic rewind and repeat provision. This is operated by affixing a piece of metal foil at one end (or both), of the tape, which closes a pair of contacts placed in the path of tape travel. This actuates a relay inside the recorder, which then reverses the direction of tape travel.

To play four-track tapes instead of two-track, the lower-price machines (and some of the more expensive ones too) have a lever or screw which can be quickly moved to change the number of tracks accommodated. The most expensive machines have separate heads for quarter-track tapes.

Almost every home recorder now has at least one tone control, and many have gone over to full bass and treble controls. And at least one maker, V-M, has left the treble control in the circuit during *record*, to enable extra equalization of the highs in record. This is a welcome feature if not carried too far.

Although the speakers in most recorders continue to be one or two comparatively small ones, they are almost all replaceable with external speakers by simple plug-in to the "External Speaker" closed-circuit jack which disables the internal speaker or speakers. END

MINIATURE RECORDERS
(Not Stereo)

Make	Model	Speed	Record Time (Min.)	Standard Reels	Record Indicator	Built-in Mon. Spkr.	Batts. Recharge	Batt. Life (Hours)[1]	Size (In.)	Weight (Lbs.)	Price
AMPLIFIER CORP. OF AMER.	312-C	3¾	45	YES	METER	NO	YES	40	12 x 9½ x 9	8	$448.00
FI-CORD	2	1⅞, 3½	15	YES	EYE	YES	YES	3	10 x 5 x 2½	4	$330.00
MOHAWK	500	3¾	22½	SPCL. CART	METER	NO	NO	50	8½ x 4 x 1⅞	3	$359.50
STELLAVOX	SM-4	7½	15	YES	EYE	YES	YES	3	11 x 5 x 2½	4	$399.00
STUZZI (Ercona)	PRO	7½	15	YES	METER	YES	NO	30	11 x 4½ x 8	8	$369.50
TRANSITAPE	1	1⅞, 3¾	22½	YES	NEON	YES	NO	50	9¾ x 6½ x 3	6½	$216.00

[1]At top speed. [2]Without charging.

HI-FI SERVICING NEEDS new methods

First of a series on high-quality audio service, this story tells how to set up a working hi-fi repair shop; the instruments you need and the cost to your customer. The next article gives step-by-step procedures

By FELIX BREMY*

ELECTRONIC servicing is a constantly changing field and, to be successful, the service shop must change with it. We got started in 1946 and fared especially well during the TV boom years from 1948 to about 1952. At first, TV sales were our major income source, but as the market approached saturation more and more sales went to the discount houses so our business concentrated in the servicing end.

In 1952, hi-fi was breaking loose, so we decided to include facilities for hi-fi sales in our plans to reconstruct and modernize that year. This gave us a steadily growing hi-fi component sales business that naturally led to servicing this equipment. This was where the need for new methods arose.

We had been following the methods previously used for radio and TV—check tubes, check voltages, etc. But they proved inadequate for the higher performance standards built into hi-fi equipment. Where the radio or TV owner is easily satisfied if it plays and sounds reasonably good, the hi-fi owner expects, and is entitled to expect, higher performance standards. We were often faced with the dilemma, "Is this the best this amplifier will do?"

We decided there was only one way to solve this problem—get test equipment that would enable us to determine the performance of the equipment exactly. That is now behind us, and is proving very successful. So we want to pass on some of the results of our experience as an aid and encouragement to others who may be facing the same problems.

There are so many performance checks to make on a hi-fi system that it is best to set the whole thing up as a routine procedure and have done with it. The routine can be followed through with each amplifier, preamp, tuner or what-have-you in a minimum of time, without getting into a situation of "chasing yourself in circles" to find an evasive fault.

This approach has so many advantages that we now see it as the only way to handle hi-fi service. In the first place, it is the quickest and most direct way to find the trouble in a system. This alone means the method pays off.

In addition, it builds customer confidence. Evidence of the consumer acceptance the method brings us is seen in the distances some of them come for our service. Of course, this is partly because, where the radio or TV owner merely wants to "get it fixed" the hi-fi owner is much more discriminating; he wants it to "sound better."

One of the things people ask us is whether we can justify the cost of this approach. We can, by scaling our charges to cover it. Our standard shop rate for radio or TV service time is $6 an hour. To cover the increased cost of the hi-fi approach, test instruments, etc., our audio laboratory rate is $10 an hour.

At first sight, this looks like a rather steep increase. But the consumer does not balk at paying it *because the time saved by our better service methods more than compensates for the higher rate so that the overall charge is no more than he would pay elsewhere.*

You and your customer

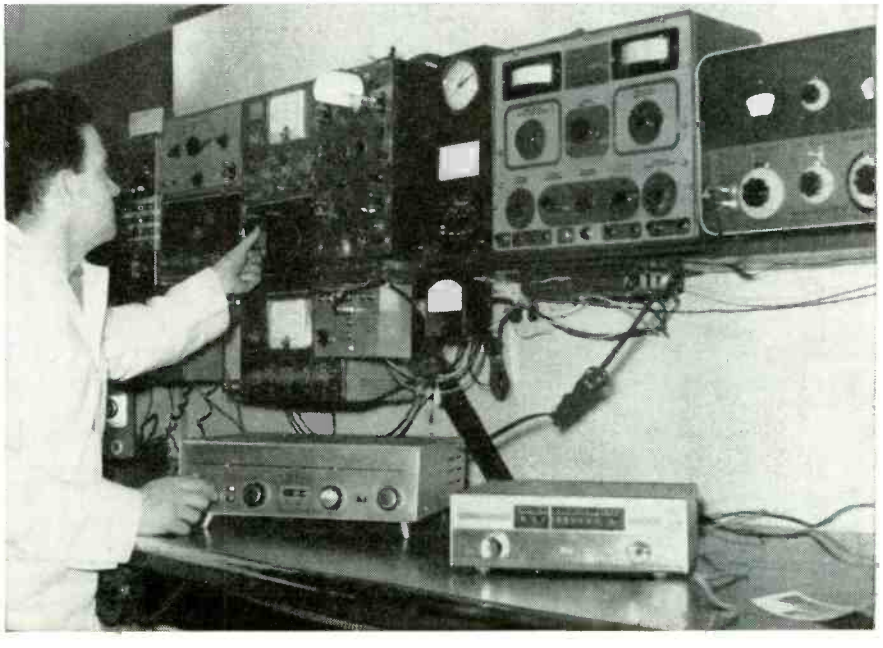
Anyone in the service business for any time must have been at both ends of the "sequence" type case, a set that started with a dried-out electrolytic, replaced by one service shop. Later a different breakdown occurs due to the restored voltage. It is repaired by another service shop. And finally a tube goes bad and is replaced by yet a third shop. To the consumer, the first two were "gyps" and the last an honest guy. With that kind of deal, it's just luck which end you happen to be at. This doesn't happen in audio servicing.

It helps you and boosts customer confidence to use some kind of test report form. It gives you a case history of the equipment for future reference and never fails to impress on the customer that he is getting his money's worth at your establishment. In the latter connection, too, we do not create an air of secrecy with "no admittance" signs, but encourage customers to see our audio test facilities and watch our technicians while they service the equipment.

Another confidence builder is a clean service area. We vacuum frequently and use paint liberally and often. The neat array of instruments and business-like forms we use also helps.

Test instruments you need

But what equipment do you need to get into audio servicing? Fortunately, this is flexible and can be adjusted to anticipated work. We can tell you what



*Owner, Bremy Electronics, 394 E. 18 St., Paterson, N. J.

we have and make some suggestions on variations for different circumstances.

The first necessity for proper audio testing is an audio oscillator or audio signal generator. We chose the Heath AG-8, which proves quite adequate. We preferred the continuously variable frequency feature of this unit to the decade frequency switching of the AG-9, even though the latter's distortion is lower.

The more recent AG-10 is undoubtedly an improved instrument, which we would get if we were starting now. We chose a kit because of the considerable cost saving, as compared with any assembled and calibrated instrument. The kit is adequate for our purposes in both accuracy of calibration and distortion content.

For the output end, an accurate audio voltmeter and some way to measure distortion are musts. We use a Heath AV-3 as a general-purpose audio vtvm, an HD-1 for harmonic-distortion measurements and an AA-1 for intermodulation tests.

If you have more money than time to invest in your instruments, you can buy finished and calibrated instruments for any of these purposes.

A good oscilloscope is another necessity. You need it to look at what you are reading on the instruments. Features that make a scope ideal for audio work are a little different than for radio and TV work but, if you have a good one already, it will probably serve. Ours is a Dumont 224-A, rather dated, but satisfactory.

So we could make really accurate frequency-response tests, we invested in a General Radio 1450-TB decade attenuator, the one with three decade switches, giving control of level measurements to steps of 0.1 db. Extremely accurate, it avoids the little inconsistencies found in less precise instruments for this purpose. Less expensive instruments could be used. Probably for practical purposes they would be accurate enough. But when we started there was a craze to see how flat an amplifier could be made, and the figure of 0.1 db had a magnified importance to many hi-fi people. A two-switch type, giving 1-db steps, really tells you as much as is meaningful in terms of audible performance.

Special equipment

Accurate testing in any of the hi-fi areas (frequency response, power or distortion) is impossible if your line voltage fluctuates as ours does—and we have yet to find a location where it doesn't. To overcome this annoyance we have a Powerstat, made by Supreme Electric Co., in the main feed to the service bench, so fluctuations can be compensated as they occur. Then we use a Weston 744 ac voltmeter as a "standard" to hold it by. We had the meter calibrated around 117 volts by a meter specialist recommended by Weston for our area. Meter plus calibration cost us $44, an extremely worth-while investment.

So much for basic audio testing. Now we come to FM tuners. For general-purpose alignment, or for tuners not among the best, we still use a Hickok model 288X. But for really accurate work we have a Measurements Co. (Boonton, N. J.) model 210A. This is an expenditure you have to be able to justify in terms of FM servicing business. But we have found it worth while. We can now return the best tuners to their owners in top working shape, which previously was impossible. The charge may be a little greater, but the job it does justifies the set owner's original purchase of a more expensive tuner, which run-of-the-mill aligning never could.

Tape recorders need speed checks, so we have a Scott Instrument Labs speed indicator for measuring the actual tape speed past the heads. Flutter and wow, for both tape and disc, are something at present we can only listen for. We would like to be able to measure them quantitatively, but are still searching for the right unit for our purpose.

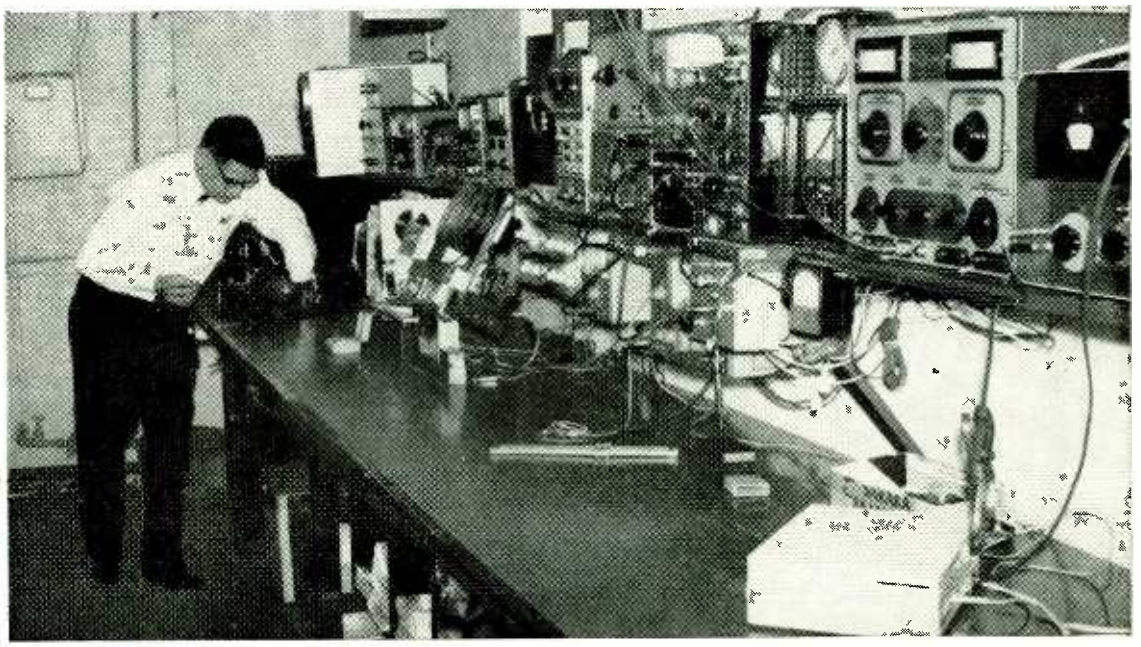
We measure stylus pressure on the disc with an Arpo pressure gauge, a French-made item obtainable through Geo. Scherr Co., 200 Lafayette St., New York. This is an important thing to be able to measure, and the cost of this item is very reasonable.

Finally, we find it essential to have a complete basic system, stereo, so the component being serviced can be substituted and given a thorough listening test. This is a great way to satisfy the customer too. By using top-grade components in the system, they can also be used for some measurement purposes as well. We use two Dyna Mark III 60-watt power amplifiers with their preamps, using their stereo conversion kit and front plate. We mounted the preamps on a swing bracket to provide ready access to the rear connections.

We use two extended-range 8-inch test speakers right at the test bench for easy recognition of major stereo defects. A selection of larger speaker systems, with 15-inch woofer, mid-range and horn tweeters are located farther back in the room for listening tests.

To complete the picture, a good turntable, arm and stereo cartridge, a high-quality stereo tape deck and a properly aligned FM tuner, provide test bench sound sources. All items used in the system were taken from lines we stock as a dealer. We merely picked components from some of the best lines we carry.

It should be emphasized that all this equipment is used for more than just checking performance *after* servicing. In most instances it is used in the service operation itself. Naturally, when equipment comes in that does not play at all, it is a matter for straight old-



(Left) Taking distortion measurements as a preliminary check on this FM receiver. (Right) Aligning the FM receiver for best hi-fi listening.

fashioned signal-tracing procedure, or voltage checks, to find the failure. But many hi-fi complaints are not a matter of "the unit doesn't work." Rather, the equipment does not perform *as it should.*

These situations are the starting point of many hassels. There are differences of opinion. Does it really play better than it did before? And who can identify just what the defect was anyway?

Typical job

Let's illustrate with an actual case. A customer brings in an amplifier suspected of producing distortion. Using our method, we find power output down and more than the specified distortion. Replacing the output tubes gives a 10% increase in maximum power and a substantial reduction in distortion. The customer is satisfied we found the trouble.

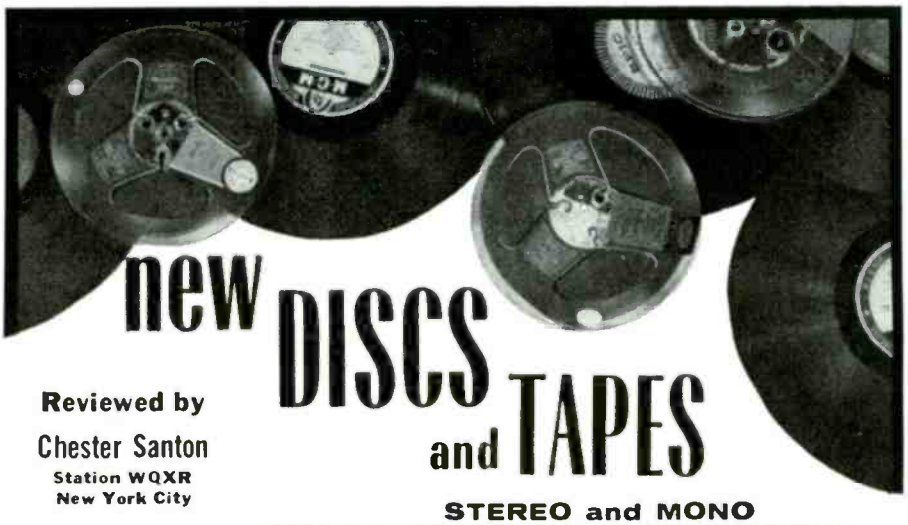
But had we been restricted to the old method, we would have found his tubes still check out "good" even on a first-rate mutual conductance tube tester. If we merely replace the tubes as routine, because of their age, the customer could suspect unnecessary parts replacement. If the tube tester's finding is taken, we could go on a troubleshooting trip that could take a week, and nobody would be happy. But the new performance test method lets us do a quick, reliable service job.

You can work out your own way of making charges to cover your investment. Whichever way you do it, you will find your customer a very different type from your radio–TV service client. A lot has been said on both sides about radio–TV servicing. By honest operation and fair charges, you can stay in business. You will probably get the reputation we have: "not the cheapest place, but reliable." Even so, there will be those sequence cases where you happen to get "the wrong end."

But for the hi-fi customer there is nowhere to go for service—or almost nowhere. He looks down the yellow pages at the "Radio Dealers & Service" listings with little hope of finding someone who can do a thorough job on hi-fi. So what are we all waiting for?

We get plenty of customers besides those who buy hi-fi components from us. Discount stores don't tackle service—not hi-fi, anyway. All the hi-fi owner wants to know is where to take it for service. So it is not surprising, as we found, that a small ad in the local paper regularly brings really good results. All you need is your name, a short message, "All makes of high-fidelity equipment reliably serviced," and your phone number.

New methods have to be learned. Routines for each test can be formalized, so they can be performed in the minimum time, and a test sheet provides an automatic check so your technician can work to a systematic routine. In a second article we will detail the tests and methods used. END



new DISCS and TAPES

STEREO and MONO

Reviewed by
Chester Santon
Station WQXR
New York City

DISCUSSING with audio dealers the demonstration records listed this month, I discovered complete agreement on one point. In New York City, today's demonstration items are regular releases selected with greater ease. Music has completely replaced sound effects for demonstration purposes. Unlike the situation a year ago, a large percentage of stereo discs are now considered worthy of demo use.

Doubling in Brass
Morton Gould and His Symphonic Band
RCA Victor Stereo Record LSC-2308

RCA's stereo discs are now coming through with an added ingredient in the pressing material. The term "miracle surface" on the jacket identifies the new anti-static formula. I've sampled about 15 releases so treated and they do not attract dust in the manner long familiar to LP collectors. The records looked cleaner when first taken out of the unsealed jackets. Subsequent dust does not cling in the way it used to. This particular Morton Gould pressing was unique in one respect. A half-dozen bubbles scattered throughout the disc were plainly audible. Another copy of the same release was as quiet and blemish-free as the rest of the new anti-static items. The improvement in signal-to-noise ratio reveals minute details in Gould's flexible arrangements of *Yankee Doodle, Dixie, American Patrol* and six Sousa marches.

TCHAIKOVSKY: 1812 Overture
Fritz Reiner conducting Chicago Symphony Orchestra
RCA Victor Stereo Record LSC-2241

As all audiophiles know, this overture has been considered one of the top tests of a mono rig, and most stereo conversions are bound to meet up with the *1812* sooner or later. With this in mind, I decided to compare the early London version (CS-6038 with Kenneth Alwyn and the London Symphony Orchestra), the Mercury disc (Dorati and the Minneapolis, SR-90054) and this stereo reissue by Reiner and the Chicago Symphony. In terms of spacious acoustics and incisive playing, the Victor version has the lead. It is, however, rather cramped for groove space. Unlike the other two versions, it occupies less than one side of a disc. The London and Mercury jobs use closer mike pickups to deliver the rich lows of the bass drum made possible by wider grooves. Instrumental groups are less easy to spot in the Mercury pickup pattern. The problem of reproducing the bells and cannon in the finale is still a tough one. Most of the stereo pickups now in use seem to have too much mass to do justice to very heavy modulation in a stereo groove. I have played these three records with a stereo pickup . . . . mass requires a minimum stylus pressure of 4 grams in order to track properly. Then, using the same tone arm, I repeated the test with a stereo pickup whose mass had been reduced to the point where stylus pressure could not exceed three grams without introducing audible distortion. Each version of the *1812* had cleaner, more transparent sound with the pickup of lower mass.

Music of Lehar and Strauss
Anton Paulik conducting Vienna State Opera Orchestra
Vanguard Stereolab Record SRV 111-SD

The latest $2.98 Stereolab demonstration disc piles up new evidence that this series is one of the best bargains in the business. Unlike the usual stereo discs made to sell for $3, the frequency range includes sweet highs that would do credit to many full-price items on the market today. Very low noise level in the pressing. Lehar and Strauss waltzes predominate in the lineup of light music but galops and polkas get their share of attention in bright-sounding acoustics.

Highland Pageantry
Pipes and Drums and Regimental Band of the Black Watch
RCA Victor Stereo Record LSP-1525

Recorded individually, a group of bagpipes or a military brass band is a challenge to any sound system. Combine the two and you have a heaping measure of test material. Try the beginning of Side A as the bagpipes move forward in the left channel. When they attain full volume, they are joined by the military band which is heard in the right channel. If your stereo pickup can separate the rumpus raised by these two groups, you should find smooth sailing in the days ahead. In addition to parade and ceremonial music of the Black Watch regiment, the record also contains tunes made famous by Sir Harry Lauder.

CHOPIN: *Concerto No. 2 In F Minor*
Andante Spianato and Grande Polonaise
Artur Rubinstein, piano
Alfred Wallenstein conducting Symphony of the Air
RCA Victor Stereo Record LSC-2265

Unlike the Beethoven piano concerto series of a few years ago with boomy sound that drew considerable criticism in audio circles, this release offers the finest sound Rubinstein has enjoyed on stereo discs. Adherence to the RIAA curve retains a smoothness and naturalness in the sound of the piano that is still a rarity these days. Rubinstein, for many years the top-

ranking interpreter of Chopin, takes full advantage of stereo's depth to communicate his understanding of the score.

New Sounds at the Roosevelt
Larry Elgart and His Orchestra
RCA Victor Stereo Record LSP-2045

Here's a stereo setup that places the listener at the edge of the handstand. The smooth restraint of Larry Elgart's distinctive style is heard to best advantage at a playback level high enough to bring out the rhythm section located in the center of the band. At low level, the saxes on the left and brasses on the right tend to dominate the scene.

PUCCINI: *Turandot*
Alberto Erede conducting Chorus and Orchestra of Accademia Di Santa Cecilia, Rome
London Stereo Records (3) OSA-1308

On discs, the opera *Turandot*, with its exotic setting of China in the days of the emperors, is extremely effective in stereo. The Chinese gongs, bells and wooden blocks have been recorded with fabulous presence. Heard in the foreground, they place the large chorus in deeper-than-average stereo perspective. With ample reserve of power in playback facilities, this recording easily surpasses the mono version of the work as recorded by the same cast.

TCHAIKOVSKY: *Violin Concerto in D Major*
MENDELSSOHN: *Violin Concerto in E Minor*
Isaac Stern, violin
Eugene Ormandy conducting Philadelphia Orchestra
Columbia Stereo Record MS-6062

The latest stereo versions of the Mendelssohn violin concerto offer interesting contrast. A recent RCA disc (LSC-2314) features Heifetz in the same work. Stern's warmer tone is miked at greater distance. On the other hand, the orchestral accompaniment on the Heifetz disc (Boston Symphony under Munch) occupies a wider area between speakers than does the Philadelphia Orchestra. The Tchaikovsky side is a corker, placing Stern at the head of the list in my book.

DVORAK: *Symphony No. 5 in E Minor*
Bruno Walter conducting Columbia Symphony Orchestra
Columbia Stereo Record MS-6066

One month has seen the release by Columbia of two versions of the Dvorak *New World Symphony*. In addition to this item, an Epic stereo disc (BC-1026) carries a new performance by George Szell and the Cleveland Orchestra. The Walter reading, broad and generous in phrasing, has the better sound and surface. The Szell version offers greater separation and a more polished ensemble whose reflexes pattern themselves more closely to the commands of the conductor.

BEETHOVEN: *Symphony No. 9 in D Minor*
Symphony No. 8 In F
Charles Munch conducting Boston Symphony Orchestra
RCA Victor Stereo Records (2) LSC-6066

Those seeking a fuller measure of German seasoning in the performance may have to look elsewhere, but RCA has placed on the market the best-engineered stereo recording of the Beethoven *Ninth* available to date. The tympani in the second movement has the neat tautness of a good mono disc. In the final choral movement, soloists and the New England Conservatory Chorus maintain their identity during the loudest orchestral passages.

RIMSKY-KORSAKOV: *Scheherazade*
Leonard Bernstein conducting New York Philharmonic
Columbia Stereo Record MS-6069

Although this performance does not convey the warmth and poetry of the Beecham stereo version, it leads all stereo releases in the sound department. The Ansermet, Monteux and Rossi records are already dated in audio quality and Columbia has dropped the noise level to a point far below that of the other discs.

BACH: *Brandenburg Concertos*
Charles Munch conducting Boston Symphony Orchestra
RCA Victor Stereo Records (3) LSC-6140

This is the first complete stereo Brandenburg set to occupy six record sides. London manages in five and Columbia in four. It's interesting to note that the mono version of this Tanglewood recording is available on two records. RCA's liberal use of groove space results in an audible difference in sound that will have its greatest effect on people who do not have to buy their own phonograph records. The alert playing of the Boston Symphony's first-desk personnel, heard in natural closeup, is in many ways the best of the current crop. I don't go along with the use of a present-day piano in the *Fifth Concerto*, written to give the harpsichord its first starring role in orchestral chamber music. Room ambience at Tanglewood's Theatre-Concert Hall is ample for the demands of this intimate music.

In this space will appear a report on recordings being used by leading audio dealers across the country when demonstrating the performance of component systems. Unless already covered, most of the discs or tapes selected by the dealer for use in his showroom will be reviewed in future issues.

Among the dealers checked in New York City, Harvey Radio Co. has been playing the Deutsche Grammophon stereo disc (DGS 712013) of Offenbach's *Gaite Parisienne*; Electronic Workshop, the new Columbia stereo disc (CS 8098) *Duke Ellington at the Bal Masque*; Thalia Hi-Fi Audio, the London stereo album of Wagner's opera *Das Rheingold* (OSA 1309). Found effective at Allied Radio in Chicago is Mercury's stereo music of Leroy Anderson (SR 90047).

WAGNER: *Das Rheingold*
Georg Solti conducting Soloists and Vienna Philharmonic Orchestra
London Stereo Records (3) OSA-1309

This album sums up the progress made in stereo discs up to the moment this was written. The opera, although a stranger to records, has stage effects whose sounds defy description when recorded in London's latest stereo techniques. Wagner specified 18 anvils beaten approximately in unison, 7 harps and a thunder apparatus as part of the score. Impressive as these are on a big system, the recording of the orchestra is sufficient to make this the outstanding demonstration album of the year. A fine system reveals the soaring highs and rich bass of the best mono discs. Performance is tops. Full stereo spread is combined with a dynamic range that is startling in its impact. Don't miss this one.

SCHUBERT: *"Trout" Quintet*
Fine Arts Quartet with Frank Glazer, piano
Concert-Disc Stereo Record CS-206

The most accessible and tuneful work for piano and string quartet takes on new zest in the grooves of this record. Directionality is natural and easily defined. No other version in the stereo catalog excels this one in sheer cleanness of sound.

Shearing on Stage
George Shearing Quintet
Capitol Stereo Record ST-1187

Claremont College in Southern California is the scene of this first live-performance recording by the Shearing Quintet. It is, without question, their most diverting effort on stereo records to date. The brief introductory remarks by George Shearing are as easy-going as his well-known piano style and establish excellent rapport with each audience. Without recourse to cross-channel antics, Capitol has achieved maximum stage effect with stereo that is completely spontaneous.

NOTE: *Records below are 12-inch mono LP and play back with RIAA curve unless otherwise indicated.*

FALLA: *Three-Cornered Hat* (Complete Ballet)
Jesus Arambarri conducting Orquesta de Conciertos de Madrid
Columbia ML-5358

Owners of monophonic moving-coil pickups are warned to introduce severe cutoff of highs before playing this one for a neighbor. Even variable-reluctance cartridges with a lot of damping will reveal that this record does not follow the RIAA recording curve. The performance, more authentic in flavor than other recorded versions of the complete ballet, is well worth the extra effort involved in flattening out the curve. Listen for the piccolo in the opening measures of the work. Once those highs have been brought under control, you have the setting for the rest of the record.

For the Very First Time
Glenn Miller and His Orchestra
RCA Victor LPM-6100

The tunes heard in this fancy-package three-record set are taken from off-the-air recordings made while the Miller band was broadcasting a quarter-hour series of CBS shows from 1940 to 1942. The sound quality of the air checks is poor even by standards of that time. To make matters a bit more uncomfortable for the engineers in charge of the dubbing process, the original glass-base acetates were not protected against dust and scratches. Any suggestion of highs as we know them on discs today had to be sacrificed in the transfer to LP. The spirit of the Forties remains very much alive in the sound of its leading band.

Barney Kessel Plays Carmen
Contemporary M 3563

In one of the major surprises of the present jazz scene, Contemporary's star guitarist, Barney Kessel, takes on the best-known tunes of the world's most popular opera. His adaptation of Bizet's *Carmen* has sufficient fire and good humor to start a new trend. Andre Previn, Shelly Manne, Buddy Collette and Victor Feldman are prominent in the supporting cast. Very clean sound.

BEETHOVEN: *Violin Concerto in D Major*
Leonid Kogan, violin
Kiril Kondrashin conducting State Orchestra of USSR
Lion CL-40001

Russian performances imported by MGM Records are now available on their lower-priced Lion label. Kogan is a fine artist so the record represents a good buy for bargain hunters who are willing to put up with record surfaces that are somewhat less than the best.

Speak Low
Maurice Levine and His Orchestra
Warner Bros. B-1313

Updated and generally stylish treatment of a dozen Kurt Weill tunes that cover some of his lesser-shows such as *Firebrand of Florence* and *Love Life*. The theater-size orchestra sounds better with less than usual Warner processing of the signal. END

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, 154 West 14th St., New York 11, N. Y.

Integrate for STEREO

Why all amps on one chassis may be better

By LARRY STECKLER
ASSOCIATE EDITOR

WHY put all your stereo equipment on one chassis? Because it's cheaper! One integrated amplifier—two preamps, two power amplifiers, one stereo adapter and one power supply all on the same chassis—costs less than the same units on separate chassis, each with its own power supply. But assuming you've already decided you want an integrated amplifier, how do you go about picking the right one for you?

That depends on several things: the equipment you now have, how much you can afford to spend and what you want from your new stereo amplifier. If you now have a monaural system with a 60-watt amplifier and have decided to replace it with an integrated amplifier, you'll want a unit that will deliver at least the same amount of power. So you'll need a unit that has two 30-watt channels at a minimum. You will also want to be sure that the new unit has about the same or better specifications than the units you are now using.

You also have something new to contend with: crosstalk—the amount of interaction between the two channels. The less the better—the larger the separation, the less the interaction.

Also make sure the amplifier has all the inputs you are going to need. In an integrated amplifier, the switching system gets kind of complicated. So the number of inputs is usually smaller than for a comparable monophonic unit. Fig. 1 shows the switching used in the Pilot model 240. It has five pairs of inputs and uses a four-pole five-position switch to select the desired pair. It also has a three-pole four-position switch that is used to select the mode of operation—stereo, stereo reverse, mono channel A and mono channel B.

Another consideration is the type of output stage. Some use a standard push-pull pentode output stage with 35C5's, 35DZ8's, 6AQ5's, 6AV5's, EL-84's, ECL-82's, 6V6's, 50L6's and 6CA7's. Others use the Ultra-Linear output stage with 6CA7's, 6BQ5's and EL-84's. One set, the Masco SA-202, uses a single-ended

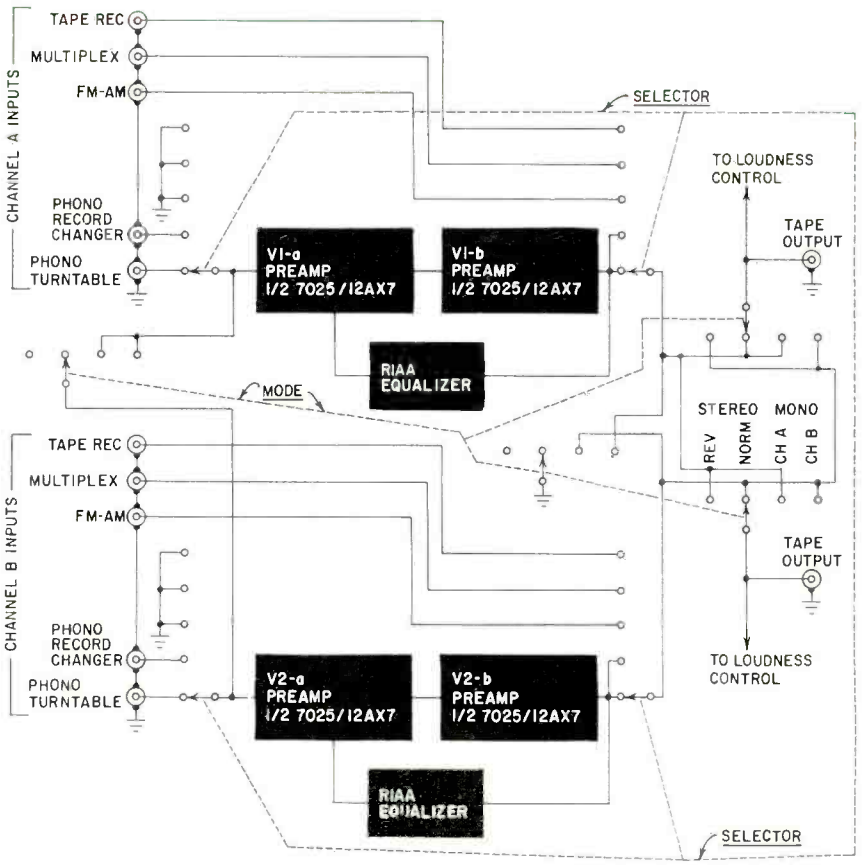


Fig. 1—That stereo switching is complicated, is clearly shown by this partial block diagram of the Pilot model 240.

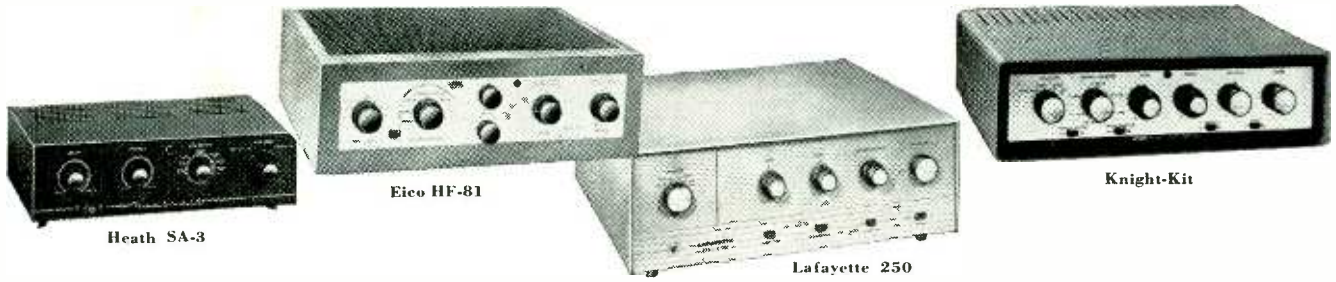
output for each of the two channels when operating stereo, and switches them to a push-pull output for mono operation. The switching is handled before the first voltage amplifier (Fig. 2).

Some sets are ac–dc and don't have

INTEGRATED STEREO AMPLIFIER SPECIFICATIONS

Manufacturer	Model	Output per Channel (Watts)	Distortion	Sig-to-Noise Low-level input (db down)	Sensitivity Mag Phono (mv in)	Channel Separation (db)	Bass & Treble Controls	Loudness Control (If Any)	Stereo Tape Output	Pairs of Inputs	Approx. Price (Audiophile Net)
ALLIED	KNIGHT KN-520	10	HARMONIC 2%	50	3	45	SEPARATE	NONE	NO	3	$64.50
	KNIGHT KN-740	20	HARMONIC 1%	52	5	50	GANGED	SWITCH IN	YES	5	$99.50
	KNIGHT KN-760	30	HARMONIC 0.75%	52	5	50	SEPARATE	SWITCH IN	YES	5	$149.95
ARKAY	CS-28	14	HARMONIC UNDER 1% IM UNDER 1%	70	3.5	NI	GANGED	SWITCH IN	YES	5	$64.95* $99.95**
	CS-12	6	HARMONIC 0.9% IM 1.2%	60	330 (HI LEVEL)	45	GANGED	SWITCH IN	YES	5	$39.95*
BELL	CARILLON 6060	30	HARMONIC UNDER 1% IM 0.7%	71	5	APPROX. 55	SEPARATE	SEP. CONTROL	YES	7	$219.95
	3030	15	HARMONIC 0.5%	78	3	APPROX. 55	GANGED	SEP. CONTROL	YES	5	$169.95
	PACEMAKER 2221	10	HARMONIC 2%	65	3	APPROX. 55	GANGED	NONE	YES	1+AM, FM	$129.95
	PACEMAKER 2212B	7	UNDER 3% TOTAL	60	350 (HI LEVEL)	APPROX. 55	GANGED	NONE	YES	1+AM, FM	$69.95
BOGEN	AC220	10	HARMONIC UNDER 1%	60	4.5	45	GANGED	SWITCH IN	NO	3	$79.95
	DB230A	30	HARMONIC UNDER 1%	75	4	BETTER THAN 50	SEPARATE	SWITCH IN	YES	5	$189.50
	DB212	12	HARMONIC 1% IM UNDER 2%	55	4	BETTER THAN 50	SEPARATE†	NONE	YES	5	$119.95
DeWALD	CONCERTO N-1200-B	15	IM APPROX. 1%	75	6	BETTER THAN 50	SEPARATE	SEP. CONTROL	YES	5	$99.95
EICO	HF-81** HF-81K*	14	HARMONIC UNDER 1%	60	4	BETTER THAN 40	SEPARATE	NONE	YES	5+AM, FM	$109.95** $69.95*
ERIC	DUAL TEN 2460	8	HARMONIC 1%	65	NI	NI	SEPARATE	COMB. LOUDNESS-VOL.	NO	3	NI
FISHER	X-101A	20	0.7% TOTAL	80	3	50	SEPARATE	SWITCH IN	YES	6	$194.50
GENERAL ELECTRIC	MS-4000	20	UNDER 1%	62	3.5	40	GANGED	SEP. CONTROL	YES	3+MONO PHONO MONO AUX.	$166.55
	MS-2000	14	UNDER 1%	55	3.5	40	GANGED	SEP. CONTROL	YES	3+MONO PHONO MONO AUX.	$127.35
GROMMES	24PG	12	HARMONIC 1% IM 2%	80 (HI LEVEL)	4	NI	GANGED	SWITCH IN	YES	5	$99.95
	40PG	20	HARMONIC 1% IM 2%	80 (HI LEVEL)	4	NI	GANGED	SWITCH IN	YES	5	$177.95
HARMAN-KARDON	LUTE A220	10	HARMONIC UNDER 2%	50	4	BETTER THAN 50	GANGED	COMB. LOUDNESS-VOL.	YES	3	$79.95
	BALLAD A230	15	HARMONIC UNDER 1%	60	3	BETTER THAN 50	CLUTCH GANGED	SWITCH IN	YES	4	$109.95
	CHORALE A260	30	HARMONIC UNDER 0.5%	75	2.5	BETTER THAN 50	CLUTCH‡ GANGED	SWITCH IN	YES	6	$199.95
HEATHKIT	SA-3	3	HARMONIC UNDER 3% IM UNDER 3%	65	150 (HI LEVEL)	BETTER THAN 50	GANGED	NONE	NO	2	$29.95*
KNIGHT-KIT	83 YX 773	10	HARMONIC UNDER 1.5%	57	6	BETTER THAN 45	GANGED	NONE	YES	4	$44.50*
	83 YX 774	20	HARMONIC UNDER 0.5%	60	2.5	BETTER THAN 35	CLUTCH GANGED	SWITCH IN	YES	5	APPROX.* $80.00
LAFAYETTE	KT-250* LA-250**	25	HARMONIC UNDER 0.25% IM UNDER 1%	73	3	BETTER THAN 50	GANGED	SWITCH IN	YES	5	$64.50* $89.50**
	LA-235	17	HARMONIC UNDER 2% IM UNDER 1%	55	4	BETTER THAN 40	CLUTCH GANGED	NONE	YES	5	$69.50
	KT-236* LA-236**	18	HARMONIC UNDER 0.25% IM UNDER 1%	53	3	BETTER THAN 50	CLUTCH GANGED	NONE	YES	4	$52.50* $69.50**
MASCO	SA-202	2	UNDER 2% TOTAL	NI	150 (HI LEVEL)	NI	SEPARATE	NONE	NO	1	$29.95
PACO	SA-40* SA-40W**	20	HARMONIC UNDER 0.2% IM UNDER 1%	70	5	50	GANGED	SWITCH IN	YES	7	$79.95* $129.95**
PILOT	240	15	HARMONIC UNDER 1%	80	3	NI	GANGED OR SEPARATE	SWITCH IN	YES	5	$129.50
	245-A	20	HARMONIC UNDER 1%	80	3	NI	GANGED OR SEPARATE	SWITCH IN	YES	7	$199.50
RADIO SHACK	STEREOLYNE 40	20	HARMONIC 0.9% IM 1.5%	59	3	NI	SEPARATE	SWITCH IN	NO	4	$79.50
	STEREOLYNE 7	1	HARMONIC 3.5%	53	110 (HI LEVEL)	NI	GANGED†	NONE	NO	2	$29.95
SARGENT-RAYMENT	SR-17-17B	20	HARMONIC 0.48% IM UNDER 1.5%	60	3.5	41	GANGED	SEP. CONTROL	YES	6	$189.60
SCOTT, H. H.	222	12	HARMONIC 0.8% IM 0.3%	60	3	50	SEPARATE	SWITCH IN	YES	4	$139.95
	299	20	HARMONIC 0.8% IM 0.3%	60	3	50	SEPARATE	SWITCH IN	YES	5	$199.95
SHERWOOD	S-5000	20	IM 1%	60	1.9	BETTER THAN 50	GANGED	SWITCH IN	YES	5	$189.95
SONIC	S-100	5	HARMONIC UNDER 5%	56	400 (HI LEVEL)	40	SEPARATE†	NONE	NO	2	$34.95
	S-200	6	HARMONIC UNDER 2%	56	400 (HI LEVEL)	45	GANGED	SEP. CONTROL	NO	3	$49.95
	S-400	20	HARMONIC UNDER 1%	56	5	45	GANGED	SEP. CONTROL	NO	4	$99.95

NI—No information available.
*Kit
**Wired.
†Single control for bass and treble.
‡Tone control defeat switch
All specifications supplied in manufacturer's literature.



a power transformer. Instead they use a voltage doubler with selenium or silicon rectifiers. Of course, these units may present a shock hazard, so if you buy one, watch how you connect it to the line. Be sure the chassis is not connected to the hot side of the line. As far as power supplies go, both tubes and semiconductor rectifiers are used.

Some units have dc heaters to reduce noise and hum in the unit. Series-string heaters are used by Arkay in one of their integrated amplifiers. As shown in Fig. 3, two groups of three and a half tubes are placed in parallel across the ac line. It's a money-saving arrangement, but what if one half of V1 opens? This would be a toughie to find. For example, assume the lower half is open. V6, V7 and V5 would, of course, go out, but half of V1 would still be lit, making it hard to determine the cause of the bad heater string. The natural assumption would be that one of the three unlit heaters was bad.

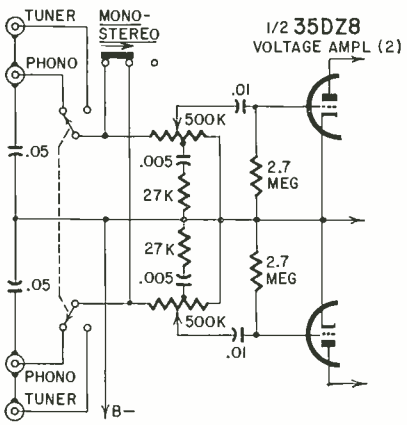


Fig. 2—Masco switches from single-ended 2-channel stereo to push-pull mono in their SA-202.

Controls and switches

Many sets use push-pull on–off switches. These let the listener leave the amplifier volume and tone controls preset at the proper positions. Turning the unit on does not interfere with these settings.

One kit, the Paco SA-40, has dual phono inputs so both a changer and turntable can be hooked up and switched in as desired. This is ideal if you don't want the kids playing their records on your turntable with its expensive arm and pickup.

Another feature that appears in some integrated units is switching the outputs to one of two or three external speaker systems. Puts hi-fi in any room of the house with a flip of the switch (it's on the amplifier's front panel). And of course, almost every unit has some kind of setting for checking balance.

Several types of balance circuits are used. They range from the very simple to the complicated. One of the simplest is that in the Harman-Kardon model A220. It is simply a 1-megohm pot connected across the two channels with its center tap connected to ground (Fig. 4). As it is turned one way it attenuates that channel, bringing its volume level down to match the other channel. When turned in the other direction, the reverse happens. The tone-control arrangements in this amplifier are also shown in Fig. 4.

Fig. 5 shows another type of balance control, used in the Bell Pacemaker and the Bell model 3030. Here two pots, each 500,000 ohms and one in each channel, are ganged in such a way that when the signal to one channel is increased (less resistance in the way) the signal to the other channel is

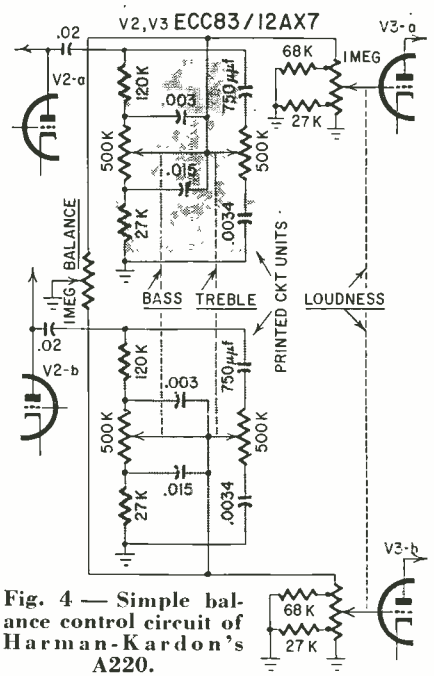


Fig. 4 — Simple balance control circuit of Harman-Kardon's A220.

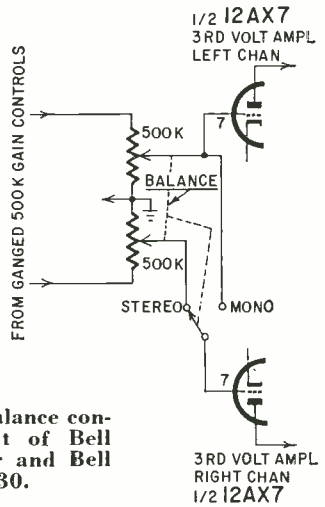


Fig. 5—Balance control circuit of Bell Pacemaker and Bell 3030.

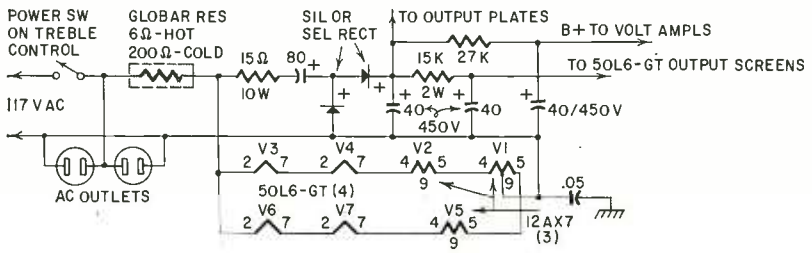


Fig. 3—Series-string heaters are used in one Arkay unit.

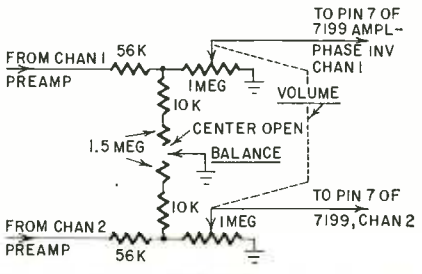


Fig. 6—Bogen DB-212 uses an open-center pot in its balance circuit.

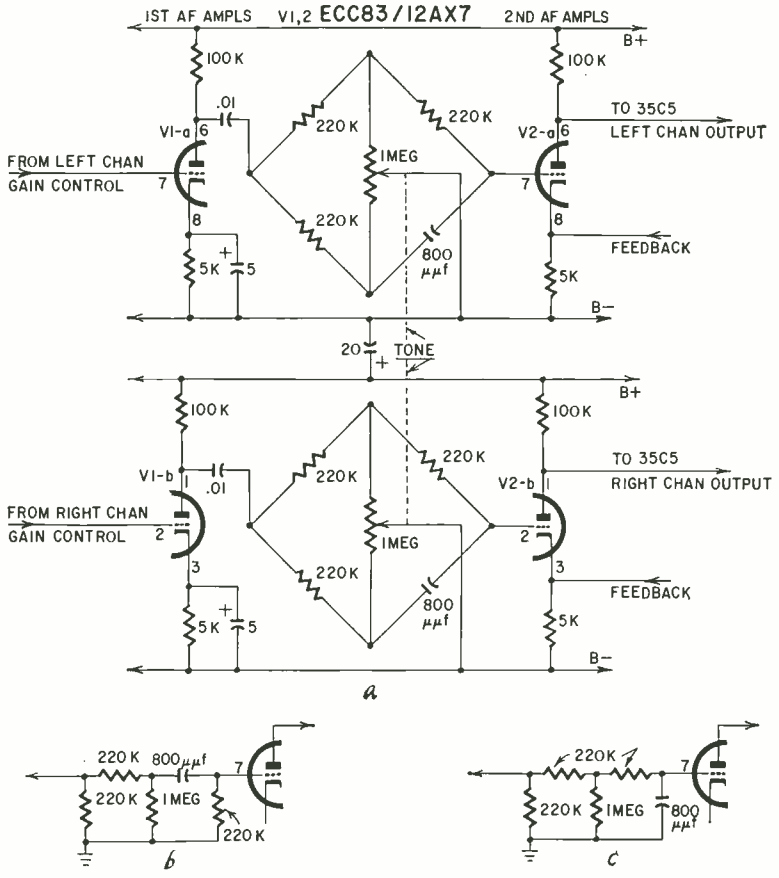


Fig. 7—A bridge type tone control is used by Radio Shack in the Stereolyne 7.

decreased (more resistance in the way). This control is also ganged to a stereo–mono switch, and in the extreme position switches the amplifier from stereo operation to mono.

Still another variation on the balance control is found in the Bogen model DB-212. A pot with an open center is used. The center arm goes to ground (Fig. 6). The two channels are kept completely separate but either one can be attenuated, independent of the other, to match its level to that of the other channel.

An interesting tone-control setup is found in Radio Shack's Stereolyne 7. Here a bridge type circuit is used (Fig. 7-a). With the ganged 1-megohm pots set in their mid-position, response is flat. But in the extreme clockwise position, it becomes a high-pass filter and removes the lower frequencies (Fig. 7-b), mainly rumble. At the other extreme of its rotation (counterclockwise), the control becomes a low-pass filter (Fig. 7-c) and removes the higher frequencies, including surface noise of worn records. Of course, the in-between settings provide variable amounts of attenuation.

Some of the Pilot amplifiers have an automatic turnoff switch. When the unit is placed in the automatic shutoff position and connected properly to a record changer, its ac supply is connected in parallel with the phono motor. When the motor goes off after the last record is played, the amplifier goes off too. Excellent for the hi-fi man who likes to go to sleep to music.

Many integrated stereo amplifiers have six possible operating positions: power off, stereo, reverse stereo, mono, channel A, mono channel B and mono channels A and B. How to tell which setting your amplifier is on is usually a job that calls for getting up from your chair and walking over to take a look. With the Sherwood S-5000 this problem is greatly simplified. Two control lights for each channel tell at a glance which arrangement is in use (Fig. 8). In the POWER OFF setting, no lights are on. In the stereo position, the top light for channel L and the bottom one for channel R are lit, and so on as shown in the diagram.

So much for circuit details. To make a real decision, you would probably like some specifications and prices. In the chart you will find a listing of many of the integrated amplifiers now on the market. They range from low to high power, from inexpensive to downright ritzy. But the one to pick is up to you. So take a look, and decide for yourself. Remember, once you've bought it, you're going to listen to it for some time. END

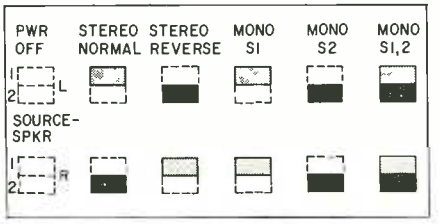


Fig. 8—From across the room, you can tell which mode of operation the Sherwood S-5000 is set up for. S1 and S2 refer to Speaker 1 and Speaker 2

List of Manufacturers

ALLIED RADIO CORP., 100 N. Western Ave., Chicago 80, Ill.
ARKAY RADIO KITS INC., 88-06 Van Wyck Expressway, Richmond Hill 18, N. Y.
BELL SOUND DIVISION, Thompson Ramo Wooldridge Inc., 555 Marion Rd., Columbus 7, Ohio
BOGEN-PRESTO CO., Div. of Siegler Corp., PO Box 500, Paramus, N. J.
DeWALD, Div. of United Scientific Labs Inc., 35-15 37th Ave., Long Island City 1, N. Y.
EICO, 33-00 Northern Blvd., Long Island City 1, N. Y.
ERIC ENGINEERING, 1823 Colorado Ave., Santa Monica, Calif.
FISHER RADIO CORPORATION, 21-21 44th Dr., Long Island City 1, N. Y.
GENERAL ELECTRIC CO., Specialty Electronic Components Dept., West Genesee St., Auburn, N. Y.
GROMMES, Div. of Precision Electronics, 9101 King Street, Franklin Park, Ill.
HARMAN-KARDON, INC., 520 Main St., Westbury, N. Y.
HEATH CO., Subsidiary of Daystrom Inc., Benton Harbor, Mich.
KNIGHT-KITS, Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.
MASCO, Mark Simpson Mfg. Co. Inc., 32-28 49th St., Long Island City 3, N. Y.
PACO ELECTRONICS, Div. of Precision Apparatus Co. Inc., 70-31 84th Street, Glendale 27, N. Y.
PILOT RADIO CORP., 37-06 36th St., Long Island City 1, N.Y.
RADIO SHACK CORP., 730 Commonwealth Ave., Boston 17 Mass.
SARGENT-RAYMENT CO., 4926 E. 12th St., Oakland 1, Calif.
SCOTT, H. H., INC., 111 Powdermill Rd., Maynard, Mass.
SHERWOOD ELECTRONIC LABS INC., 4300 N. California Ave., Chicago 18, Ill.
SONIC INDUSTRIES INC., 19 Wilbur Street, Lynbrook, N. Y.

ALL ABOUT THE REFLEX ENCLOSURE

Part VIII—Putting our knowledge to use: speaker and port positions, suiting the speaker to the enclosure and the enclosure to the speaker

By P.G.A.H. VOIGT

THE standard—one might almost say the traditional—reflex cabinet is shown in Fig. VIII–1. The box baffle previously described has about the same general shape. Therefore, *one* way of turning that box baffle into a reflex enclosure is to replace the front with a new one of traditional appearance with port and speaker openings cut to suit the speaker in use.

The speaker will settle the details of the speaker opening. Its free-air resonance frequency can be measured as described in Part II (April, 1959). If the original 32 x 20 x 12½-inch cabinet was ¾-inch ply, well reinforced at all joints, the internal volume will be about 3¼ cubic feet. With speaker frequency and internal cabinet volume known, we have enough information to use the family of curves from Part II, Fig. II–7. For convenience, that family of curves is now repeated (Fig. VIII–2) and from it we can find the approximate area of a plain 4-to-1 rectangular port which will tune the air system to match the resonance frequency of the speaker.

The port-area information obtained from Fig. VIII–2 should be used only as a guide. Ports should be cut oversize and made adjustable, but on a more

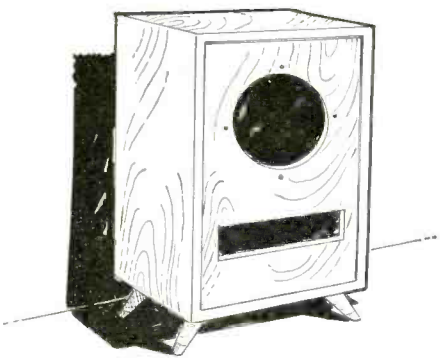


Fig. VIII–1—A reflex cabinet built in the traditional shape.

permanent basis than suggested in Fig. II–4 of Part II. In the case of a plain rectangular port, a bolt locked to a clamping strip as shown in Fig. VIII–3 and a wing nut passing through a hole in the cover provide a more permanent system. After adjusting the port as discussed in Part II to give the air system its correct frequency, the adjustment can be locked by tightening the wing nut.

If an 8-inch speaker with a free-air resonance of 58 cycles is to be used, we find from Fig. VIII-2, that the 4-to-1 port area to tune a 3¼-cubic foot cabinet to 58 cycles is about 16 square inches. A port adjusted to about 8 x 2 inches is suitable to start with.

When such a reflex system was tuned and tested the two impedance peaks came at about 38 and 79 cycles, respectively. That is about half an octave on either side of the basic resonances and with a total spread of roughly an octave. The upper peak is below the speech boom region, while the lower at 38 cycles insures that the low audio frequencies will not be lost altogether. This is therefore a useful combination.

Had the cone support been stiffer (which raises the resonant frequency) and the cabinet been tuned to match, the spread (measured in octaves) would have decreased and both peak frequencies would have gone up (the lower one considerably). Consequently, the low bass would have suffered.

When testing the 58-cycle 8-inch speaker with the 3¼-cubic-foot cabinet used as box baffle, the single peak came at 67 cycles.* A 30-cycle organ note

*I am indebted to Mr. O. C. Schwartz, trading as American Radio & T.V. Supply Co., of Toronto for the use of lab facilities to obtain these results and also the curves of Fig. VIII–2.

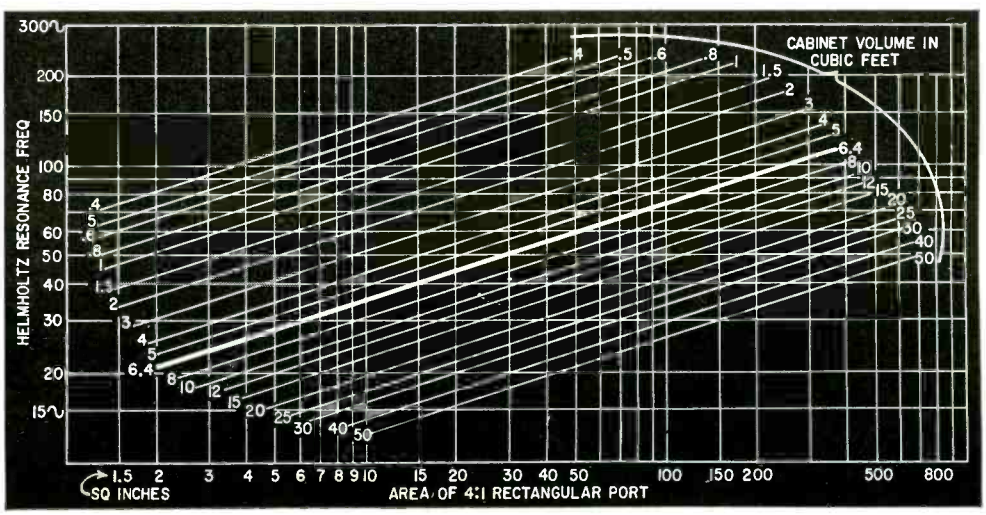


Fig. VIII–2—Relationships between Helmholtz resonance of reflex enclosures, port area, and cabinet volume.

comes more than one octave below that peak, so the efficiency there is much below that obtainable from the same cabinet when using reflex methods.

Now, when following existing designs, there is always danger of repeating the other fellow's mistakes. When designing the box baffle, the speaker was deliberately mounted near the mid-height of the cabinet in spite of the fact that a position higher up looked better.

The traditional position was rejected before because, with a speaker there, the vertical stationary wave corresponding to three half-wavelengths is excited effectively. It so happens that its frequency coincides approximately with that of the horizontal stationary wave of two half-wavelengths which is also excited. Such double excitation at a common frequency produces a major packet of trouble. By moving the speaker down to near the mid-height, that particular vertical stationary wave is not excited appreciably, so the coincidence is eliminated.

Even though the port opening will have some effect on the stationary-wave pattern in the cabinet, the same argument applies after conversion to reflex. Therefore, the box-baffle position for the speaker should be retained in spite of the inferior appearance.

How about the port?

The original front therefore remains suitable, and the only change required is that of cutting in the port opening. We thus come to the question, "What should be the shape of the port?"

Should it be round or square, should it have the customary rectangular shape, and if so, should it be four times as long as it is high or should it be as long as possible? If it is to be distinctive, what about a diamond shape or triangular? If it is to be ornamental, what about the shape of the f-holes in a violin? The possibilities seem endless.

As far as tuning is concerned, we know that the area required to tune the air cushion depends to some extent on the shape of the port. However, no matter what that shape might be, provided the area is big enough in the first place, we know from Part V (July, 1959) there is always one adjustment of port area at which the desired air inertia factor is obtainable. As far as tuning is concerned therefore, any shape will do.

With some port shapes there will be more air friction than with others; with multiple ports in particular more air friction can be expected. The Q will therefore vary, but this is a minor matter and the Q may have to be damped down anyway.

The port shape can therefore be selected on the basis of secondary factors which will be discussed later.

The original box baffle was regarded as suitable for an 8-inch and certain 10-inch speakers, but too small for a normal 12-inch speaker. Will this also

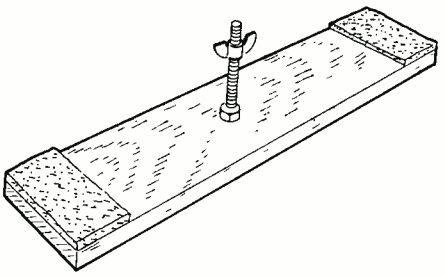


Fig. VIII–3—Clamping strip with padded ends. The bolt is locked to the wood strip.

apply if the cabinet is converted into reflex?

Well, we know that if a larger speaker is used with a given cabinet, the coupling increases and this increases the spread between the peaks. With a 12-inch speaker, for example, the coupling is more than double that with an 8-inch speaker. The natural frequency of the speaker affects matters also, and the better large-size speakers usually have natural resonance frequencies well below 60 cycles.

Suppose therefore that we have a large speaker with a resonance at 50 cycles and of such size that the cabinet coupling produces a peak spread of about two octaves. The upper peak then occurs at 100 and the lower at 25 cycles. This goes down below the important audio frequencies, so the normal low range should be reproduced well, but the upper peak frequency is dangerously close to the speech boom region.

Deliberate mistuning in this case does not seem helpful. A lower-frequency speaker, so that with the cabinet tuned to match, both peaks would go down the scale, would be better. (Any trouble from motor rumble should be cured at the source.) Still better would be the use of a larger cabinet as well, with its reduced coupling and consequently reduced peak spread. This will provide the additional advantage of a naturally lower cabinet Q.

A bigger cabinet with external dimensions of 37½ inches high x 23⅞ inches wide x 16 inches front to back made of ¾-inch ply and reinforced at all junctions has an internal volume of about 6.4 cubic feet. The ply can be cut out of a single sheet measuring 4 x 8 feet. In a system using such a cabinet with a 10-inch 35-cycle free-air-resonance speaker, the lower and upper peaks came at about 20.5 and 54 cycles, respectively (about 1.3 octaves spread). The upper peak is well clear of the speech region but the lower one is unnecessarily far down the scale. However, using damping as discussed in Part VI (Aug., 1959) (Fig. VI-4), no trouble from rumble occurred with a good turntable, while reproduction of low organ notes, though requiring plenty of power, was impressive. A 10-inch speaker with a somewhat higher natural frequency would have worked well in this cabinet. A 12-inch speaker with a 35-cycle resonance would have been OK too, though a larger cabinet would have been preferable. Larger cabinets are certainly appropriate with still larger speakers, provided the domestic situation permits!

Port position

In the case of the speaker opening, we found that the traditional layout, though desirable on grounds of appearance, would have been a mistake acoustically. If the traditional position of the port has been arrived at because it "looks right" there, then that too might be an acoustic mistake.

Before cutting port openings into good plywood, let us examine this question. In the theoretical discussion of the Helmholtz resonator, the internal volume is concerned—as far as tuning goes—only with being associated with a port arrangement having the correct air inertia factor. Whether that air inertia factor is concentrated in and around a single port or is the combined effect of several ports in parallel matters not at all.

The exact area required varies with conditions. It is reduced with multiple or slot-shaped ports and increased when the bulging air regions near the port cannot develop fully, as, for example, when the port is close to the sides or bottom of the cabinet. From the primary point of view, these variations do not have special significance and so all that matters as far as tuning is concerned is that the port area be adjusted to give the correct air inertia factor. There are however secondary factors which are well worthy of consideration.

A loudspeaker, considered purely as a piece of electromagnetic machinery, has for its prime object the conversion of electrical into sound energy.

If it did this without distortion and at uniform efficiency, then it would automatically have a uniform audio response with respect to the energy delivered into the room. Ideally, of course, it should radiate the sound uniformly into that room as well and have no hangover. At this stage, let us consider energy-conversion efficiency alone.

"Now if we can get them going together, it ought to sound like stereo!"

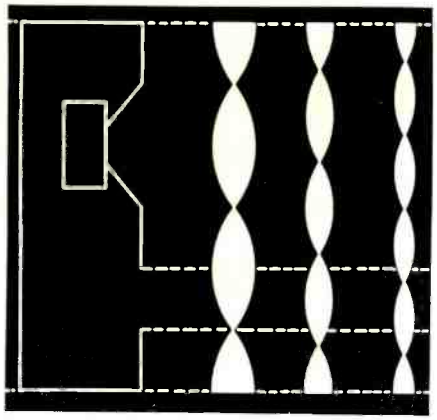


Fig. VIII–4 — Curves show pressure buildup in vertical stationary waves when there is no port.

A cone has two sides and we have discussed how unwanted stationary waves are set up inside the cabinet. At the frequencies at which these occur, the load on the rear of the cone is affected. Any alteration of the load affects the cone motion and therefore just at each of these frequencies the coil motion is affected too. This shows as an irregularity in the impedance curve of the speaker, and also affects the matching between the amplifier and coil, thus slightly altering the energy output to the coil.

This energy is shared between the coil and the cone with its front and rear surfaces. When the rear load changes from frequency to frequency as the stationary-wave pattern changes, the proportion in which the incoming energy is divided between front and rear varies too. This causes irregularities in the forward response. Further, when the signal ceases, the energy in the stationary waves within the cabinet will cause hangover.

Now when a port is cut into a cabinet, internal conditions are disturbed. Every stationary wave tends to build up pressure regions in certain places. If there is a port just there, that pressure is partially released and sound is radiated, with consequent reduction of the build-up of that wave. It may even be killed more or less completely.

A port cut in the usual place in the cabinet therefore affects most those vertical stationary waves that would have had maximum pressure regions just there if there had been no port. From Fig. VIII–4 it will be seen that the stationary waves with 3, 4 and 5 half-wavelengths would be greatly affected by a normal port in the usual place. The stationary wave of two half-wavelengths has its maximum pressure levels at mid-height and at the top and bottom, so a port in the normal position hardly affects it. The single half-wavelength standing wave has only two pressure regions, one at the top and the other at the bottom of the cabinet. The port therefore has some effect, but not as much as if it were located at either end.

With the speaker at just above mid-height as suggested, we avoid setting up appreciably the 1-half-wavelength and the 3-half-wavelength modes, but we do set up the 2-half-wavelength mode, and also the 4th and 5th to some extent. Now all these vertical modes have one thing in common—they have pressure maxima at the two ends: top and bottom of the cabinet.

If the port is shifted to either end, or divided and half placed at each end, *all* vertical stationary waves will be affected by the port's pressure release action, and since their energy is being radiated, they will be damped, possibly even killed.

They could be absorbed by using deliberate damping material and so turning their energy into heat. However, at the frequency at which they are effective, they steal power from the rear of the cone and so the frontal radiation is affected. So it seems to be more sensible to turn their energy into sound in the hope that this will make up to some extent for any forward loss.

The secondary action of the port—the way it affects the internal standing-wave pattern—can thus be used to advantage by placing the port so as to damp the unwanted stationary waves and turn the residue to use.

As far as the vertical stationary waves are concerned, this means putting the port at either end or splitting it and having ports at both ends.

Now, if two equal ports are used, the effect at low frequencies is as though the sound originates midway between the two. An arrangement using two equal ports placed symmetrically about the speaker therefore behaves as though the speaker and port positions coincide.

In Part II, when discussing the lower impedance-peak frequency—at which speaker and port flow are in opposition—it was pointed out that cancellation could not be complete, even if the opposing quantities were alike, *unless* all path lengths to the listener's ear were of equal length. Such equality of path length occurs if cone and port coincide. Ports divided and located symmetrically about the speaker therefore diminish the efficiency of reproduction of the extreme low frequencies.

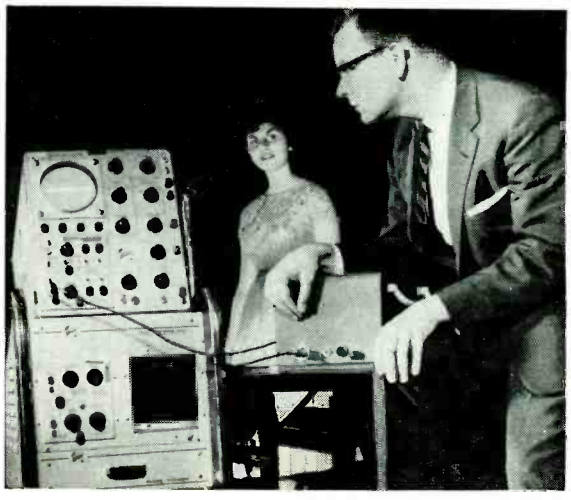
To prevent this, the distance between the cone and the mid-point between the ports should be as great as practical. This requires that the port or ports be either at the top or at the bottom of the cabinet. The next question is therefore, "where should the port or ports be, top or bottom?"

TO BE CONTINUED

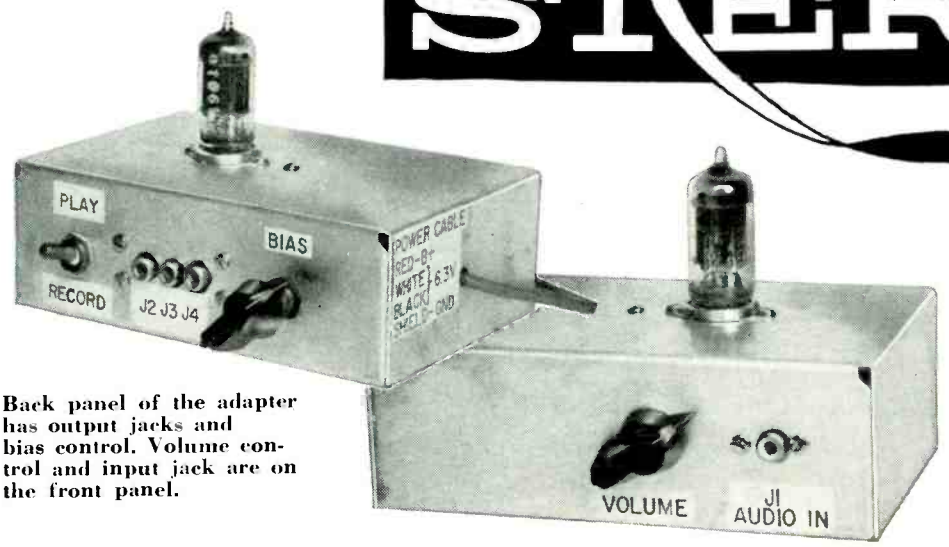
REDUCES PA HOWL

Feedback howl caused by room reverberations is minimized by a new frequency-shifting device developed at Bell Laboratories. The new method permits turning up the gain of an indoor system to roughly double that of conventional equipment before any instability problems arise.

The feedback-squelching apparatus was developed by Dr. Manfred R. Schroeder, who in 1954 formulated a theory of response fluctuations inside a room. Its central feature is a frequency-shift modulator, which creates a frequency shift of the sound equal to the period between the major peaks and adjacent valleys of the room's gain response characteristic. Thus the peaks, instead of reinforcing each other and rapidly building up to oscillation, tend to be absorbed in the valleys of the room's response characteristic. The frequency shift required is approximately 5 cycles per second, and is inaudible in speech and most types of music.

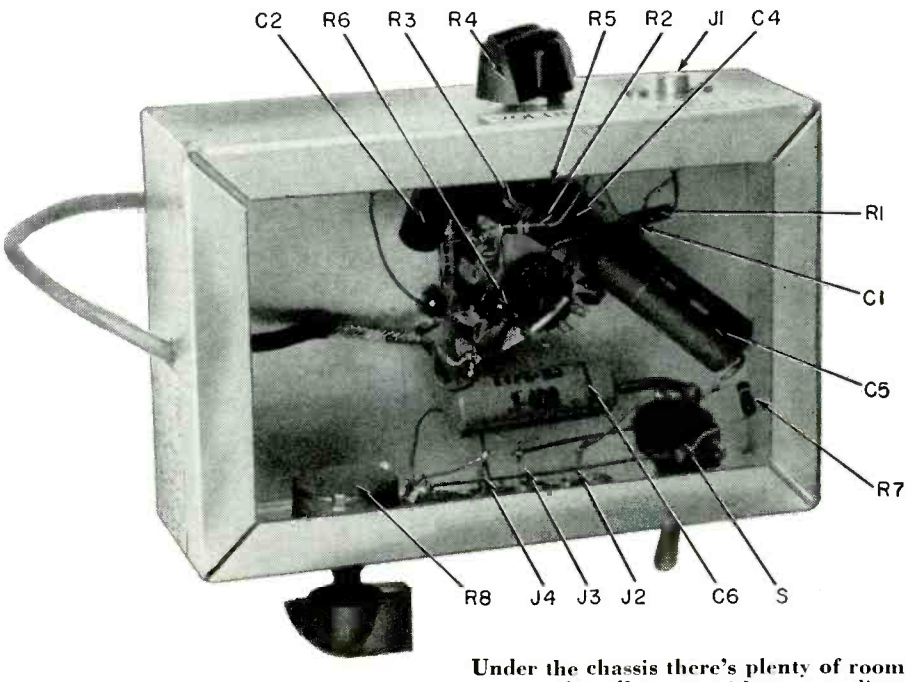


ADAPT YOUR TAPE RECORDER TO RECORD STEREO



Back panel of the adapter has output jacks and bias control. Volume control and input jack are on the front panel.

Simple 1-tube adapter turns any tape recorder with stereo playback into a 2-channel stereo recording device



Under the chassis there's plenty of room for all parts, without crowding.

By PETER A. STARK

ONE tube is all it takes to convert almost any tape recording machine to stereo recording, if it already has a stereo playback head. If it does not, it is a simple matter to add the head since most manufacturers offer head conversion kits for their recorders. Alternatively, an adapter mounted on the side of the recorder's case can be used.

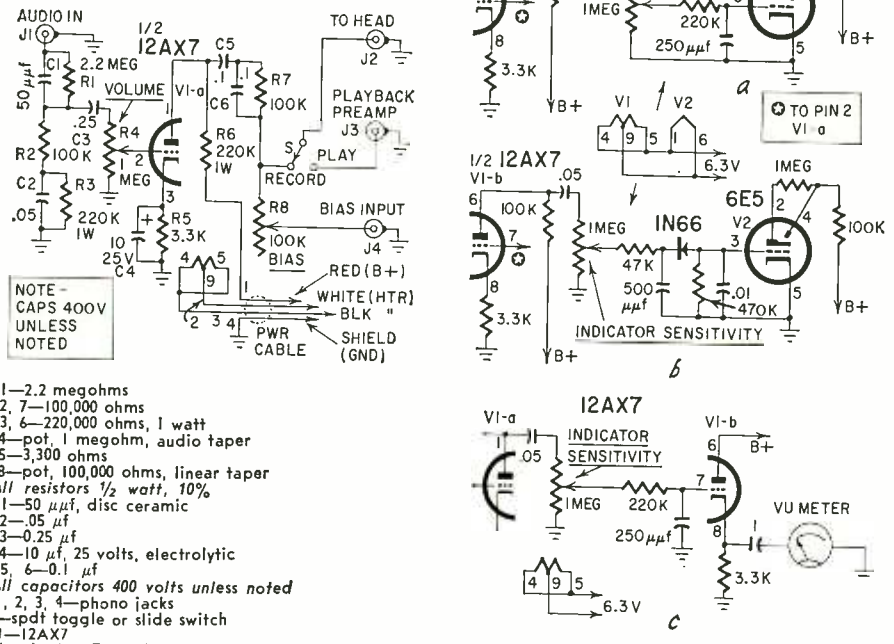
Basically, the adapter is a single-stage amplifier with appropriate equalization and bias mixing. It doesn't have a high-gain microphone preamplifier, since it is seldom that an amateur does any live stereo recording. Similarly, it doesn't have its own power supply or bias oscillator since these are already in the recorder and need not be duplicated. For the sake of simplicity (as well as low power drain) there is no volume indicator. Since this adapter will probably be used for copying records and tapes, or for off-the-air recording, it is easier to determine experimentally the optimum setting of the volume control first and then simply use the same setting for every recording.

As seen in Fig. 1, the input signal applied to jack J1 is equalized by the

Recorder response follows standard curve within 2 db. Some slight distortion is measurable, but not audible. Excellent unit for simple conversion of mono recorders to stereo. Also stereo tape machines that do not have dual record amplifiers.

One point to keep in mind: the record curve of your tape recorder may not match the record curve of the adapter. If this is so, adjust the adapter's equalizing network to get as close a match as possible. Minor differences in record curves can show up when listening to a stereo playback.

Fig. 2—Three circuits for adding a level indicator to the adapter.



R1—2.2 megohms
R2, 7—100,000 ohms
R3, 6—220,000 ohms, 1 watt
R4—pot, 1 megohm, audio taper
R5—3,300 ohms
R8—pot, 100,000 ohms, linear taper
All resistors ½ watt, 10%
C1—50 μμf, disc ceramic
C2—.05 μf
C3—0.25 μf
C4—10 μf, 25 volts, electrolytic
C5, 6—0.1 μf
All capacitors 400 volts unless noted
J1, 2, 3, 4—phono jacks
S—spdt toggle or slide switch
V1—12AX7
Chassis, 5 × 7 × 2 inches
Length of 3-conductor shielded cable (shield acts as fourth conductor)
Miscellaneous hardware

Fig. 1—Circuit of 1-tube adapter.

network consisting of C1–R1–R2–C2–R3 and applied to the recording volume control, R4. After amplification, the signal passes through a treble-boost network consisting of C6 and R7 to the switch and through to J2. The incoming bias signal applied to J4 is also mixed with the audio at this point. Potentiometer R8 permits precise adjustment of the bias current. The circuit is straightforward, reliable and completely uncritical as to parts placement.

The original unit was built into a 4 x 2⅛ x 1⅝-inch Minibox, except for the volume control and record–play switch, which were mounted externally. The later version, shown in the photos, uses a 5 x 7 x 2-inch chassis for the greater amount of space available.

How to hook it up

With the stereo head installed, one side of it is connected in place of the old monaural head. The other side should be connected to J2 of the adapter with a good quality shielded lead. Ordinary audio cable may have a capacitance of over 100 μμf per foot, and will shunt the bias signal to ground. It may even resonate with the head and cause very ragged frequency response. Using, at most, a foot or two of RG-59/U coaxial cable, rated at 21 μμf per foot, connect the head to J2 and the playback preamp to J3. Most modern hi-fi preamps have a "tape-head" input, and it can be used.

Next, use a very short length of unshielded two-conductor wire to connect J4 to the erase head. One side of the head is usually grounded. Connect this terminal to the outer ring of J4. The head's "hot" terminal is connected to the inner terminal of J4. Now connect the power cable to the appropriate points in the recorder. If possible, the B-plus lead should go to some source of 150–250 volts which has high voltage only when the recorder's controls are set for recording.

Since the adapter loads the recorder's bias-erase oscillator slightly more than before, the bias level may have to be readjusted. Connect a 100-ohm resistor in series with the head (in the ground lead), measure the bias voltage drop across it, and calculate the bias current. Adjust both channels to conform with the head manufacturer's recommended bias current, by adjusting R8 in the adapter and, if necessary, by changing the value of the series resistor in the recorder until proper bias current is obtained.

Now connect the tuner or preamp which will be used, to J1. An audio signal of at least 1.5 volts is needed for sufficient recording volume level. Adjust the volume control setting for correct volume either by pulling out the bias oscillator tube and using a vtvm to compare the levels in the adapter channel and in the presumably correct main channel, or by recording a tape and comparing it with other tapes in your collection. Mark the control setting so it can be used whenever you record from the same source. If you feel a volume indicator will help, you can try one of the several circuits in Fig. 2. Since the adapter uses only one half of a 12AX7, the other half becomes a voltage amplifier for the indicator.

The adapter is an economical way for a hi-fi enthusiast to try his hand at stereo recording, since it eliminates all unnecessary parts without sacrificing quality of reproduction. END

ELECTRONICS BEATS PARKING METER

A Franklin Manor, N.J., man was determined that he shouldn't have to pay a $1 parking ticket for overtime parking at a 30-minute meter.

He didn't pay it either. But he had to use an electronic stethoscope, a temperature-humidity sensitive time tape and an electronic brain to win.

Arnold Sprinz, 28-year-old aeronautical engineer at Picatinny Arsenal, presented in court a metered receipt, obtained with precision monitoring equipment, to prove that the meter short-timed him by five minutes.

Here's what Sprinz did:

He borrowed an electronic stethoscope, similar in principle to those used by doctors to listen to heartbeats. He used the transistorized, battery-powered instrument to pick up the tick-ticking of the meter, into which he had dropped another nickel.

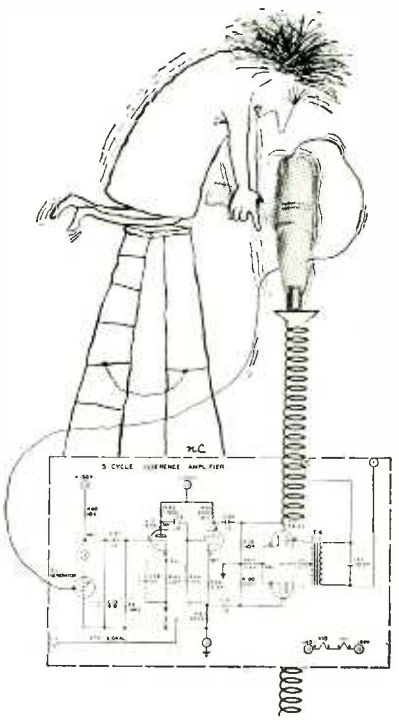
The normal parking meter runs 120 beats to the minute, he said. This particular meter was four minutes fast and the mechanism that sends up the red flag was another minute ahead.

That meant his time was up five minutes before it really was electronically.

Next Sprinz compared his recording with a humidity and temperature sensitive time tape and clocked off 30 minutes for comparison. Finally he dumped his data into an electronic brain (loaned gratis by a friend) and came up with his metered receipt.

"It wasn't the dollar but the principle of the thing," said Sprinz.

"Case dismissed," said the judge, citing that the city failed to prove the charge.—*Morristown Daily Record*



Five transistors and simple circuitry put you on the air with 2½-mile range on one of 22 available channels

TRANSISTOR TRANSCEIVER for CITIZENS RADIO

By FLOYD DUCOTE*
and HARRY COOKE*

AN all-transistor transceiver has considerable appeal to the amateur and experimenter, and also is an extremely useful item that has commercial possibilities. The transceiver described here uses only five transistors, is small in size, light in weight (approximately 1 pound, including antenna) and uncomplicated in design.

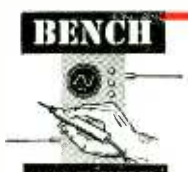
Because of the low impedance and voltage levels required, it has been possible to design a unique and extremely simple transmit–receive switching system using one dpdt snap-action switch. Under open field conditions, a pair of these transceivers provide a maximum two-way communication range of approximately 2½ miles.

Transmitter

Fig. 1 shows the transceiver's schematic. The crystal-controlled oscillator and power amplifier circuits use two Texas Instruments diffused-base, or mesa, transistors. V2 is operated as a crystal-controlled Hartley oscillator with the crystal acting as the feedback element between the emitter and the tap on the tank coil. Since the diffused-base transistor has an alpha cutoff frequency greater than 90 mc, there is no difficulty in obtaining dependable oscillation at 27 mc.

The variable capacitor, C7, resonates the tank circuit at the crystal frequency. The signal that drives the base of the modulated class-C power amplifier, V1, is tapped off L2. The power amplifier tank coil, L1, is tapped to match the 50-ohm antenna to V1's output resistance. Capacitor C1, 500 μμf, connects the output to the antenna.

*Texas Instruments, Inc., Dallas, Tex.



BENCH TESTED

A transceiver following the specifications of this article was built up by I. Queen of our staff, and tested at the laboratory of a major communications equipment manufacturer. Results of these tests show that at any frequency at which the transmitter section can be set (using a 27.075-mc crystal), frequency variation is less than 1,000 cycles. At one particular setting (varies from unit to unit because of minor construction differences and component tolerances), frequency variation was less than 10 cycles.

This does not mean that any set constructed by a reader will fall within equally close tolerances, even if layout and components are duplicated as closely as possible. **Wherever possible, the completed job should be checked out by a service technician who holds the second-class license permitting him to work on such transmitting equipment.**

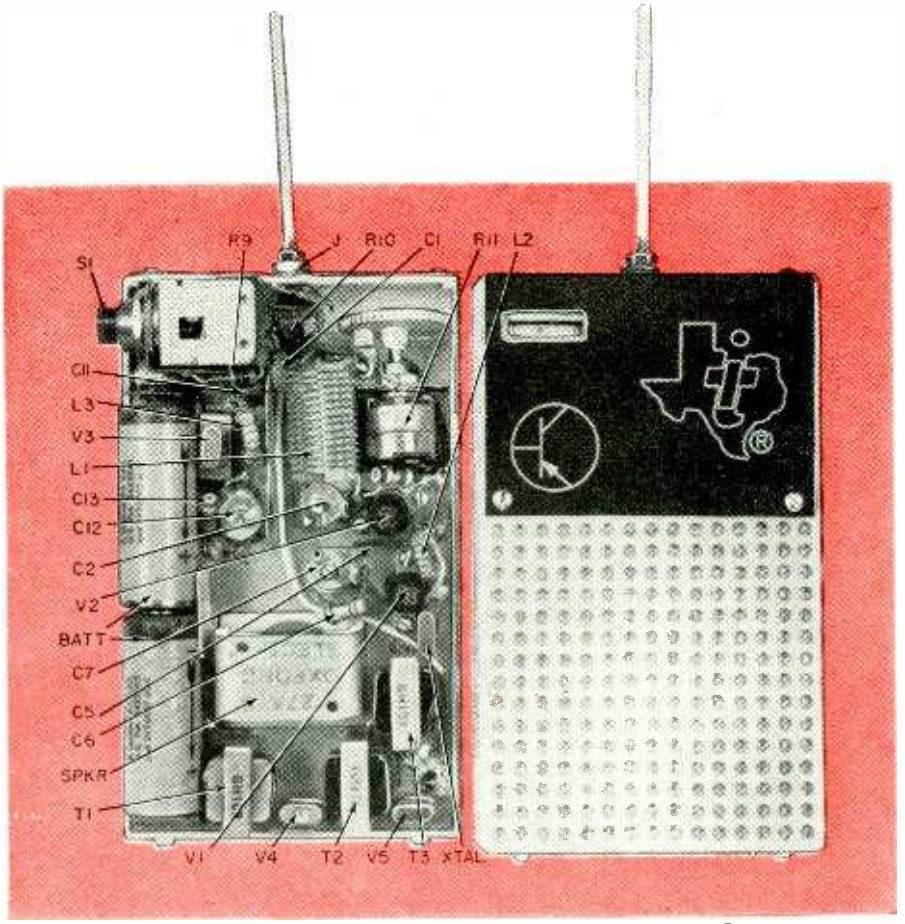


Photo 1—Front and rear views of the transceiver built by Texas Instruments.

Collector modulation is used to get the greatest efficiency for a given collector power. The bottom end of L1 is bypassed for rf by a .01-μf capacitor but the collector voltage is obtained from T3's primary, which acts as a modulation choke. Transformer T3's secondary is open during transmission and, in effect, is not in the circuit. Transistor V5 is a medium-power audio device operated as a class-A modulator. The audio drive for the modulator comes from V4, a conventional class-A amplifier.

In the transmit position, the speaker acts as a microphone and is matched to V4's input by an additional 12-ohm winding on T1. The transformer's original 20,000-ohm primary is used in the receive position. Since the audio gain of V4 and V5 is more than sufficient to produce 100% modulation, an attenuator is used at the modulator input—across T1's 12-ohm primary.

The input power to the final stage, V1, is approximately 30 mw, while the power output to the antenna is 20 mw. This is a good indication of the excellent efficiency (65%) of the diffused-base transistor. The antenna is center-loaded to present a 50-ohm resistance at its bottom end. Construction of the antenna is shown in Fig. 2. One end of the antenna is filed down for a snug fit in the antenna post (J), which is a miniature phono jack.

Receiver

The receiver uses a 2N309 self-quenching superregenerative detector. The circuit is a variation of the two-terminal grounded-base oscillator, with feedback provided by a 4.7-μμf capacitor between the collector and emitter. RFC4 is a 22-μh choke that is self-resonant at approximately 27 mc. This elevates the emitter from ground at the signal frequency and makes oscillation possible. The 220,000-ohm base-bias resistor and the .001-μf bypass capacitor produce a quench frequency of approximately 50 kc. In general, a lower quench frequency provides better sensitivity but is more difficult to eliminate from the audio amplifier. The .01-μf capacitor, C15, prevents the quench voltage from overloading the audio amplifier.

PARTS LISTS

R1—430 ohms, 5%
R2, 5—18,000 ohms
R3, 6, 13—2,200 ohms
R4—470 ohms
R7—220,000 ohms
R8, 14—1,000 ohms
R9—10 ohms
R10—33 ohms
R11—pot, 20,000 ohms
R12—15,000 ohms
R15—8,200 ohms
R16—1,200 ohms
R17—100 ohms
R18—220 ohms
All resistors ½-watt 10% unless noted
C1, 11—500 μμf, ceramic
C2, 7, 12—3–30 μμf, air trimmer
C3, 4, 5, 6, 8, 9, 15—.01 μf, ceramic
C10—.001 μf, ceramic
C13—4.7 μμf
C14—40 μf, 3 volts, electrolytic
C16, 17, 19, 20—.005 μf, 3 volts, electrolytic
C18, 21—.005 μf, ceramic
C22—100 μf, 15 volts, electrolytic
All capacitors 75 volts unless noted. Subminiature units only
BATT—5-volt mercury batteries in series (2) (Mallory TR-164-R or equivalent)
L1—14 turns, tapped at 3 turns (Air Dux No. 416, B&W Miniductor No. 3003 or equivalent)

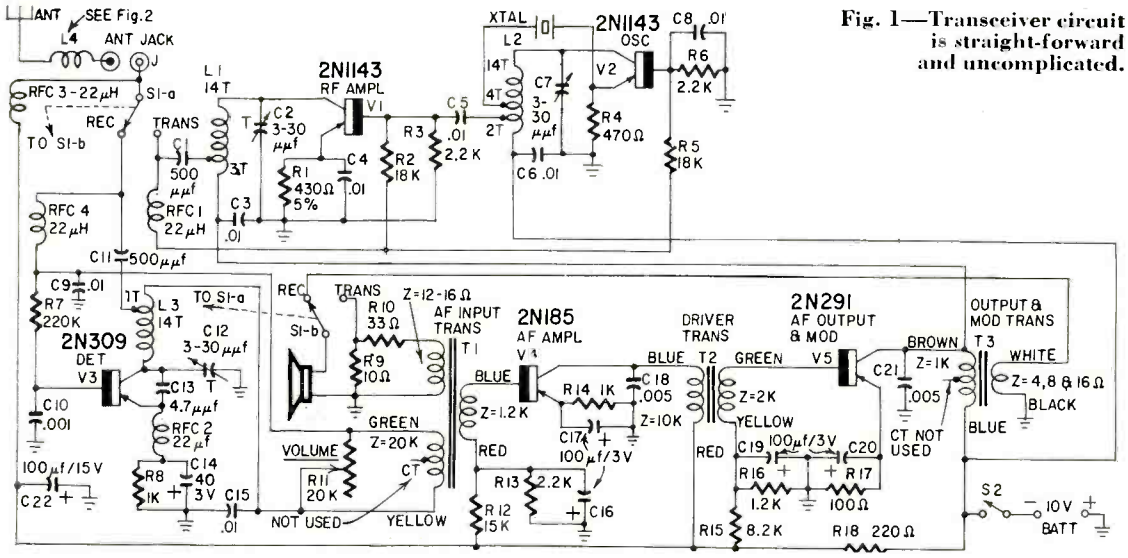


Fig. 1—Transceiver circuit is straight-forward and uncomplicated.

L2—14 turns, tapped at 2 turns and 4 turns (Air Dux No. 416, Miniductor No. 3003 or equivalent)
L3—14 turns, tapped at 1 turn (Air Dux No. 416, Miniductor No. 3003 or equivalent)
L4—44 turns, centered on ½-inch polystyrene rod (see Fig. 2) (Air Dux No. 432, Miniductor No. 3004 or equivalent)
RFC1, 2, 3, 4—22 μH (Delevan 1537 series or equivalent)
S1—dpdt snap-action switch (Minneapolis Honeywell 2-PB11-T or equivalent)
S2—spst
T1—dual-input transformer: primary, 20,000 ohms; secondary, 1,200 ohms—modified by adding a second primary of 80 turns of No. 38 enameled wire for the speaker input-output windings (Gramer-Halldorson GH109 or equivalent)
T2—driver transformer: primary, 10,000 ohms; secondary, 2,000 ohms (Gramer-Halldorson GH-117 or equivalent)
T3—output transformer: primary, 1,000 ohms; secondary, 12–16 ohms (Gramer-Halldorson GH107 or equivalent)
V1, V2—2N1143 (see text)
V3—2N309
V4—2N185
V5—2N291
Speaker (Oxford 27AT5 or equivalent)
Case
Antenna (see Fig. 2) 26½ inches long, made from ⅛-inch brass rod
Knob for volume control
Miscellaneous hardware

The detected audio voltage is developed across T1's 20,000-ohm primary. Collector voltage for V3 is supplied through this same primary winding. A 20,000-ohm volume control across the primary controls the level of the received signal. V4 is a simple voltage amplifier, and V5 is a class-A audio output which drives the 3-ohm speaker. The receiver requires a 5-μv signal to get a 10-db signal-to-noise ratio.

The transmit–receive switching system is possible because of the low impedance and voltage levels associated with transistors. The 22-μh chokes have low dc resistances, so any voltage drops are negligible. On the other hand, the Q's are high enough so that the chokes can shunt an rf signal circuit with very small loss.

In the RECEIVE position (as shown), S1-a and RFC3 carry the supply voltage via RFC4 to V3's collector and base, thus activating the receiver's detector. The signal from the antenna also travels through S1-a to the tap on L3 which is the receiver's signal input. In the receive position, S1-b connects the speaker to the audio amplifier's output. When the switch is pressed, S1-a connects the antenna to the rf power amplifier's output at the tap on L1. At the same time, the −10-volt supply is connected to the forward bias resistors on V1 and V2, causing them to become operative. The audio amplifier's input is connected to the loudspeaker (which is now the microphone) by S1-b.

The layout is not particularly critical but good rf practices should be observed, especially in the transmitter circuitry.

The transmitter is tuned by adjusting C7 for maximum output as indicated by a grid-dip meter placed close to L2. After C7 has been tuned, the grid-dip meter is moved to the antenna near the loading coil and C2 is adjusted for maximum output.

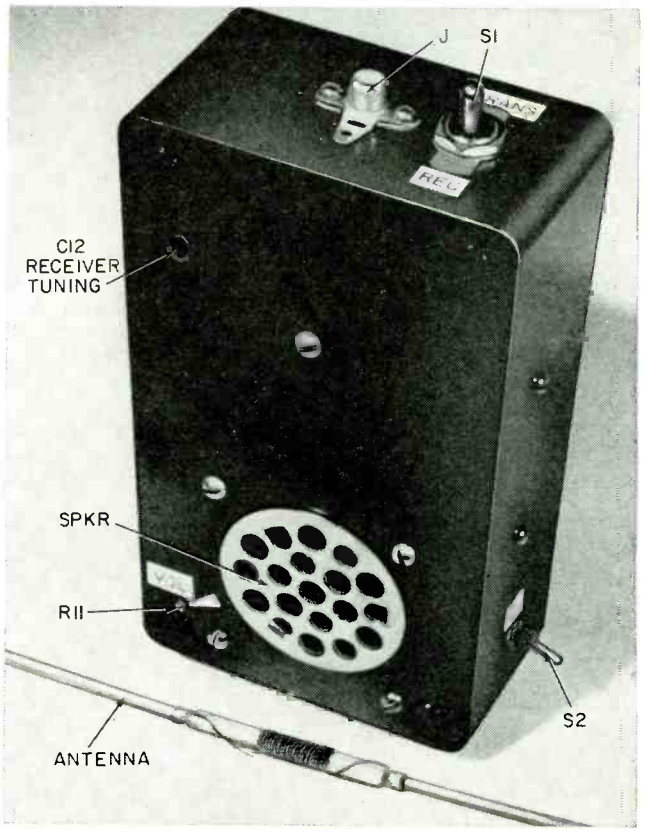


Photo 2—Front view of the R-E Citizens Radio transceiver.

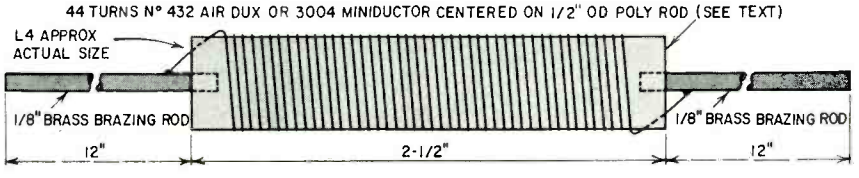


Fig. 2—Construction of the center-loaded whip antenna.

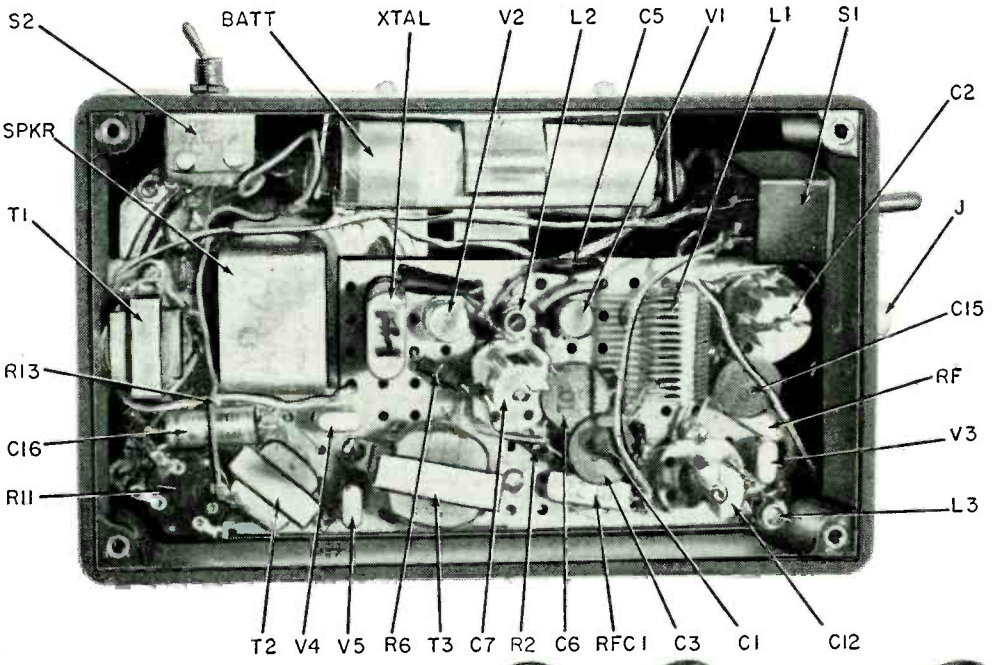
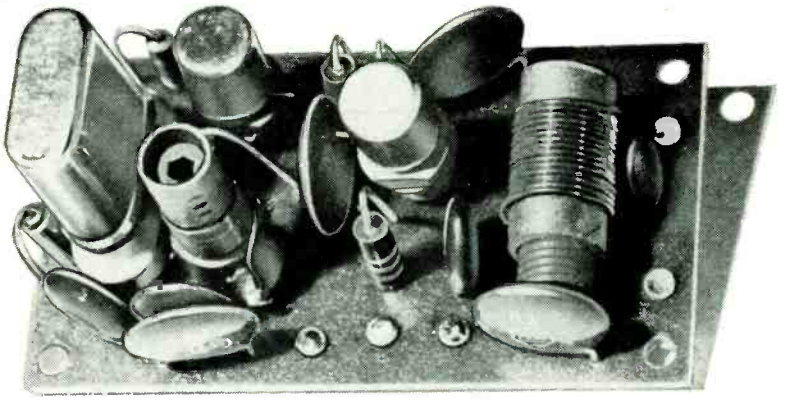


Photo 3—Inside the compact R-E transceiver.



(Below) A 2-transistor printed circuit transmitter rf chassis developed by International Crystal Mfg. Co. for Citizen's Band radio. It might be used in the transistor transceiver described in this article to help the constructor who feels that he may have difficulty in building a unit that will be on frequency and within tolerance.

The receiver's frequency adjustment, C12, can be made either with a signal generator or with another transmitter. The detector has very good limiting characteristics, so the signal used for tuning must be very small.

If two of these transceivers are operated within 50 feet of each other, the radiated signal from the detector of one receiver may be picked up by the other receiver.

Construction Details

L2 and L3 were wound on Ferramic Q toroidal cores to conserve space. Since these cores are not always available through parts jobbers, their equivalents in standard helical coils are given. The crystal is a postage-stamp type specially constructed for these transceivers but standard types of crystals will work just as well.

To add the 12-ohm primary to T1, the frame and core must be removed from the transformer. The outside tape must also be removed before winding on the new primary. Since the audio amplifier's gain is more than adequate, the additional winding can be reduced to 40 turns for easier winding. The original windings should not be disturbed when making this modification.

Editorial note

The transceiver in Photos 3 and 4 was constructed by Mr. Queen of the RADIO-ELECTRONICS staff and completely checked out by a radio engineering laboratory to insure that you can duplicate it with the assurance that it will meet FCC specifications. Some components in the original unit were replaced by types that are more readily available and case dimensions and parts layout were adjusted accordingly.

The 2N1143 transistors used in the transmitter section are comparatively expensive—around $16 each. Less expensive high-frequency transistors with approximately the same characteristics as the 2N1143 were tried as possible substitutes but did not work well in this circuit.

In the RADIO-ELECTRONICS transceiver, L1 is 14 turns of a B & W type 3011 Miniductor with the tap 3 turns from the "cold" end. L2 and L3 are each 18 turns of No. 30 enameled wire closewound on CTC (Cambridge Thermionic Corp.) PLS6 forms. L2 is tapped at 3 and 6 turns, and L3 at 1½ turns. L4 consists of 44 turns of No. 26 enameled wire closewound on a ¼-inch diameter polystyrene rod 2 inches long. The ends are drilled to receive the brass antenna rods. The ends of L4 are soldered to the rods as in Fig. 2.

C1, 2 and 3 are E. F. Johnson type 30M8 3–32-$\mu\mu$f 28-plate variables with one rotor and one stator plate removed from the rear and the shaft cut down slightly to fit the cabinet used.

RFC-1, -2, -3 and -4 are National type B15978 22-μh inductors.

T1 is a Lafayette type AR-104 input transformer with a 50-turn primary of No. 38 enameled wire added to match the 3.2-ohm speaker. Adding this winding is a tedious job and extreme care is needed to avoid breaking the wire or damaging the original windings and to prevent shorts to other windings or the core.

T2 is a Lafayette AR-109 and T3 is an AR-138. An output transformer with a 3.2-ohm secondary was selected to match the 3.2-ohm speaker which is easier to obtain than 12- or 16-ohm miniature types.

R11, the volume control, is a 15,000-ohm potentiometer which was the closest to the specified value in a miniature type.

The bakelite case and cover are Lafayette MS-216 and MS-217, respectively.

The crystal must be a third-overtone type cut for the desired Citizens radio channel. Its frequency tolerance must be .005% or better. **Manufacturers guarantee the frequency tolerance of their crystals only when they are used in the circuit used for calibration. In this and many other oscillators, tuning the tank circuit causes variations in output frequency. Therefore, the transceiver's oscillator must be tuned by or under the supervision of a commercial radio operator with a Radiotelephone Second-Class or higher-grade license.** You can have your transceiver tuned and checked out by the technician who normally services fire, police, public utility or marine radiotelephone equipment in your area. An operator at a broadcast station may have the equipment to do the job for you. END

RADIO

REJUVENATION for the AM Detector

AM detector uses voltage-doubler action—drives audio output stage direct

By LEONARD E. GEISLER*

FOR years, radio manufacturers have been foisting the diode detector circuit (Fig. 1-a) and its low-level highly distorted audio output onto an unsuspecting public. (Don't think output is distorted? See Fig. 1-b.)

Many serious workers have explored various types of detectors, looking for one which would yield high output with low distortion. None, however, is nearly as perfect as that which we shall describe here. The use of negative feedback techniques to reduce conventional detector distortion has been described,[1] but apparently not adopted.

On the other hand, we have developed a very simple, inexpensive detection system which neatly sidesteps most, if not all, failings of the conventional detector. Using either tubes or semiconductors, this detector reproduces *all* the information on the original carrier —excepting sidebands lost during rf and if amplification—without introducing appreciable distortion of its own. (This *is not* an original circuit; it is the familiar half-wave voltage doubler.)

What it is and how it works

The circuit uses a pair of diodes—vacuum-tube or semiconductor—*wired as a simple diode integrator*. Parts used are at an absolute minimum (see Fig. 2). Values of C1 and C2 are usually 47 and 470 $\mu\mu$f, respectively. R1 may be from 250,000 ohms to 2 megohms. The output coupling capacitor can be any value from .001 through 0.1 μf to suit individual taste.

When a modulated rf wave is introduced at point A, the negative-going portion of the sine wave causes D2 to conduct and both C1 and C2 are placed in series across the input. Both capacitors are presented with the same amount of input voltage from the if transformers, but since C1 is much smaller than C2, most of the charge appears across it. As the wave falls back through zero and to its maximum positive excursion, D2 is cut off and C2 is effectively isolated from point A. D1 now conducts, discharging C1. At this time, point B has a charge of approximately $\left(\frac{C1}{C2}\right)$ V. As the wave proceeds to its maximum positive value, D1 still conducts heavily and does so until the wave, reversing, reaches the zero line once more. When the next negative-going portion arrives, D2 does not conduct until the voltage at point A exceeds the charge at point B. The voltage presented to C1 and C2 is therefore slightly less than on the first negative wave. However, the potential at point B rapidly builds up to the peak-to-peak value of the input waveform. By inserting R1 between point B and ground, the charge on C2 is bled off to produce a useful output. The additional resistor and capacitor (R2 and C3) shown between X and ground provide a takeoff point for recovery of avc bias. A useful byproduct of this R-C circuit is that it acts as a bass-boosting device at low settings of R1. If it is undesirable or sound is too high in the "off" position use a volume control near the 2-mehohm value, or replace it with a 250,000-ohm fixed resistor and put a 500,000-ohm volume control directly between amplifier grid and ground.

Due to the unbalanced manner in which the conventional diode detector loads the if transformer's secondary, the diode fails to produce undistorted af output. The diode integrator–detector, on the other hand, presents essentially a capacitive load to both the positive and the negative excursions of the rf waveform. C1 appears in parallel with the trimmer capacitor on the if transformer secondary and therefore the action of the detector has little effect on the tuned circuit. What additional capacitance there is can be trimmed out and the secondary of the if transformer is in resonance once more. Therefore, this is essentially a no-load detector. It allows maximum output voltage to be developed, something practically impossible with conventional methods of detection. Rectified rf dc voltages of 100 or more are easily obtained between point B and ground—depending on the turns ratio of the if transformer secondary. The audio "ripple" component of the dc output is very large in amplitude, often exceeding 35 volts peak to peak, more than sufficient audio drive for a conventional output tube such as the 6AQ5, 6V6, etc. Normally, diodes do not amplify, but the action of this circuit is such that amplification seems to be taking place. Actually, most of the output developed is that which is usually wasted.

FM–AM detector

By substituting an rf transistor for D1 and a 1N34-A diode for D2, this circuit becomes an excellent FM detector. See Fig. 3 for details.[2] By inserting a limiting circuit ahead of the integrator, with provisions for switching in and out, the circuit detects AM or FM "at the flick of a switch." It is not very adaptable to conventional FM reception with vacuum-tube diodes. However, as an AM detector, the vacuum-tube version is exceptionally immune to QRM—noise—and has proved to be an ideal detector for converting or repairing old communications type receivers. END

*Chief engineer, Japan Electronic Trading Co., Tokyo, Japan.

[1]John Markus and Vin Veluff, Editors, "Stabilized Negative Impedances," *Electronics For Communication Engineers*, McGraw-Hill.

[2]P. L. Burton and F. Willis, "Unusual Transistor Circuits," *Wireless World*, March 1958.

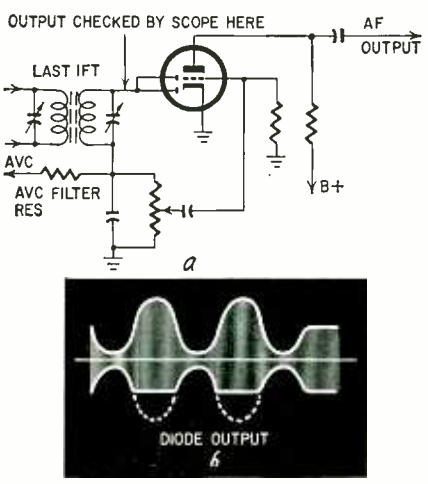


Fig. 1-a—Conventional diode detector circuit. Dc flows in if transformer's secondary, upsetting circuit Q; b—waveform showing how conventional diode conducts during more than 50% of rf cycle, generating unwanted distortion.

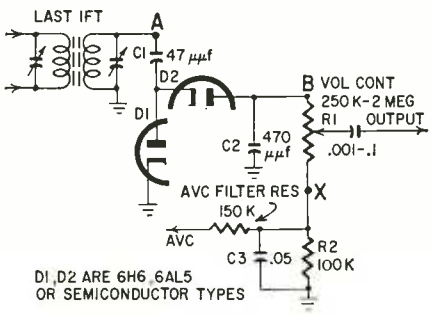


Fig. 2—Diode integrator–detector circuit. Diodes may be 6AL5, 6H6 or semiconductor units such as 1N35's.

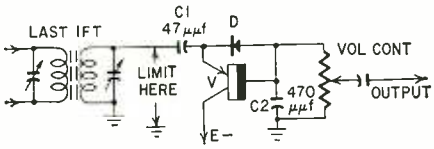
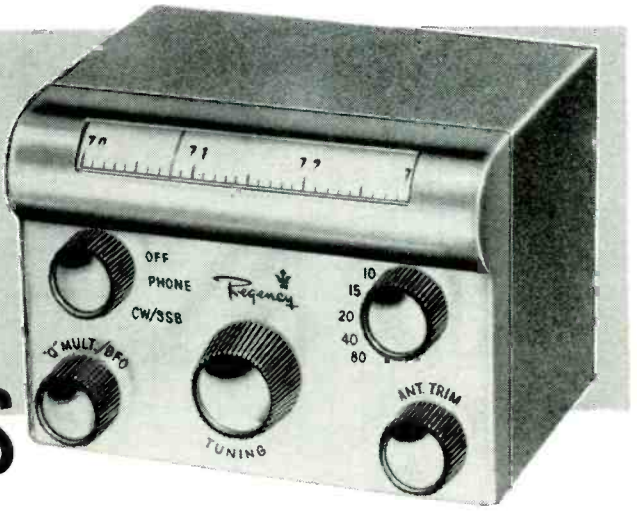


Fig. 3—FM detector version of Fig. 2 circuit. Using transistor instead of diode permits better discrimination of FM. Pair of back-to-back diodes inserted at "Limit Here" eliminates unwanted AM component from output. Switching out diode limeters converts detector back to AM operation.

TRANSISTOR CONVERTER hauls in HAM BANDS

Two-transistor unit puts the ham bands, including SSB transmission, on any home, auto or portable AM radio



By ROBERT F. SCOTT
TECHNICAL EDITOR

THE Regency ATC-1 all-transistor converter is designed for use with any home, auto or portable broadcast receiver to receive AM, SSB and CW signals in the 80-, 40-, 20-, 15- and 10-meter amateur bands. It is extremely compact—3¼ x 4¾ x 4-1/16 inches—and weighs only 30 ounces. A maximum of 600 μa is drawn from its three penlight cells so useful operating time approaches battery shelf life.

Each amateur band covers the full length of the slide-rule drum dial. The converter features a Q multiplier for high selectivity, bfo for CW and SSB reception and a clamp diode to prevent overloading or transistor damage by strong signals from nearby rigs.

The converter is inserted in series with the lead-in between the antenna and the set's antenna post. When turned off, the converter is bypassed and the antenna switched to the receiver.

How it works

The circuit of the ATC-1 is shown in Fig. 1. It is a superheterodyne unit with its output normally adjusted to 1230 kc. This frequency was selected so the receiver's oscillator would not produce harmonics falling in any amateur band. The heterodyne converter (V1) is an SB-100 surface-barrier transistor. The oscillator circuit operates on fundamentals on the three lower-frequency bands and on the second harmonic on 15 and 10 meters. The oscillator signal is on the high side of the signal frequency on 80, 40 and 20 meters and on the low side for 15 and 10 meters. Second-harmonic operation on the two higher-frequency bands gives more reliable oscillator operation and minimizes oscillator pulling.

The SB-100 is connected as an autodyne converter which combines the functions of local oscillator, mixer and if amplifier. The oscillator is a common-base type with feedback from the tickler coil in the collector circuit to the tuned circuit feeding the emitter. Oscillations are sustained at the oscillator transformer's frequency as set by C8-b. The base is effectively grounded for rf through the 30-μμf blocking capacitor (C12) and the tuned secondary of the antenna transformer.

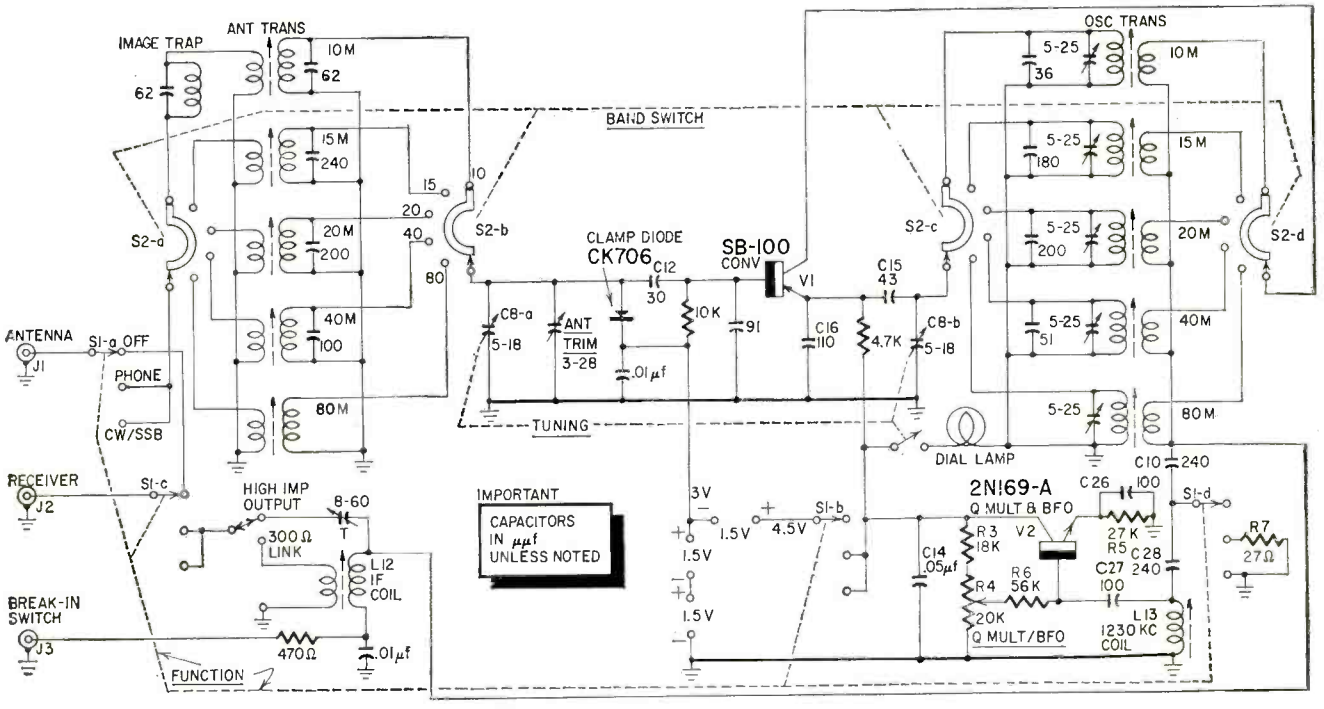
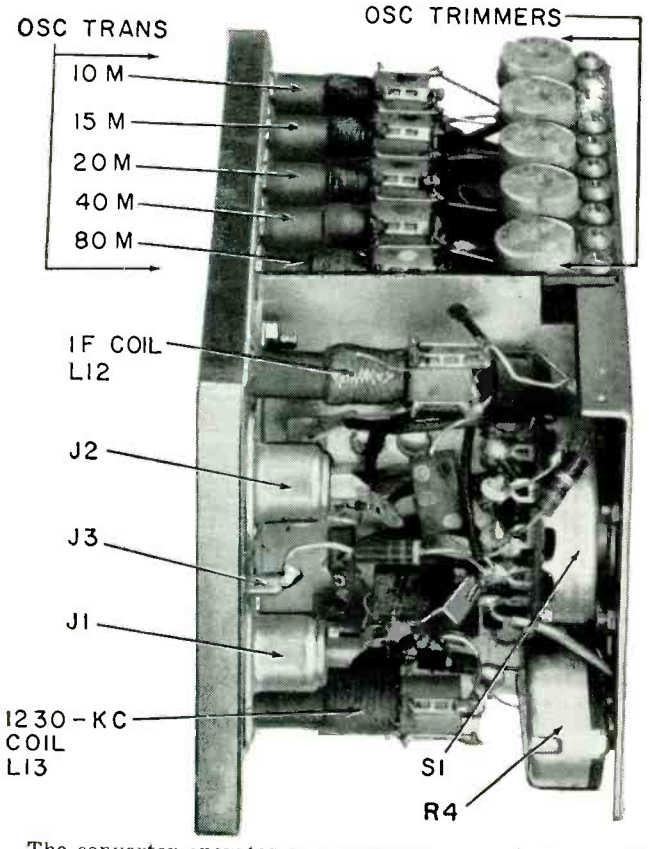
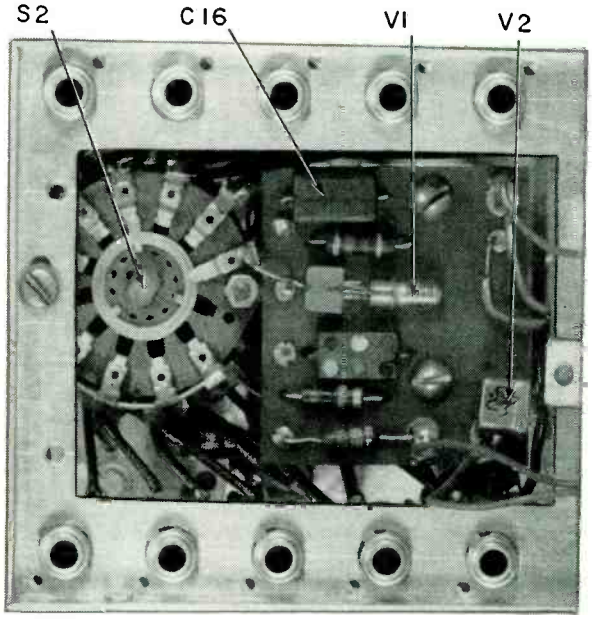


Fig. 1—Circuit of the converter.



Top-chassis view of the two-transistor unit.

The converter chassis seen from below.



The converter operates as a common-emitter arrangement. The antenna is connected to the primary of the antenna transformer selected by S2 and the desired signal is tuned in by C8-a across the secondary. The incoming signal is applied to the base of the transistor which is biased for non-linear operation. The emitter is effectively grounded by C16 and by C15 and the tuned winding of the oscillator transformer in series. The incoming signal on the base mixes with the oscillator signal on the emitter to produce a 1230-kc if signal across if coil L12 in the collector circuit. This if signal is fed to a high-impedance receiver antenna input circuit through a trimmer capacitor or to a low-impedance input circuit through a 300-ohm link winding.

The selectivity of the average converter–receiver combination is restricted to that of the receiver's front-end and if circuits. The average broadcast receiver is not selective enough for good performance on the crowded amateur bands so adequate selectivity has been built into the ATC-1 converter. This is done by providing a 1230-kc if with an exceptionally high Q.

As in any passive tuned circuit, the Q of if coil L12 is $R/\omega L$, where R is the equivalent circuit resistance *paralleled* across the tuned network and ω is $2\pi f$. The selectivity of the circuit varies inversely as R. Thus, selectivity and circuit Q approach infinity as R increases.

The Q multiplier

The ATC-1 uses a circuit called a *Q multiplier* to give the converter–receiver combination selectivity approaching that of a good communications receiver with a crystal or equivalent filter. Q multiplication is obtained by shunting the 1230-kc if coil with a regenerative circuit that develops a *negative* resistance (R_n). The effective resistance (R_{eff}) of the tuned circuit is then $R(-R_n)/R + (-R_n)$ or $R \times R_n/R_n - R$. Since R_{eff} is greater than R, the Q of the circuit is multiplied by the ratio of these two resistances. As R_n approaches R, circuit amplification increases and bandwidth decreases. When R_n exceeds R, the circuit oscillates.

The 2N169-A is connected in a basic Colpitts oscillator circuit with the emitter returned to the midpoint of a capacitive voltage divider consisting of C26 in series with the base–emitter capacitance. Fig. 2 shows the similarity between the circuit of the 2N169-A and a vacuum-tube Colpitts oscillator. The circuit inductance is L13, the 1230-kc bfo and Q multiplier coil. The gain of the circuit, and thus the amount of regeneration, is controlled by R4, which varies the base bias. This regenerative network is coupled to if coil L12. Emitter resistor R5 is used in place of the cathode choke in the vacuum-tube circuit to improve stability.

When the FUNCTION switch is in the CW/SSB position, C28, the tuning capacitor for L13, and L12's tuning capacitor (C10) are both grounded by S1-d. The Q MULT/BFO (regeneration) control is advanced just beyond the point where V2 starts to oscillate when receiving CW signals. On SSB signals, the regeneration control is advanced further to increase the output of V2 and provide the optimum level for exalted-carrier

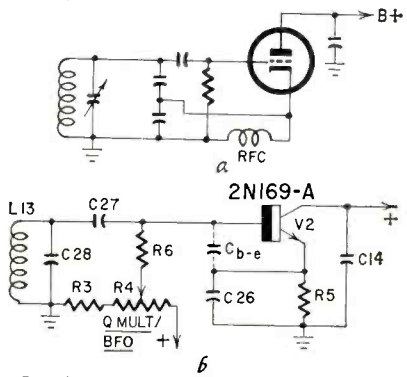


Fig. 2—Colpitts oscillators: a—Typical vacuum-tube unit. b—Transistor circuit used in the converter.

type reception. Stray coupling between L12 and L13 provides sufficient bfo injection voltage for CW and SSB.

When the switch is thrown to PHONE, R7 is inserted between ground and the junction of C10 and C28. L12 and L13, linked solely by stray capacitive and inductive coupling for CW and SSB, are now coupled by their collective currents flowing through R7. This provides a degree of coupling between the Q multiplier and if circuits and reduces the Q of each slightly to prevent excessive sideband cutting on AM signals. R4 is adjusted so the Q multiplier is just on the verge of oscillation for maximum gain and selectivity.

The additional coupling provided by R7 decreases the bandwidth of the 1230-kc if circuit and increases its gain over a narrow band of frequencies. Any signal falling on the peak of the narrowed passband is amplified much more than one falling down on the

RADIO, TV and the USSR

By LARRY STECKLER
ASSOCIATE EDITOR

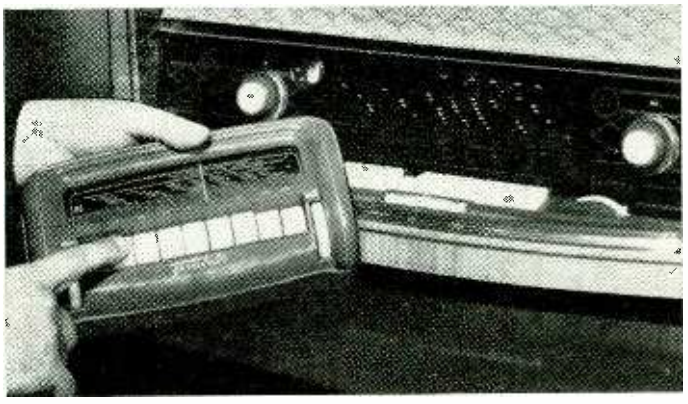
THE most startling thing about the electronics section of the Soviet Exhibition at the New York Coliseum was that everything looked vaguely familiar. All the TV's, radios, record players and even stereo equipment looked like US-made (or European imports) that had been twisted slightly. (Even the Russians admit that their color TV system follows RCA's.)

Radio

Radio receivers range from the very simple to the extremely complex, but all cover at least two bands, and some cover as many as six or seven with electronic bandspread over important sections. Almost all cover the European FM band. Units come in all sizes and shapes, from the small 4-tube plastic-cased table model to the complicated console multi-band receiver which has a distinct likeness to many of the European imports seen in the US.

While exciting features are rare, one line of sets has a remote control worthy of special note. It connects to the set by way of a long thumb-thick cable. The remote unit looks like a miniature replica of the set's front panel and provides remote control of almost all receiver conditions and functions. The photo shows the remote-control unit in front of the set it controls.

The same receiver has an automatic station seeker. The operator simply presses a button—on the receiver or the remote control—and this mutes the set while it tunes to the next active station, stops and resumes playing. The remote control includes pushbutton band selection, bass and treble controls, on–off, and automatic and manual tuning. The system is apparently similar to that used in US auto radios.



The Festival, a multi-band radio receiver with its unusual remote-control unit.

A switch on the receiver itself is used to select the best antenna for the band being listened to.

Auto radios, in both tube and transistor versions were on display, and there were several transistor portables, one powered by a bank of solar cells built into its carrying handle. Some short-range communications gear designed for farmhouse to farmer-in-the-field use was also shown, but seemed rather bulky and complicated.

Television

All Russian TV sets incorporate printed circuitry, and one type of flyback transformer serves for all receivers. It is, in some undisclosed manner, easily adjusted and produces between 14 and 17 kv, depending on its setting. Also, many sets have pushbutton channel selection, a feature which US manufacturers discovered leads to excessive cost and servicing problems. The video if falls between 35 and 39 mc with a bandwidth of no less than 4.5 mc in 14-inch receivers and 6 mc in the 21-inch sets. While the 12 channels used correspond roughly to US channels, they are not the same. Each one is wider, 8 mc, and they all fall between 49.75 and 229.75 megacycles. Uhf is not used for television in Russia today nor are any uhf stations anticipated.

The Russian system uses 625 lines in its TV picture to work in with its 50-cycle line voltage and vertical sweep, making it compatible with Western European standards except for the difference in channel width and sound-carrier separation.

The Soviet TV receiver comes in three screen sizes—14, 17 and 21 inches. Anything larger calls for a projection set. The 14-inch models are the least expensive and the lowest in quality of the line. They have from 12 to 15 tubes and 4 to 6 diodes. Intercarrier receivers, they use a 6.5-mc sound if. They have either one or two small speakers, usually two.

The 17-inch version is a somewhat better set. It usually runs from 14 to 18 tubes and 5 to 8 diodes (4 of these are in the power supply). It is also an intercarrier set. Some models have a better speaker system than the less expensive 14-inch models.

The 21-inch receivers are the deluxe units. They may have as many as 21 tubes and 14 diodes and include an FM receiver, record player and power amplifier. They have split sound, which calls for a separate sound if strip. As many as seven speakers may be incorporated in their sound system, and some models use two audio amplifiers, one for the high frequencies and the other for the lows. Each amplifier feeds a set of speakers—in opposite ends of the cabinet—producing a quasi-stereo effect. Some sets also incorporate an FM receiver. The TV section is turned off and the separate sound section is used along with the receiver's tuner to pick up FM broadcasts in the 67.5- to 73-mc band.

The Soviet's transistor TV is still in the experimental stage, but some units were on display. They have a 10-inch screen and, like their big brothers, use printed circuitry. It takes 30 transistors and an undisclosed number of crystal diodes to put a picture on its screen. The set can be powered by a 12-volt rechargeable battery or by using a power pack off the ac line. Power consumption is 13 watts.

Hi-fi units, record players and tape machines follow US standards in respect to speeds and recording systems. The only way to sum it up is that some of the equipment seen at the show would look awfully good in anyone's living room. Of course, there is no way to tell whether these units are mass-produced or hand-built as there are no published figures. But compare these 1959 statistics:

	TV Sets in Use	*TV Stations in Use*
United States	51,000,000	548
Soviet Union	2,600,000	77

END

Transistor Converter

(Continued)

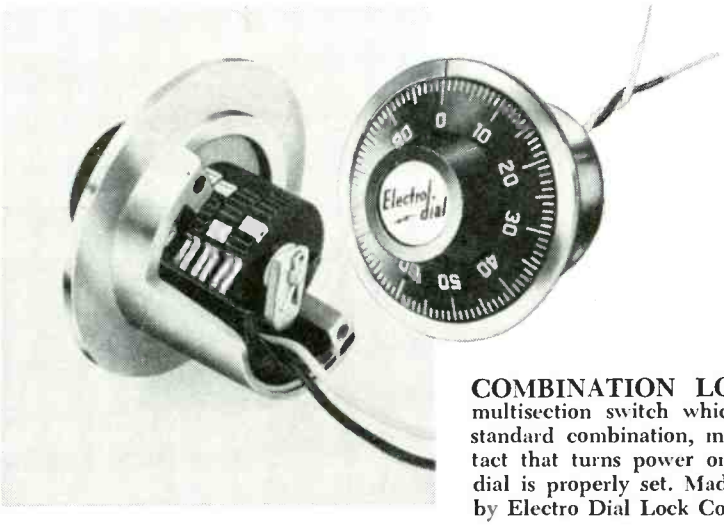
slope of the response curve. Thus, the overall selectivity of the converter–receiver combination is considerably better than that of many general-purpose shortwave receivers or the converter–receiver combinations generally used for amateur mobile work.

The dial lamp is controlled by a momentary type switch closed by pushing in on the tuning knob. This increases battery life by minimizing the use of a dial lamp that draws much more current than the transistors.

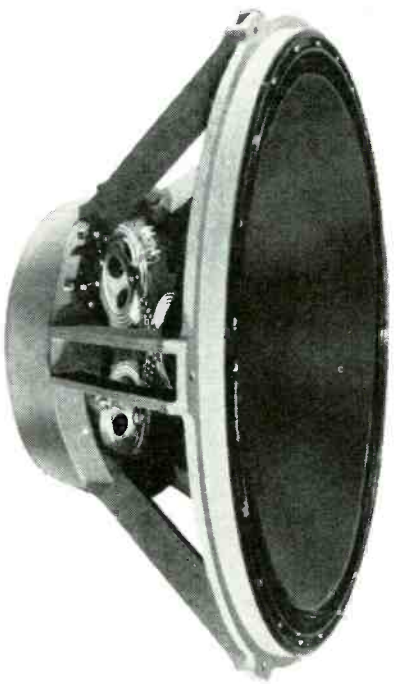
A BREAK-IN SWITCH jack in series between the SB-100's collector and ground facilitates break-in operation when the ATC-1 is used for amateur communications. A shielded single-conductor cable with a phono type plug on one end is connected across normally closed contacts on the transmitter's send–receive relay. The relay contacts open the collector return lead and disable the converter when transmitting. A shorted phono plug in J3 completes the circuit when break-in operation is not used. END

what's new?

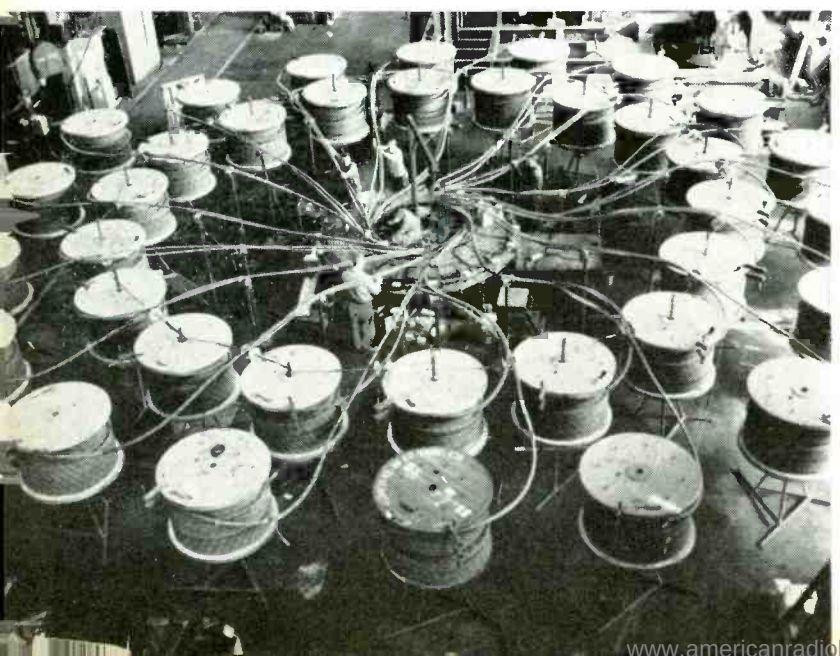
SHIP THAT NEVER GOES TO SEA is land-based replica of navigational section of submarine at Sperry's Ashore Polaris Navigation Center on Long Island, N.Y. Night picture shows sail (conning tower) structure, with a glimpse of the submarine body through the windows. This body contains complete Polaris navigational equipment, exactly as used on submarines; periscope atop sail is used to take positions by astronomical observation. Will be used to study problems in inertial-astronomical navigation and installation of equipment on submarines; later for training purposes.



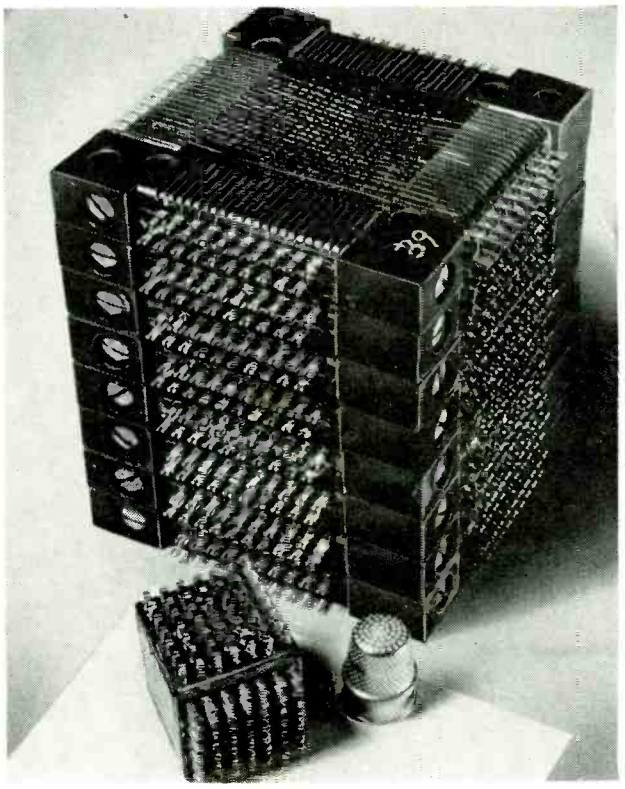
COMBINATION LOCK is rotary multisection switch which operates like standard combination, makes series contact that turns power on when Electro-dial is properly set. Made in Hollywood by Electro Dial Lock Co.



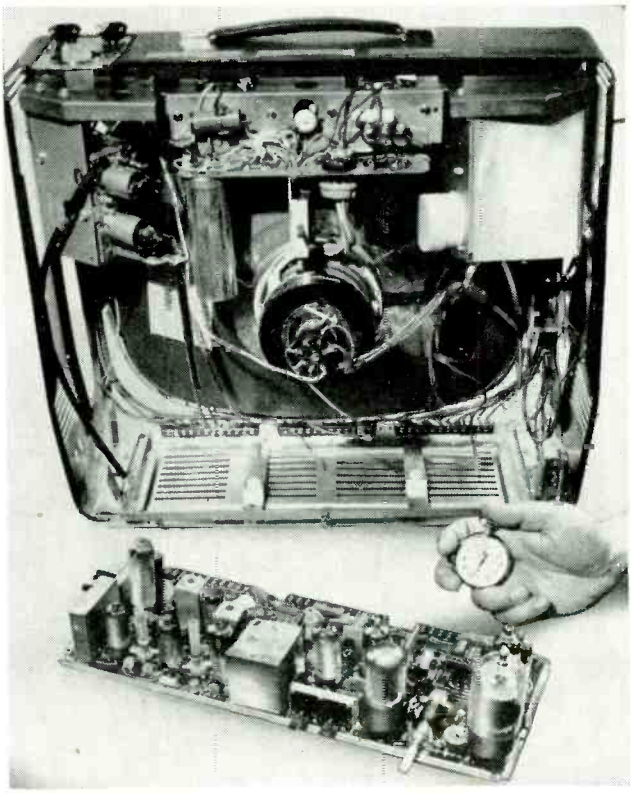
MASSIVE 32-INCH SPEAKER has three voice coils driving cone in parallel. Its three magnets total over 14 lbs. Monarch International, Hollywood, supplies this driver, which is two inches larger in diameter than the big high-fidelity speaker pictured in August RADIO-ELECTRONICS (p. 54).



BIGGEST COIL-WINDING job is to result in a monster coil which will stand 5 feet high, weigh 60 tons, contain 6 miles of tape-wound copper bar. Current will be about *1,000,000* amperes, creating magnetic clamping forces near 6,000 tons. Believed to be the biggest coil ever built, it will be used to create a spark discharge to heat air for supersonic wind tunnel. Being built by G-E for the Army Engineers, Tullahoma, Tenn.



MINIATURE MEMORY STACK saves space in big computers. Small stack of ferrite cores (note thimble) has only 96 connections, yet stores over 2,000 pieces of information indefinitely, as much as larger stack. Developed by General Ceramics Corp., Keasbey, N. J.



EASY-TO-SERVICE chassis of the new Motorola TV set is connected in circuit with spring clip contacts, can be removed for servicing in 33 seconds. The strip containing contacts can also be taken out and set put in operation with chassis on edge, easily accessible for servicing. Color-coded conductors on printed-circuit board make circuit tracing quicker and simpler.

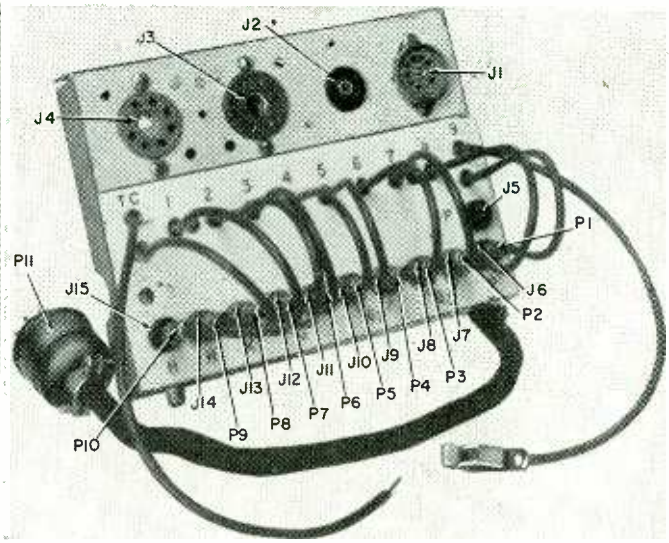
NEW RECHARGEABLE flashlight battery plugs into the ac line overnight to restore its original 2.5 volts (1.25 volts per cell). Made by Sonotone, the sintered-plate nickel-cadmium cells were originally developed for military use in missiles and jet aircraft, have recently been adapted for industrial and home use. Screwing cap on battery switches it from "charge" at 117 volts to "discharge" at 2.5 volts.

SUNMOTOR (2 volts at 200 ma) drives fan from silicon photocell. The little device was constructed by Dr. Bruno Lange of Berlin on his 25th anniversary as a photoelectric cell manufacturer. The motor runs even on light from ordinary household bulbs. Efficiency is about 10%.

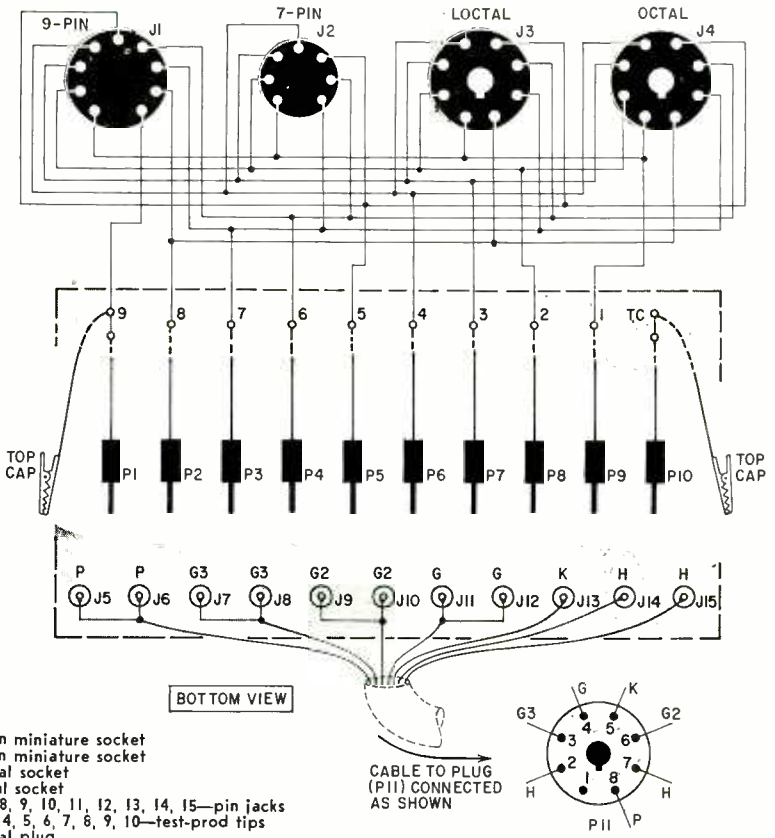
new LIFE for your TUBE TESTER

Simple adapter brings the old tube checker up to date

By LEO L. BOWMAN



Patch-cord arrangement on adapter makes it possible to test all types of receiving tubes with octal, loctal, 9- or 7-pin miniature bases.



J1—9-pin miniature socket
J2—7-pin miniature socket
J3—loctal socket
J4—octal socket
J5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15—pin jacks
P1, 2, 3, 4, 5, 6, 7, 8, 9, 10—test-prod tips
P11—octal plug
Chassis, 1 x 4¾ x 6½ inches
Alligator clips (2)

Circuit of the tube-tester adapter.

WITH an ever-growing list of new, newer and newest receiving tubes, the radio–TV technician's tube tester tends to become obsolete very rapidly. In only a year or two, the technician discovers that his tester will not check many of the tubes possible with the new models.

That is exactly the position I found myself in a while ago, so I decided to do something about it. I could buy a cheap tester each year or two and have an instrument I couldn't trust, or I could buy one of the better instruments at a much higher cost. Neither possibility appealed to me.

After some thinking and experimenting, I came up with the adapter shown in the diagram and photos. With this unit I can test any tube, so long as it has an octal, loctal, 7-pin or 9-pin miniature base. This covers all new types; my old tester will handle all others. [The loctal socket can be left out of the adapter if your tube checker has one. It is doubtful that any new loctal types will be manufactured.—*Editor*]

I built the unit into a small chassis —1 x 4¾ x 6½ inches—so it would fit into the line-cord compartment of my tube tester. The photo shows the layout I used. Other technicians may have other needs, requiring a different layout. This is not a problem as no critical wiring is involved.

As you may expect, the adapter's plug is inserted into the octal socket of the tube tester. The cable connected to this plug goes to the adapter and is connected to the various pin jacks. My unit is set up so the adapter plug is considered as a 6SK7—the tube tester's switches are set up for a 6SK7.

The pin jacks are all connected to their respective tube-socket pins—lead 1 goes to pin 1, lead 2 to pin 2 and so on. Two plate and grid caps are also provided—one connects to the pin-9 terminal, the other is marked TC for top cap.

To use the adapter, plug it into the tube tester and set the tester's switches for a 6SK7. Then set filament voltage for the tube you are going to test. Set other tube-checker controls as if you were testing a similar type tube that the checker can handle. Next plug the tube into the adapter and set up the patch cords for the tube you are checking. If pin 1 is the plate, patch cord 1 is connected to the jack marked P. Make a note of the settings and you'll be all set the next time you run into this tube.

It might be wise to test new known-good tubes before using the tester to check tubes that may be bad. In this way you will know where to set the controls to get a reading in the middle of the GOOD range. When doing this, connect a milliameter in the plate circuit of the adapter and set the shunt controls to pass the rated plate current of the tube.

The only point to remember is that the switching arrangement of your tube tester should be set for a 6SK7 whenever you use the adapter. Just change heater voltage and shunt settings of the instrument to conform to the tube type being tested. END

Test instrument for the audiophile covers 3 mv to 300 volts and has a frequency span of 15 to 20,000 cycles

Audio Millivoltmeter

By MARTIN De FRANCE

BASICALLY, a millivoltmeter consists of a high-gain amplifier followed by a voltmeter. However, things are not quite as simple as the definition might lead one to believe. The precision, linearity and stability of the instrument are very important factors and have been duly taken into account in the accompanying circuit, by H. Schreiber and published in *Toute la Radio* (September, 1957).

The instrument measures from 3 mv to 300 volts, over the frequency range from 15–200,000 cycles. The critical voltages are stabilized. A 10% variation in the line voltage results in a 1% to 3% variation in gain, mainly because of the variation in the voltage of the heater.

Fig. 1 shows a cathode-follower probe containing a 6AB4 which is used for all voltages up to 10 volts—the cathode follower is linear up to 15 volts. Larger voltages could be measured with an ordinary voltmeter but, as an added convenience, three extra ranges have been added: 30, 100 and 300 volts, with direct input. A resistance divider is used to cover 3 mv to 300 volts in 11 ranges.

The amplifier uses two high-transconductance pentodes (an EF80/6BX6 and ½ of a 6U8) to provide a total gain of about 1,000. The gain is stabilized and the bandwidth increased by using cathode feedback with a small shunting capacitor to increase gain at high frequencies.

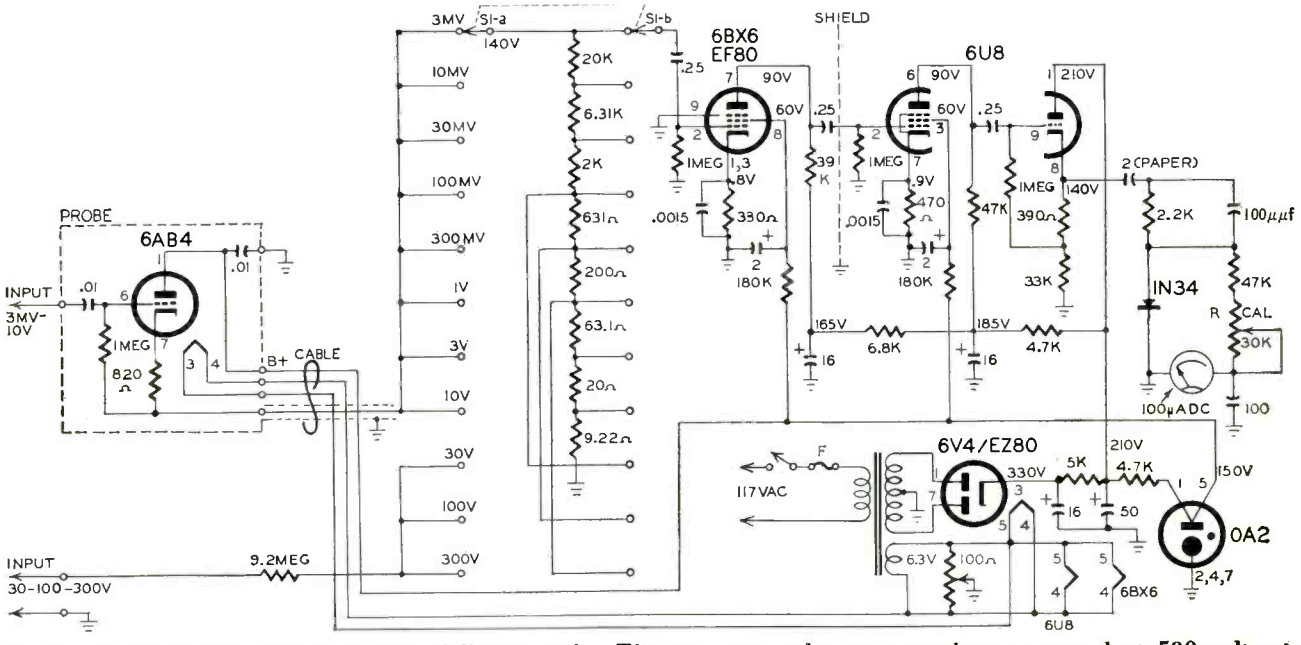


Fig. 1—The millivoltmeter and its cathode-follower probe. The power transformer secondary was rated at 580 volts ct. A 600-volt ct secondary will probably work well.

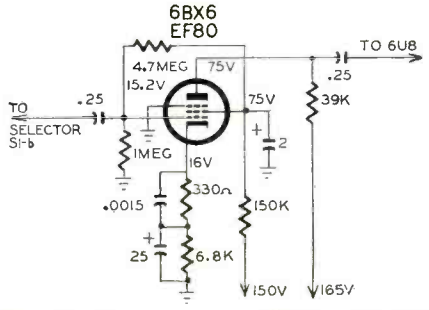


Fig. 2—For greater stability, try this variation in the input tube's circuit.

Without the capacitors, response is linear up to 50,000 cycles. With the capacitors, it is linear up to 200,000 cycles.

A clever trick has been used to eliminate any instability due to the second amplifier's plate current. This stage drives a cathode follower whose load resistance is such that total anode current for the amplifier and cathode follower remains constant.

The cathode follower provides a low-impedance source to drive the meter through a crystal rectifier. A high-frequency compensating R-C circuit has been added, and potentiometer R allows for calibration.

The ranges on the selector switch are approximate. Actually, they are not quite in a 1–3–10 ratio. The ratio is constant and equal to $\sqrt{10}$—that is 3.16—between any two adjacent ranges.

The power supply uses a transformer and a standard rectifier (EZ80/6V4). A good filter is provided, and a regulator tube stabilizes the B-plus to the input cathode follower and the screens. The large capacitor across the meter eliminates short-term fluctuations. The normal voltages have been indicated on the diagram.

If better stabilization is wanted, a variant of the original circuit can be used (Fig. 2). It uses heavy dc feedback to stabilize the plate current and the quiescent working point. The same technique is commonly used for temperature compensation with transistors.

A hum-balancing potentiometer is used to ground the heater circuit. A small shielding partition is recommended to avoid unwanted coupling between the two amplifying stages. The resistors in the input voltage divider should be precision types. END

New Transistor Clock Radio Kit

EVERYTHING A CLOCK-RADIO CAN OFFER . . . AND PORTABLE TOO!

- Completely portable, all-transistor circuit
- Runs up to 500 hours on standard batteries
- Deluxe features at half the cost
- Easy to assemble

HEATHKIT TCR-1

$45.95

"YOUR CUE" TRANSISTOR CLOCK RADIO KIT (TCR-1)

Take all the deluxe features found in the most expensive clock-radios, add the convenience of complete portability, plus a modern 6-transistor battery operated circuit . . . then slash the price at least in half, and you have the new Heathkit "Your Cue" Transistor Portable Clock Radio.

Packing every modern clock-radio feature into a compact, beautifully styled turquoise and ivory plastic cabinet, "Your Cue" lulls you to sleep, wakes you up, gives you the correct time and provides top quality radio entertainment in and out-of-doors. It can also be used with the Heathkit Transistor Intercom system, opposite page, to provide music or a "selective alarm" system for one or more rooms covered by the intercom system.

An "Alarm-set" hand, hour hand, minute hand and sweep second hand grace the easy-to-read clock dial. All controls are conveniently located and simple to operate. The "lull-to-sleep" control sets the radio for up to an hour's playing time, automatically shutting off the receiver when you are deep in slumber. Other controls set "Your Cue" to wake you to soft music, or conventional "buzzer" alarm. A special earphone jack is provided for private listening or connection to your intercom or music system. At all times crystal-clear portable radio entertainment is yours at the flick of a switch.

The modern 6-transistor circuit features prealigned IF's for ease of assembly. A tuned RF stage and double tuned input to the IF stage assure top performance. The built-in rod-type antenna pulls in far-off stations with outstanding clarity while a large 4" x 6" speaker provides tonal reproduction of unusual quality.

Six easily obtainable penlight-size mercury batteries power the radio receiver up to 500 hours, while the clock operates up to 5 months from a single battery of the same type. Ordinary penlight cells may also be used with reduced battery life.

The handsome two-tone cabinet, measuring only 3½" H. x 8" W. x 7½" D. fits neatly into the optional carrying case for beach use, boating, sporting events, hunting, hiking, or camping.

Wherever you are, you'll find "Your Cue" your constant companion. Shpg. Wt. 5 lbs.

LEATHER CARRYING CASE
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NO. 93-3
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Shpg. Wt. 2 lbs.

HEATH COMPANY/Benton Harbor, Mich.

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New Transistor Intercom Kit

TALK WITH ANY OR ALL FIVE STATIONS WITH YOUR OWN INTERCOM SYSTEM

- Battery Power Permits Placement Anywhere
- Versatile Unit has Many Important Uses
- Complete Privacy of Conversations Assured

TRANSISTOR INTERCOM KIT (XI-1 and XIR-1)

A flexible, versatile transistor intercom, has been developed by Heath engineers to enable you to set up your own communications system at an unbelievably low price.

Consisting of a master unit (XI-1) and up to five remote stations (XIR-1), the system is designed for any remote unit to call the master, for any remote station to call any other remote station, or for the master unit to call any single remote unit or any combination of remote units. Complete privacy is assured, since a call to a remote station cannot be interrupted or listened to while the remote unit is in operation unless switched in by the master unit. Used with clock-radio, opposite page, it can serve as a music or "selective alarm" system.

Transistor circuitry means long life, instant operation and minimum battery drain. Eight ordinary, inexpensive "C" flashlight batteries will run a unit for up to 300 hours of normal "on" time. Circuitry is especially designed for crisp, clear intelligible communication and the instant operation feature allows tuning of the units off between calls, extending battery life. Use of battery power does away with power cords, allowing each unit to be placed where most convenient. Only two wires are required between the master unit and each remote station. Beautifully styled, the Heathkit Intercom presents a new approach in design. Both master and remote stations have two-piece cases in ivory and turquoise for a rich, quality appearance. Batteries not included. Shpg. Wt. 6 lbs.

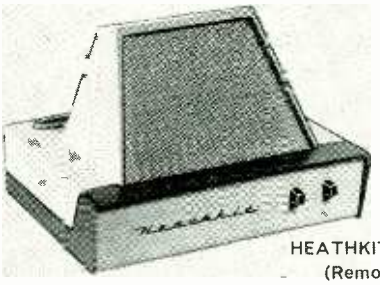
AC POWER SUPPLY (XP-1)

A permanent power supply for 24-hour operation of the XI-1 Intercom on household current. Converts 110 V. AC to well filtered 12-volt DC output, eliminating the need for batteries. Power supply is small, compact and fits in space normally occupied by batteries.

HEATHKIT XP-1.....$9.95

HEATHKIT XI-1 (Master)

$27.95



HEATHKIT XIR-1 (Remote)

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Shpg. Wt. 4 lbs.

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Get the SP-2A Stereo Preamp kit now, or the SP-1A monophonic version which you can easily convert to stereo whenever you choose by assembling the second channel (C-SP-1A) and plugging it into your SP-1A.

The SP-2A permits stereo, two channel mixing, or either channel monophonic use, and includes a remote balance control.

Six inputs (12 in the stereo version) accommodate tape, magnetic phono and microphone, plus three separate high level inputs. Level controls provided on "mag. phono" and high level inputs. Switch selects NARTB equalization for tape head input, and RIAA, LP or 78 RPM compensation for mag. phono input

HEATHKIT SP-1A (monophonic) Shpg. Wt. 13 lbs.....$37.95

HEATHKIT C-SP-1A (not shown) (converts SP-1A to SP-2A) Shpg. Wt. 4 lbs....$21.95

New

HEATHKIT SP-2A (stereo) Shpg. Wt. 15 lbs.

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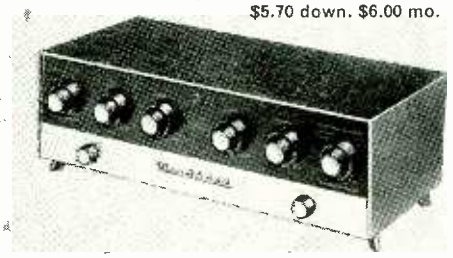
$5.70 down. $6.00 mo.



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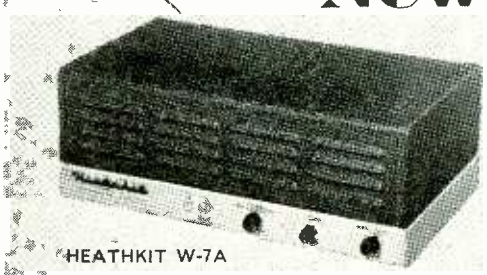
New

55 WATT HI-FI AMPLIFIER KIT (W-7A)

Utilizing advanced design in components and tubes to achieve unprecedented performance with fewer parts, Heathkit has produced the world's first and only "dollar-a-watt" genuine high fidelity amplifier. Meeting full 55-watt hi-fi rating and 50-watt professional standards, the new improved W-7A provides a comfortable margin of distortion-free power for any high fidelity application.

The sleek, modern styling of this unit allows unobtrusive installation anywhere in the home. The clean, open layout of chassis and precut, cabled wiring harness makes the W-7A extremely easy to assemble. Shpg. Wt. 28 lbs.

SPECIFICATIONS—Power output: Hi-Fi rating, 55 watts; Professional rating, 50 watts. **Power response:** ±1 db from 20 cps to 20 kc at 55 watts output. **Total harmonic distortion:** Less than 2% from 30 cps to 15 kc at 55 watts output. **Intermodulation distortion:** Less than 1% at 62 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 80 db below 55 watts, unweighted. **Damping factor:** Switch on front panel for selecting either maximum (20:1) or unity (1:1). **Output impedances:** 4, 8 and 16 ohms and 70-volt line. **Power requirements:** 117 volts, 50/60 cycles, 90-160 watts. **Dimensions:** 8½" D. x 6¾" H. x 15" W.



HEATHKIT W-7A

$54.95

Stereo Amplifiers

FOR THE FINEST IN STEREO...

"DELUXE" 14-WATT STEREO AMPLIFIER KIT (SA-1)

Offering every deluxe feature imaginable in a stereo amplifier, the SA-1 also provides 14 watts per stereo channel and 28 watts total monophonic power. Separate bass and treble tone controls for each stereo channel permit you to adjust sound reproduction to suit your taste. A 4-position function switch (stereo, stereo reverse, channel A, channel B) makes it possible for any monophonic source to be fed into either channel individually or to both channels simultaneously. By adjusting the individual channels, you can even impart a pseudo-stereo effect to monophonic program material. A special "dimension" control eliminates the "hole-in-the-middle" effect sometimes produced through varying stereo recording practices. The SA-1 features five switch-selected inputs for each channel; magnetic phono, tape head, and three auxiliary inputs for high level sources. A special sixth position on the selector switch permits use of a monophonic magnetic phono cartridge, through either or both channels. Magnetic phono inputs are RIAA equalized; tape head input is NARTB equalized. All inputs, except that for the "tape head" feature individual level controls. Ganged volume controls permit adjusting the gain of both channels simultaneously, and a separate balance control allows precise channel balancing. Internal amplifier controls for each channel are also provided. Beautifully styled with vinyl-clad steel cover in leather-like texture of black and inlaid gold design. Shpg. Wt. 30 lbs.

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14-WATT STEREO AMPLIFIER KIT (SA-2)

Complete control of your entire stereo system is at your fingertips with this versatile Stereo Amplifier-Preamplifier combination. Providing 14 watts per stereo channel, or 28 watts total monophonic, the SA-2 offers every modern feature required in a master stereo control center, and at a price to please the budget minded. Shpg. Wt. 23 lbs.

SPECIFICATIONS—Power output: 14 watts per channel, "hi-fi"; 12 watts per channel, "professional"; 16 watts per channel, "utility". **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Controls:** dual clutched volume; ganged bass, ganged treble; 4-position selector; speaker phasing switch. **AC receptacle:** 1 switched, 1 normal. **Inputs:** 4 stereo or 8 monophonic. **Outputs:** 4, 8 and 16 ohms. **Dimensions:** 4½" H. x 15" W. x 8" D. **Power requirements:** 117 volts, 50/60 cycle, AC, 150 watts (fused).

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This amazing performer delivers more than enough power for pure, undistorted room-filling stereophonic sound at the lowest possible cost. Featuring 3 watts per stereo channel and 6 watts as a monophonic amplifier, the SA-3 has been proven by exhaustive tests to be more than adequate in volume for every listening taste.

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The amplifier is tastefully styled in black with gold trimmed control knobs and gold screened front and rear panel. A tremendous buy at this low Heathkit price! Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: 3 watts per channel. **Power response:** ±1 db from 50 cps, 20 kc at 3 watts out. **Total harmonic distortion:** less than 3%; 60 cps, 20 kc. **Intermodulation distortion:** less than 2% @ 3 watts output using 60 cycle & 6 kc signal mixed 4:1. **Hum and noise:** 65 db below full output. **Controls:** dual clutched volume; ganged treble, ganged bass; 7-position selector; speaker phasing switch; on-off switch. **Inputs (each channel):** tuner, crystal or ceramic phono. **Outputs (each channel):** 4, 8, 16 ohms. **Finish:** black with gold trim. **Dimensions:** 12¼" W. x 6¾" D. x 3¼" H.

New HEATHKIT Amplifiers & Tuners

A NEW AMPLIFIER AND PREAMP UNIT PRICED WELL WITHIN ANY BUDGET

14-WATT HI-FI AMPLIFIER KIT (EA-3)

This thrilling successor to the famous Heathkit EA-2 is one of the finest investments anyone can make in top quality high fidelity equipment. It delivers a full 14 watts of hi-fi rated power and easily meets professional standards as a 12-watt amplifier.

Rich, full range sound reproduction and low noise and distortion are achieved through careful design using the latest developments in the audio science. Miniature tubes are used throughout, including EL-84 output tubes in a push-pull output circuit with a special-design output transformer. The built-in preamplifier has three separate switch-selected inputs for magnetic phono, crystal phono or tape, and AM-FM tuner. RIAA equalization is featured on the magnetic phono input. Shpg. Wt. 15 lbs.

NOTE THESE OUTSTANDING SPECIFICATIONS—Power output: 14 watts, Hi-Fi; 12 watts, Professional; 16 watts, Utility. **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms.

HEATHKIT EA-3

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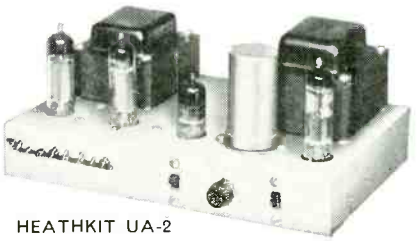
NEVER BEFORE HAS ANY HI-FI AMPLIFIER OFFERED SO MUCH AT SO LOW A PRICE

New

"UNIVERSAL" 14-WATT HI-FI AMPLIFIER KIT (UA-2)

Meeting 14-watt "hi-fi" and 12-watt "professional" standards, the UA-2 lives up to its title "universal" performing with equal brilliance in the most demanding monophonic or stereophonic high fidelity systems. Its high quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Buy two for stereo. Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: Hi-Fi rating, 14 watts; Professional rating, 12 watts. **Power response:** ±1 db from 20 cps to 20 kc at 17 watts output. **Total harmonic distortion:** Less than 2% from 20 cps to 20 kc at 14 watts output. **Intermodulation distortion:** Less than 1% at 14 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** 73 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms. **Damping factor:** Switched for unity or maximum; maximum damping factor 15:1. **Input voltage for 14 watt output:** .7 volts. **Power requirements:** 117 volts 50/60 cycles, 55 watts. **Dimensions:** 10" W. x 6½" D. x 4¾" H.



HEATHKIT UA-2

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MORE STATIONS AND TRUE FM QUALITY ARE YOURS WITH THIS FINE TUNER KIT

New

HIGH FIDELITY FM TUNER KIT (FM-4)

This handsomely styled FM tuner features better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with on-off switch, flywheel tuning and prewired, prealigned and pretested tuning unit. Clean chassis layout, prealigned intermediate stage transformers and assembled tuning unit makes construction simple—guarantees top performance. Flywheel tuning and new soft, evenly-lighted dial scale provide smooth, effortless operation. Vinyl-covered case has black, simulated-leather texture with gold design and trim. Multiplex adapter output also provided. Shpg. Wt. 8 lbs.

SPECIFICATIONS—Tuning range: 88 to 108 mc. **Quieting sensitivity:** 2.5 uv for 20 db of quieting. **IF frequency:** 10.7 mc. **Image ratio:** 45 db. **AFC correction factor:** 75 kc per volt. **AM suppression:** 25 db. **Frequency response:** ±2 db 20 to 20,000 cps. **Harmonic distortion:** Less than 1.5%, 1100 uv, 400 cycles 100% modulation. **Intermodulation distortion:** Less than 1%, 60 cycles and 6 kc mixed 4:1 1100 uv, 30% modulation. **Antenna:** 300 ohms unbalanced. **Output impedance:** 600 ohms (cathode follower). **Output voltage:** nominal .5 volt (with 30% modulation, 20 uv signal). **Power requirements:** 105-125 volts 50/60 cycle AC at 25 watts. **Overall dimensions:** 4½" H. x 13¼" W. x 5½" D.

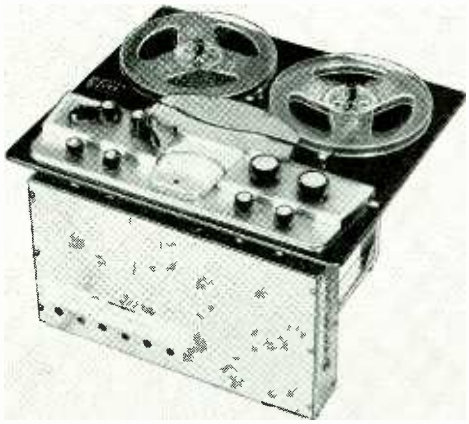
HEATHKIT FM-4

$34.95

HEATH COMPANY/Benton Harbor, Mich.

a subsidiary of Daystrom, Inc.

New HEATHKIT Tape Recorders



- Choice of 3 Outstanding Models
- Compare With $350-$400 Machines
- Preassembled Tape Mechanism
- Choice of Monophonic or Stereo models
- Complete versatility
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PROFESSIONAL QUALITY TAPE RECORDER KITS (TR-1 Series)

Enjoy the incomparable performance of these professional quality tape recorders at less than half the usual cost. These outstanding kits offer a combination of features found only in much higher priced professional equipment, generally selling for $350 to $400. Not the least of these special features is the handsome styling which characterizes the kits . . . a semi-gloss black panel is set off by a plastic escutcheon in soft gold, which is matched by black control knobs with gold inserts. The mechanical assembly, with fast forward and rewind functions, comes to you completely assembled and adjusted; you build only the tape amplifier. And, you'll find this very easy to accomplish, since the two circuit boards eliminate much of the wiring. Separate record and playback heads and amplifiers allow monitoring from tape while recording and a "pause" control permits instant starting and stopping of tape for accurate cueing and tape editing. A digit counter is provided for convenient selection of any particular recording. Push-pull knob provides instant selection of 3¾ or 7½ IPS tape speed. Safety interlock on record switch reduces possibility of accidental erasure of recorded tapes. Shpg. Wt. 30 lbs.

SPECIFICATIONS—Tape speed: 7.5" and 3.75" per second. **Maximum reel size:** 7". **Frequency response (record-playback):** ±2.5 db, 30 to 12,000 cps at 7.5 IPS; ±2.5 db, 30 to 6,500 cps at 3.75 IPS. **Harmonic distortion:** 1% or less at normal recording level; 3% or less at peak recording level. **Signal-to-noise ratio:** 50 db or better, referred to normal recording level. **Flutter and wow:** 0.3% RMS at 7.5 IPS; 0.35% RMS at 3.75 IPS. **Heads (3):** erase, record, and in-line stereo playback (TR-1C, monophonic playback). **Playback equalization:** NARTB curve, within ±2 db. **Inputs (2):** microphone and line. **Input impedance:** 1 megohm. **Model TR-1D & TR-1E outputs (2):** A and B stereo channels. **Model TR-1C output (1):** monophonic. **Output levels:** approximately 2 volts maximum. **Output impedance:** approximately 600 ohm (cathode followers). **Recording level indicator:** professional type db meter. **Bias erase frequency:** 60 kc. **Timing accuracy:** ±2%. **Power requirements:** 105-125 volts AC, 60 cycles, 35 watts. **Dimensions:** 15½" W. x 13½" D. Total height 10¾". **Mounting:** requires minimum of 8½" below and 1½" above mounting surface. May be operated in either horizontal or vertical position.

MODEL TR-1C Monophonic Tape Deck: Monophonic Record and Playback. **$159.95** $16.00 DWN. $14.00 MO.

MODEL TR-1D Two Track Stereo Tape Deck: Monophonic Record and Playback, plus Playback of 2-track Pre-recorded Stereo Tapes (stacked). **$169.95** $17.00 DWN. $15.00 MO.

MODEL TR-1E Four Track Stereo Tape Deck: Monophonic Record and Playback, plus Playback of 4-track Pre-recorded Stereo Tapes (stacked). **$179.95** $18.00 DWN. $16.00 MO.

MODEL C-TR-1C Conversion Kit: Converts TR-1C to TR-1D (see TR-1D description above). Shpg. Wt. 2 lbs. **$19.95**

MODEL C-TR-1D Conversion Kit: Converts TR-1D to TR-1E (see TR-1E description above). Shpg. Wt. 2 lbs. **$14.95**

NOTE: To convert TR-1C to TR-1E, purchase both C-TR-1C and C-TR-1D conversion kits.

STEREO-MONO TAPE RECORDER KITS (TR-1A Series)

Here are the tape recorders the avid hi-fi fan will find most appealing! Their complete flexibility in installation and many functions make them our most versatile tape recorder kits. This outstanding tape recorder now can be purchased in any one of three versions. You can buy the new two-track (TR-1AH) or four-track (TR-1AQ) versions which record and play back both stereo and monophonic programming, or the two-track monophonic record-playback version (TR-1A) and later convert to either two-track or four-track stereo record-playback models by purchasing the MK-4 or MK-5 conversion kits. The tape deck mechanism is extremely simple to assemble. Long, faithful service is assured by precision bearings and close machining tolerances that hold flutter and wow to less than 0.35%. Power is provided by a four-pole, fan-cooled induction motor. One lever controls all tape handling functions of forward, fast-forward or rewind modes of operation. The deck handles up to 7" tape reels at 7.5 or 3.75 IPS as determined by belt position. The TR-1A series decks may be mounted in either a vertical or horizontal position (mounting brackets included). The TE-1 Tape Electronics kits supplied feature NARTB equalization, separate record and playback gain controls and a safety interlock. Provision is made for mike or line inputs and recording level is indicated on a 6E5 "magic eye" tube. Two circuit boards simplify assembly.

MODEL TR-1A: Monophonic two-track record/playback with fast forward and rewind functions. Includes one TE-4 Tape Electronics kit. Shpg. Wt. 24 lbs. **$99.95** $10.00 DWN. $9.00 MO.

TR-1A SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 50 to 12,000 cps; 3.75 IPS ±3 db 50 to 7,000 cps. **Signal-to-noise ratio:** better than 45 db below full output of 1.25 volts/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

MODEL TR-1AH: Two-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

TR-1AH SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ± db 40 to 10,000 cps. **Signal-to-noise ratio:** 45 db below full output of 1 volt/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase frequency:** 60 kc (push-pull oscillator).

MODEL TR-1AQ: Four-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-4 Tape Electronics kits. Shpg. Wt. 36 lbs. **$149.95** $15.00 DWN. $13.00 MO.

TR-1AQ SPECIFICATIONS—Frequency response: 7.5 IPS ±3 db 40 to 15,000 cps; 3.75 IPS ±3 db 40 to 10,000 cps. **Signal-to-noise ratio:** 40 db below full output of .75 volts/channel. **Harmonic distortion:** less than 2% at full output. **Bias erase:** 60 kc (push-pull oscillator).

HEATH COMPANY/Benton Harbor, Mich. a subsidiary of Daystrom, Inc.

New "Acoustic Suspension" Hi-Fi Speaker System Kit

HEATHKIT AS-2U (unfinished)

$69.95

HEATHKIT AS-2M (mahogany) **$79.95**
HEATHKIT AS-2B (birch) **EACH**

NOW—FOR THE FIRST TIME —EXCLUSIVELY FROM HEATH

ACOUSTIC SUSPENSION HI-FI SPEAKER SYSTEM KIT (AS-2)

A revolutionary principle in speaker design, the Acoustic Research speaker has been universally accepted as one of the most praiseworthy speaker systems in the world of high fidelity sound reproduction. Heathkit is proud to be the sole kit licensee of this Acoustic Suspension principle from AR, Inc., and now offers for the first time this remarkable speaker system in money-saving, easy-to-build kit form.

The 10" Acoustic Suspension woofer delivers clean, clear extended-range bass response and outstanding high frequency distribution is provided by the specially designed "cross-fired" two-speaker tweeter assembly.

Another first in the Heathkit line is the availability of preassembled and prefinished cabinets. Cabinets are available in prefinished birch (blond) or mahogany, or in unfinished birch suitable for the finish of your choice. Kit assembly consists merely of mounting the speakers, wiring the simple cross-over network and filling the cabinet with the fiberglass included. Shpg. Wt. 32 lbs.

SPECIFICATIONS—Frequency response (at 10 watts input): ±5 db, 42 to 14,000 cps; 10 db down at 30 and 16,000 cps. **Harmonic distortion:** below 2% down to 50 cps, below 3% down to 40 cps at 10 watts input in corner room location. **Impedance:** 8 ohms. **Suggested amplifier power:** 20 watts minimum. **Suggested damping factor:** high (5:1 or greater). **Efficiency:** about 2%. **Distribution angle:** 90° in horizontal plane. **Dimensions:** 24" W. x 13½" H. x 11¾" D.

New Test Equipment

HEATHKIT FMO-1 Price to be announced

AN INSTRUMENT LONG-AWAITED BY SERVICE TECHNICIANS EVERYWHERE!

HEATHKIT FM TEST OSCILLATOR KIT (FMO-1)

Here in one compact, easy-to-use instrument are provided all the test signals and sweep frequencies required for fast, easy alignment and troubleshooting of RF, IF and detector sections of FM tuners and receivers. An instrument unique in the test equipment field . . . being the only one of its type designed especially for FM service work.

SPECIFICATIONS—Output frequencies: for RF alignment, 90 mc (FM band low end), 100 mc (FM band middle range), 107 mc (FM band high end). **Modulation:** 400-cycle incidental FM. **IF and detector alignment:** 10.7 mc sweep. **Sweep width markers:** 200 kc to over 1 mc, variable, 10.7 mc (crystal), 100 kc sub-markers. **Modulation:** 400-cycle AM. **For other applications:** 10.0 mc (crystal) and harmonics, 100 kc, 400-cycle audio. **Controls:** main frequency selector, modulation switch/concentric level control, marker oscillator switch/concentric level control, sweep width—power switch, output control, AF-RF (source impedance) switch. **Power supply:** transformer, selenium rectifier. **Power requirements:** 105-125 V, 50/60 cycles, 12 watts. **Cabinet size:** 7¾" H. x 4¾" W. x 4¾" D.

HEATHKIT RF-1

$27.95

PREASSEMBLED AND ALIGNED BANDSWITCH/COIL ASSEMBLY

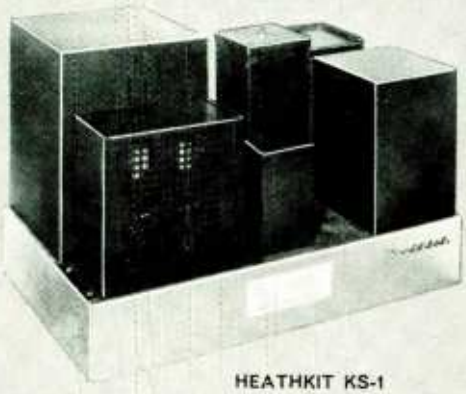
RF SIGNAL GENERATOR KIT (RF-1)

Moderately priced, and capable of precision performance the RF-1 provides highly accurate and stable RF signals for trouble-shooting and aligning RF and IF circuits of all kinds. Modulated or unmodulated RF output of at least 100,000 microvolts is available, controlled by both fixed-step and continuously variable controls. A built-in 400 cycle audio generator with 10-volt output provides internal modulation of RF signal and is available separately for audio tests. A preassembled bandswitch and coil assembly, aligned to factory precision standards, eliminates the need for special alignment equipment. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Frequency range: Band A, 100 kc to 320 kc; Band B, 310 kc to 1.1 mc; Band C, 1 mc to 3.2 mc; Band D, 3.1 mc to 11 mc; Band E, 10 mc to 32 mc; Band F, 32 mc to 110 mc. **Calibrated harmonics:** 110 mc to 220 mc. **Accuracy:** 2%. **Output:** impedance, 50 ohms; voltage, in excess of 100,000 uv on all bands. **Modulation:** internal, 400 cycles approx. 30% depth; external, approx. 3 V across 50 k ohm for 30%. **400 cycles audio output:** approx. 10 V open circuit. **Tube complement:** V1 12AT7 RF oscillator, V2 6AN8 modulator and output. **Power requirements:** 105-125 V 50/60 cycles AC, 15 watts. **Aluminum cabinet dimensions:** 6¼" W. x 9½" H. x 5" D.

New HEATHKIT

Ham Radio Gear



HEATHKIT KS-1

$169.95

TOP POWER WITH ECONOMY AND SAFETY

KILOWATT POWER SUPPLY KIT (KS-1)

The KS-1 is designed as a companion to the "Chippewa" Linear Amplifier and is also suitable for supplying plate power to most other RF amplifiers in the medium to high power class. The KS-1 features an oil-filled, hermetically sealed plate transformer to minimize corona, a swinging choke in the filter circuit for good regulation, and a 60-second time delay relay to permit adequate heating of the mercury vapor rectifiers before application of plate voltage. All components are conservatively rated and well insulated for long life and dependable service. Shpg. Wt. 105 lbs.

SPECIFICATIONS—Maximum DC power output: 1500 watts. **Nominal DC voltage output:** 3000 or 1500 volts. **Maximum DC current output:** Average 500 ma, peak 1000 ma. **Regulation:** 180 to 600 ma (typical linear amplifier), 8%; 0 to 300 ma (typical class C amplifier), 10%; 0 to 500 ma, 15%. **Ripple:** Less than 1%. **Tube complement:** (2) 866A mercury vapor rectifiers. **Recommended ambient temperature:** 50 to 100 degrees F. **Circuit:** Two half-wave mercury vapor rectifiers in a full wave, single-phase configuration with swinging choke input filtering. **Line power requirements:** 115 V, 50/60 cycles, 20 amperes; 230 V, 50/60 cycles, 10 amperes. **Chassis size:** 17¾" W. x 12" H. x 13" D.

HEATHKIT KL-1

$415.00

MOVE TO THE TOP IN TRANSMITTING POWER

"CHIPPEWA" KILOWATT LINEAR AMPLIFIER KIT (KL-1)

The KL-1 operates at maximum legal amateur power inputs in SSB, CW or AM service using any of the popular CW, SSB and AM exciters as a driver. Premium tubes (4—400's) push the "Chippewa" to top performance levels while a centrifugal blower provides more than adequate cooling. Shpg. Wt. 70 lbs.

SPECIFICATIONS—RF section: Driving power required (10 meters): Class AB1 (tuned grid) 10 watts peak; Class C (tuned grid) 40 watts; Class AB1 (swamped grid) 60 watts peak. **Power input:** Class AB1 (SSB-voice modulation) 2000 watts PEP; Class AB1 (SSB-two tone test) 1300 watts; Class AB1 (AM linear) 1000 watts; Class C (CW) 1000 watts. **Power output (20 meters):** Class AB1 (SSB-voice modulation) 900 watts PEP; Class AB1 (SSB-two tone test) 550 watts; Class AB1 (AM linear) 300 watts; Class C (CW) 750 watts. **Output impedance:** 50 to 72 ohms (unbalanced). **Input impedance:** 50 to 72 ohms (unbalanced). **Band coverage:** 80, 40, 20, 15 and 10 meters. **Panel metering:** 0 to 50 ma, grid current; 0 to 100 ma screen current; 0 to 5000 volt plate voltage; 0 to 1000 ma plate current. **Tube complement:** Final tubes, (2) 4-400A; clamp tube, (1) 6DQ6; voltage regulators, (4) OD3, (2) OC3. **Power requirements:** AC (power supply primary circuit), 250 watts, 115 volt, 50/60 cycles; DC, 3000 to 4000 volts, 450 ma. **Cabinet size:** 19½" W. x 11¾" H. x 16" D.

HEATHKIT XC-2

$36.95

2-METER CONVERTER KIT (XC-2)

Extends coverage of the Heathkit "Mohawk" Receiver to the 2-meter band. May also be used with receivers tuning a 4 mc segment between the frequencies of 22 and 35 mc when appropriate crystal is used. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Noise figure: 4.5 db; 1 uv signal provides 20 db thermal noise quieting. **Sensitivity:** approx. .1 uv input will provide a signal better than 6 db over noise level. **Gain:** approx. 40 db. **Pass band:** essentially flat 144 to 148 mc; approx. 35 db down at 143 and 149 mc. **Image rejection:** better than 100 db (tunable). **Output impedance:** 50 to 75 ohms. **Input impedance:** 50 to 75 ohms; 300 ohms with balun. **Frequency:** input, 144 to 148 mc; output, 22 to 26 mc with crystal supplied. **Tubes:** 6AM4, 6BS8, 6EA8, 12AT7. **Crystal:** .005% 3rd overtone. **Power requirements:** 150 volts DC at 50 ma (dropping resistor supplied for 210 VDC RX-1 operation) 6.3 volts AC/DC at 1.375 amps. **Size:** 9" W. x 5½" H. x 4¾" D.

HEATHKIT UT-1

$28.95

"BEST BUY" UTILITY POWER SUPPLY KIT (UT-1)

This power supply is ideal for converting the Heathkit "Cheyenne" and "Comanche" mobile transmitter and receiver to fixed station operation; or may be used to provide necessary filament and plate voltage for a wide variety of amateur equipment. Features silicon diode rectifiers, high capacity filters for superior dynamic regulation, and line filtering to minimize TVI and reduce receiver line noise. On ICAS basis, provides 150 watts DC plus filament power for 6.3 volt or 12.6 volt filament applications (6.3 VAC., 8 amps. or 12.6 VAC., 4 amps.; 600 VCD., 250 ma or 600 VDC., 200 ma and 300 VDC., 100 ma). Less than 1% ripple; excellent regulation. Housed in attractive green and gray-green cabinet measuring 9" long, 4¾" wide, 6" high. Shpg. Wt. 15 lbs.

New Citizen's Band Transceiver

WIRED OR KIT FORM

HEATHKIT CB-1
$42.95
(kit model)

HEATHKIT W-CB-1
$60.95
(wired model)
$6.10 dwn., $6.00 mo.

Both models include transceiver, crystal, microphone and two special power cords.

- No Tests to Take—No Operator's License Required
- Any Citizen 18 or Older Can Have Own Station
- Hundreds of Business and Personal Uses

CITIZEN'S BAND TRANSCEIVER KIT (CB-1)

The Heathkit CB-1 Citizen's Band Transceiver is a compact radio transmitter and receiver combination designed to operate on the new 11-meter "Citizen's Band". No tests to take, no special knowledge or operator's license required . . . you need only fill out forms we supply, and mail them to FCC to apply for station license. Operates just like any short wave radio used by police and other communication services. Front panel switch selects both "transmit" and "receive". Two or more Heathkit Transceivers provide you with your own 2-way radiotelephone system for making necessary business and personal contacts with family, friends or associates. A Heathkit accessory power supply makes the CB-1 completely portable for use in cars, trucks, boats, etc., using 6 or 12 volt batteries. With appropriate accessory antenna, the CB-1 can be used for communicating between truck and office, home and automobile, boat and shore, farm-house and field . . . literally hundreds of useful applications. Comes complete with microphone, 2 power cords for mobile or fixed operation, station ID card, call letters, and crystal for one channel and FCC application form. Order power supply and antenna separately. Attractively styled in two-tone "mocha" and "beige". Shpg. Wt. 10 lbs.

SPECIFICATIONS—Receiver type: Superregenerative detector w/rf stage. **Power input:** 5 watts maximum to plate of final RF amplifier (FCC requirement). **Transmitter frequency control:** Third overtone type quartz crystal operating within 0.005% of marked channel frequency between −20° and +130° F. **Modulation:** AM plate and screen modulation automatically limited to less than 100% (FCC requirements). **Power supply:** Internal 117 V, 50/60 cycles, AC (35 watts). For 6 V battery power, use Model VP-1-6 Vibrator Power Supply (6.5 amps); for 12 V battery power, use VP-1-12 (4 amps). **Total B+ requirements:** 260 volts at 60 ma; total heater requirements, 6.3 volts at 1.8 amps, or 12.6 volts at 0.9 amps. **Power rectifier:** 2 silicon diodes in full wave voltage doubler circuit. **Microphone:** Combination hand-held and desk type, ceramic element, plastic case, with cord and connector. **RF output impedance:** 50 ohms. **Speaker size:** 3½" (round). **Undistorted audio power output:** Approximately 1 watt. **Line cords:** Two supplied, one for AC operation, one for battery operation. Power circuits automatically switched when appropriate line cord is plugged in. **Cabinet dimensions:** 8" H. x 6" D. x 9¾" W.

SPECIFY FREQUENCY CHOICE
(1st and 2nd choice)

CLASS D CITIZEN'S BAND FREQUENCIES

26.965 mc	27.035 mc	27.115 mc	27.185 mc
26.975 mc	27.055 mc	27.125 mc	27.205 mc
26.985 mc	27.065 mc	27.135 mc	27.215 mc
27.005 mc	27.075 mc	27.155 mc	27.225 mc
27.015 mc	27.085 mc	27.165 mc	*27.255 mc
27.025 mc	27.105 mc	27.175 mc	

*This channel shared with Class C Radio Control.

ANTENNAS

CBU-1 "UTILITY" ANTENNA.....$9.95
Good coverage, portable antenna for temporary mobile or fixed installations. 45½" base-loaded antenna, 12' connecting cable, mounting bracket and clip. 3 lbs.

CBM-1 "MOBILE" ANTENNA.....$19.95
Best coverage mobile installation. Easy to install spring base, ¼ wave, 9' whip; 15' connecting cable and necessary hardware. 7 lbs.

CBF-1 "FIXED LOCATION" ANTENNA...$19.95
Excellent coverage, ¼ wave "ground plane", 9' elements; 50' connecting cable and mounting bracket. 7 lbs.

WIRED AND KIT FORM POWER SUPPLIES FOR MOBILE USE

6 volt Vibrator Power Supply for use with 6 volt batteries.
KIT—Model VP-1-6. Shpg. Wt. 4 lbs.....$7.95
WIRED—Model WVP-1-6. Shpg. Wt. 4 lbs.....$11.95

12 volt Vibrator Power Supply for use with 12 volt batteries.
KIT—Model VP-1-12. Shpg. Wt. 4 lbs.....$7.95
WIRED—Model WVP-1-12. Shpg. Wt. 4 lbs.....$11.95

HEATHKIT

ORDER BLANK

NOTE: all prices and specifications subject to change without notice.
Enclosed find ( ) check ( ) money order. Please ship C.O.D. ( )

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

On Parcel Post Orders include postage for weight shown. All prices are NET F.O.B. Benton Harbor, Michigan, and apply to Continental U.S. and Possessions only. 20% Deposit required on all C.O.D. orders.

HEATH COMPANY BENTON HARBOR 20, MICH.
a subsidiary of Daystrom, Inc.

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QUANTITY	ITEM	MODEL NO.	PRICE
	☐ SEND FREE HEATHKIT CATALOG	POSTAGE	
		TOTAL	

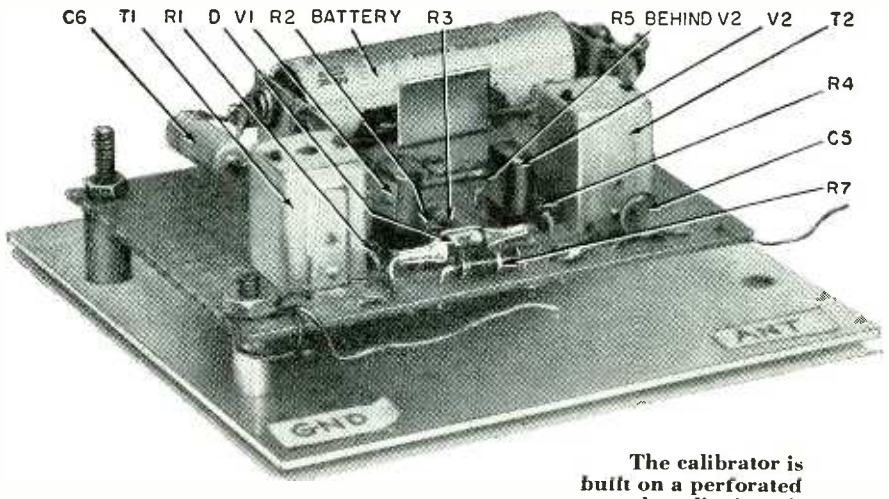
HEATHKITS are also available at your Dealer see listing on next page

TEST INSTRUMENTS

SHORTWAVE CALIBRATOR

Two-transistor unit delivers a variety of extremely accurate frequencies

By I. QUEEN
EDITORIAL ASSOCIATE



The calibrator is built on a perforated phenolic board.

THIS little device helps calibrate shortwave receivers, marks ham bands and checks signal generators. It puts out strong signals at 100-kc intervals. They appear, for example, through the broadcast band at 600, 700, 800 kc. Still higher, they get weaker, but are still useful.

There is good reason for the strong output. This instrument is *not* a 100-kc generator, with weak rf output because of high harmonic order. Instead, there are two fundamentals and both are at relatively high frequencies. One oscillator is tuned to 400 kc, the other to 500. They are mixed in a diode to generate sum and difference beats.

No claim can be made for lab precision for this device, since it does not use crystals. However, any desired accuracy may be attained by comparing frequency with WWV as standard.

Parts are inexpensive and easy to get. Two penlight cells power the device. No switch is shown on the schematic; power is shut off by removing one of the batteries from its holder.

Calibrating the calibrator

It is easy to adjust the calibrator's frequency with the help of an all-wave receiver. First, tune one if transformer (in the calibrator) to 500 kc by listening for a harmonic at a WWV frequency: 2.5, 5.0 or 10.0 mc. Do this with receiver bfo shut off. As you adjust the transformer core, you will hear a tone when the harmonic beats with WWV.

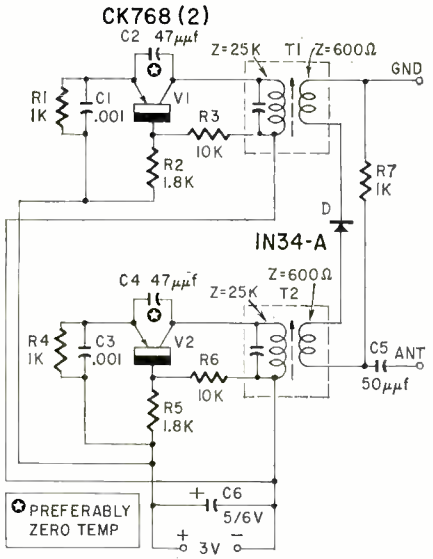
Now tune the second transformer to 400 kc. Listen in at 2 mc with the bfo off. As the core is adjusted to 400 kc, its fifth harmonic will beat with the fourth harmonic of 500 kc and you will hear the audio beat.

Tuning may also be done with a broadcast receiver if desired. Listen for 500-kc harmonics at 1,000 and 1,500 kc. Harmonics of 400 kc will be heard at 800, 1,200 and 1,600 kc. These signals will make a swish or hissing sound on a receiver without a bfo.

To illustrate the accuracy, suppose you hear a 1-kc beat to indicate that the (10th) harmonic of 500 kc is heterodyning with the WWV carrier at 5 mc. This means you are in error by 1,000 parts in 5,000,000 or .02%! If you tune closer to zero beat, you will obtain even greater precision.

You should now hear beats every 100

TEST INSTRUMENTS



NOTE: TUNE ONE TRANSFORMER TO 400 KC, THE OTHER TO 500 KC

R1, 4, 7—1,000 ohms
R2, 5—1,800 ohms
R3, 6—10,000 ohms
All resistors ½-watt 10%
C1, 3—.001 μf, disc ceramic
C2, 4—47 μμf, zero temperature coefficient
C5—50 μμf, disc ceramic
C6—5 μf, electrolytic
All capacitors 6 volts or higher
BATT—3 volts, penlight cells (2 in series)
D—1N34-A
T1, 2—subminiature if transformers: primary, 25,000 ohms; secondary, 600 ohms (Lafayette MS-268 or equivalent)
C1, 2—CK768
Battery holder
Phenolic chassis board
Miscellaneous hardware

Circuit of the calibrator. T1 and T2 are 455-kc transistor if transformers. On MS-268's, terminal 3 goes to the collector, 5 goes to B− and 4 is not used. Secondary lugs are 1 and 2.

kc through the broadcast band and well into the short waves. On a receiver with bfo, they will be clear steady whistles.

To use the calibrator, couple it to a receiver by tying lead ANT to the antenna post and GND to ground. Disconnect your regular antenna, of course.

500-kc oscillator

You can easily convert this device to a straight 500-kc oscillator by removing the 400-kc transistor. Likewise, you will have a 400-kc oscillator if you remove the other transistor. As a 500-kc oscillator, for example, you will hear signals only at 1,000, 1,500, 2,000 kc, etc.

To adjust a 455-kc if transformer to 500 kc you must turn the core (with a small, insulated screwdriver) counterclockwise nearly all the way. For 400 kc, turn it clockwise nearly all the way. Of several transformers tried, these frequencies were reached in every one. Sometimes you may have to force the core screw slightly to reach the desired frequency. This causes no damage if only a small fraction of a turn is needed past the limiting stop. To *lower* frequency you may add a small capacitor (about 25 μμf) across the transformer primary. END

TEST INSTRUMENTS

CALCULATED BETA vs TESTER INDICATIONS

I_C	1ma	1ma	1ma	1ma	1ma
I_B	200μa	100μa	50μa	25μa	12.5μa
$I_E=(I_C+I_B)$	1.2ma	1.1ma	1.05ma	1.025ma	1.0125
Calculated Alpha $\left(\frac{I_C}{I_E}\right)$	.83	.909	.95	.975	.987
Beta (Meter)	5	10	20	40	80
Calculated Beta $\left(\frac{\alpha}{1-\alpha}\right)$	4.88	9.99	19.8	39.8	79.6

(*Continued from page 77*)

An alpha scale can be added to the base-current meter if desired, or the currents may be compared. The comparison method is preferred, as it is more versatile and accurate.

I_B plus I_C equals I_E. Alpha equals ΔI_C divided by ΔI_E and is always less than unity.

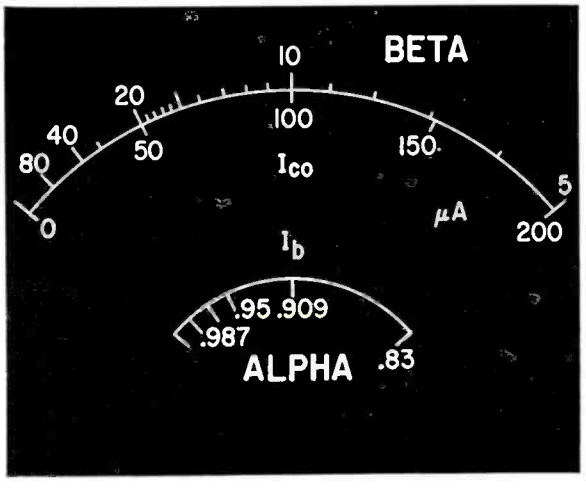
Beta is equal to alpha divided by 1 minus alpha and is always more than unity. It may be seen that the nearer alpha approaches 1, the higher beta will be.

Actually these simple relationships are not entirely true as read by the meter, for they will vary slightly with variations in I_{CO}, collector voltage and meter nonlinearity. Using the collector current for our standard 1 ma rather than the emitter would cause beta to be calibrated at odd points on the meter scale. However, I feel that the measurements are within the accuracy readable by the meter as they constitute an error of only 1% or less in most cases (see chart).

In matching transistor pairs, whether they be both n-p-n, p-n-p, or one of each, three important points should be matched: input impedance, beta and output impedance. While the tester is not calibrated for measuring input and output impedances, the dc component or resistance function can be matched by observing base and collector currents at known collector voltages, or the two currents can be plotted on a graph to determine the ac slope or small-signal impedance. If a number of transistors are available for matching, test them in the usual manner and select the ones nearest the gain desired. Then, without moving the setting of the potentiometer, and noting the base- and collector-current readings, insert the selected transistors one after the other until one is found which equals the first transistor in both readings.

Further tests or graphs may be made as desired. Since switching from NPN to PNP does not change the testing circuitry, but merely the position of the transistor in the circuit, complementary pairs may be matched with ease. For such tests both sockets may be used at once, since the alternate socket is on what might be called standby and will not affect the test being made on the other.

While the tester measures the transistor characteristics mentioned above, it also gives rapid, logical indications relating to transistor rejection, or the bad ones on the "good–bad" testers. For example, a collector-to-base short will cause a high collector current not controllable by the potentiometer. A base-to-emitter short will make it impossible to raise collector current to 1 ma. An

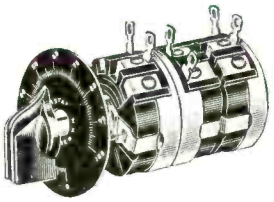


Full-size drawing of meter face with alpha scale added.

CLAROSTAT CONTROLS FOR AUDIO

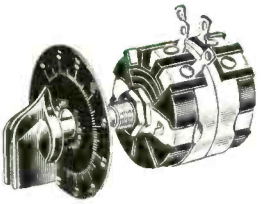
CONSTANT IMPEDANCE CONTROLS

Clarostat Constant Impedance T-pads are utilized in circuits to maintain constant required values for perfect balancing. In either input or output. Knob and dial are supplied. Resistance range available of 4 to 2,000 ohms. 10 watts audio.



SERIES CIT

CONSTANT IMPEDANCE CONTROLS



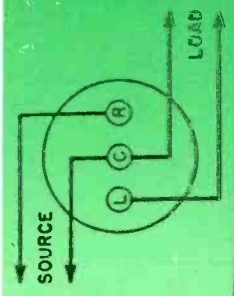
SERIES CIL

For circuits requiring an L-pad, to maintain balance of associated circuitry. Provide continuous range of from 0.5 to 30 db attenuation in 90% of rotation; last 10%, infinite attenuation. Handles up to 10 watts audio. Resistance range of 4 to 2,000 ohms. Knob and dial included.

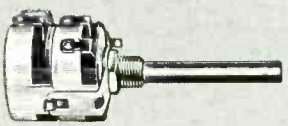
CONSTANT IMPEDANCE OUTPUT ATTENUATORS

SERIES CIB

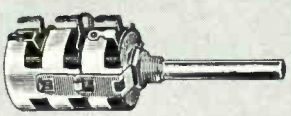
Handle up to 30 watts audio. Linear attenuation in 3 db steps up to 24 db, then 30 db. Recommended as an output attenuator to individual speaker or group of speakers, or as input attenuator to power amplifier. Resistance range of 6 to 600 ohms. Single-hole mounting. Knob and dial included.



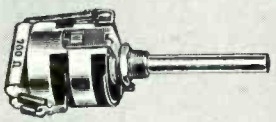
SPACE-SAVING CONSTANT IMPEDANCE ATTENUATORS



SERIES CIL43



SERIES CIT43



SERIES CIBT43

These units provide audio control at low cost and in minimum space. They will handle up to 4 watts audio and are ideal for individual-speaker control. Resistance range of 4 to 500 ohms.

CIT43 and CIBT43 have constant input and output impedances, while CIL43 has constant input impedance only.

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TEST INSTRUMENTS

Many low-power transistors, both p-n-p and n-p-n, were tested. The instrument was found easy to use and read. Beta values compared very closely to those obtained on another dc beta tester known to be accurate.

On I_{co}, most transistors measured near zero. Another checker showed that these units had low leakage. Two or three other units showed 100 μa or more I_{co} on M2. These units slammed M1 way past full scale during beta tests, regardless of potentiometer setting.

For maximum meter protection the following procedure was found simple and suitable: First test for I_{co} with pot turned down. Advance gradually, watching I_{co}. **If it reaches 100 μa or more, don't test for beta or you may injure the meter.**

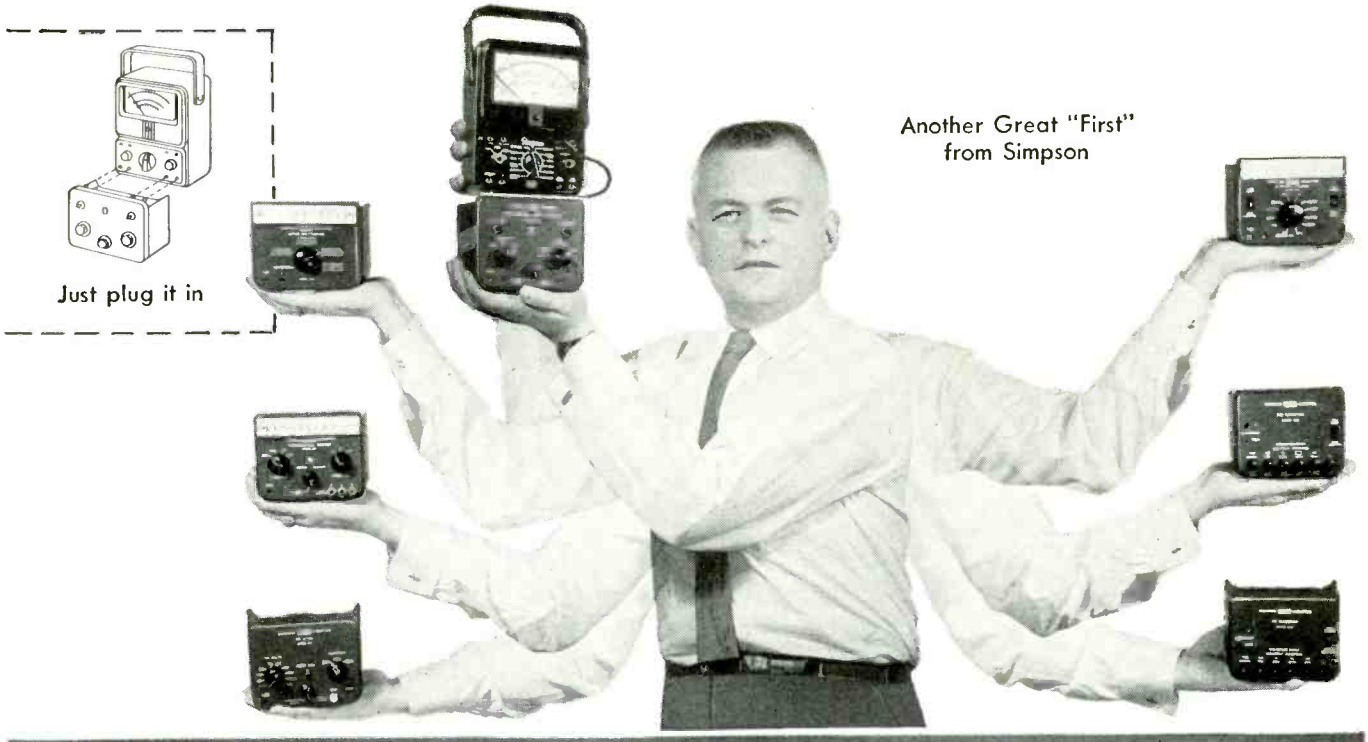
open collector will show no collector current, but will show base current. An open emitter will show no collector current until checked in the I_{co} test. An open base will show a very small collector current which the pot has no control over and no I_{co}.

Power transistors may be given a good–bad check by measuring I_{co} with the switch in the BETA position. This will be read on the 2-ma meter. Manufacturers advise that over 2 ma is excessive I_{co} for a power transistor. To make this test, connect the transistor collector to the socket collector, the base of the transistor to the socket *emitter* pin and leave the transistor emitter open. **Testing a power transistor in the conventional manner will damage the meters.**

It is difficult to make a comprehensive power check for transistors in a tester of this type. The maximum power limits must not be exceeded, while at the same time the test should define these maximum limits. For this reason, power transistors were not included as part of the range of this instrument, with the exception of I_{co} as just mentioned.

This transistor checker was worth the effort put into it, and it is earning its keep. END

New Simpson "Add-A-Testers"



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Frequency Range: 50 cycles to 3000 cycles

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Wattage: Continuous 25 watts (8,600 ohms)
50 watts (4,16 ohms)
Intermittent 50 watts (8,600 ohms)
100 watts (4,16 ohms)
Accuracy: ±5%, with 260 ±10% nominal
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VIDEO-FREQUENCY testing is not difficult, if the basic principles are clearly recognized. The test setup is shown in Fig. 1. First, a double curve with trace and retrace is displayed, as seen in Fig. 2. The generator phasing control is adjusted to bring trace and retrace into phase (layover). Then the zero-volt blanking switch is used to convert the retrace into a zero-volt base line.

As in Fig. 3, the zero-frequency point appears in the center of the pattern when the sweep generator is tuned to "0." Sometimes the zero-frequency point is displayed as a "marker" (Fig. 3). Other times the zero-frequency point looks like a "notch" (Fig. 2). This depends upon the characteristics of the generator and the demodulator probe.

We tune the sweep generator to bring the zero-frequency point to the end of the base line, as illustrated in Fig. 4. It makes no difference whether zero frequency appears at the left-hand or right-hand end of the base line.

Most video-frequency sweep generators have some type of built-in marker indication. The markers are used to identify frequency points on the curve, as shown in Fig. 5.

Leave the yoke behind

Sometimes when I have to pull a chassis I would like to avoid having to pull the yoke as it would be a great timesaver.—A. S., New York, N. Y.

You could use a yoke substitution box, with a 5- or 8-inch test picture tube. These will not accommodate all flybacks, of course, but are suitable for the more commonly used types. Your parts jobber can supply you with literature on commercial units.

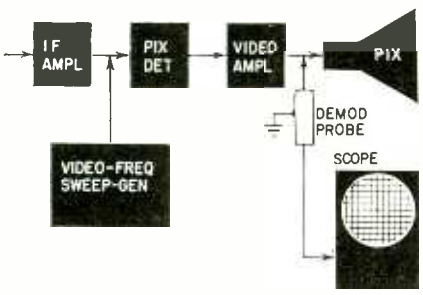


Fig. 1—Test setup for checking video amplifiers.

Poor width

I have run into insufficient width and picture blooming on a Videola 1531 after conversion to a 21EP4 picture tube. The high voltage measures 12 kv. —W. N., Santa Monica, Calif.

Inadequate width is caused by low deflection voltage to the yoke. Blooming will occur at 12 kv because the brightness control must be turned too high. The remedy is to bring up the voltages in the flyback system. First, the drive to the 6BG6 should be advanced. I assume that this has already been tried. The plate voltage on the horizontal oscillator and horizontal discharge tubes can be increased somewhat, to obtain more drive. Also, the 5,100-ohm screen resistor can be reduced to raise the screen voltage. However, it should not be raised above the point that gives more than 400-ma peak, or 110-ma average cathode current in the 6BG6. If the voltages are still insufficient, install a heavier flyback, to match the present yoke.

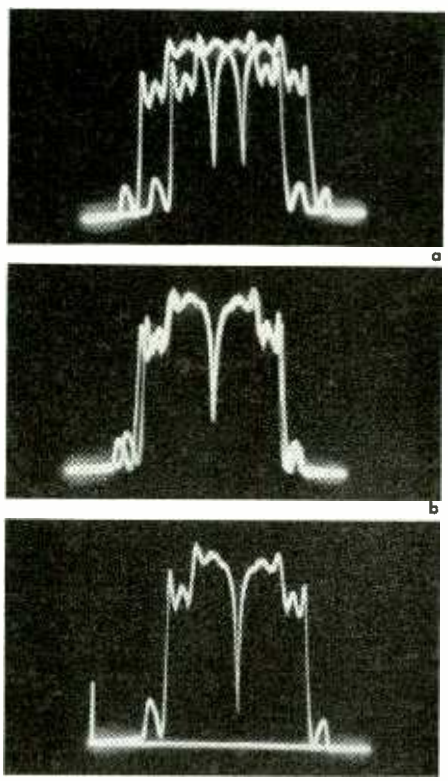


Fig. 2—Steps in getting proper display of the video amplifier response curve: a—Double response curve, trace and retrace out of phase. b—Phasing control adjusted for layover of trace and retrace. c—Retrace blanking switch on. Retrace is converted to a zero-volt base line.

60-cycle buzz

We recently repaired a Magnavox CT-332 that had age trouble. A signal generator shows that the age follows the input signal level properly. However, there is a 60-cycle buzz which can be minimized by adjusting the fine-tuning control, but cannot be eliminated. Alignment has been made in accordance with the service data.—W. J. C., Waukegan, Ill.

First, determine whether this is a case of sync, vertical sweep or vertical blanking buzz. Sync buzz does not change in tone as the vertical hold control is turned through its range (to make the picture roll). On the other hand, sweep or blanking buzz will change tone. To eliminate sweep buzz, replace faulty decoupling capacitors connected to the vertical sweep system. Blanking buzz can be eliminated by correcting or improving the shielding of the audio input circuits against stray fields from the high-voltage section and the picture tube. To check for sync buzz caused by if overloading, use override age bias. If this clears up the buzz, the age circuit needs attention. If not, check the position of the sound carrier on the overall response curve. It should not be higher than 10% on the curve. Align to control the sound-carrier height. Sync buzz is also caused by incorrect

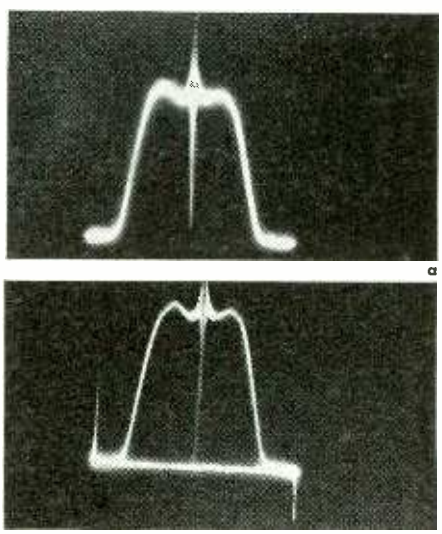


Fig. 3—The zero frequency point often appears as a marker: a—Video response curve with generator tuned to zero frequency. b—Same curve with retrace converted to zero-volt base line.

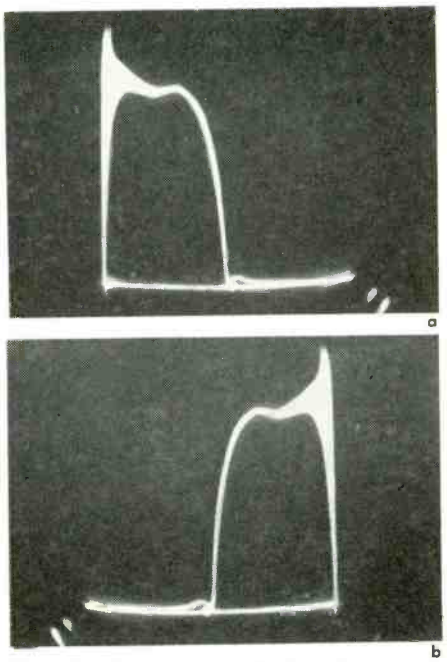


Fig. 4—One of the double images is tuned off the base line to bring the curve into a standard form. Either left or right side may be used.

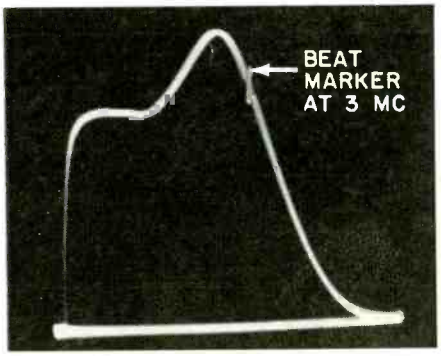


Fig. 5—Beat marker display on a video response curve.

dc voltages at the limiter tube, and misalignment of the sound if section.

Buzz by pix tube

I have cured the buzz in an Emerson 603146, but would like to ask why the condition caused sound buzz. When the grounding wires to the picture-tube coating made poor contact, the buzz was heard. However, when the brightness control was turned down, the buzz stopped. I do not believe the buzz is radiated from the picture tube.—L. S., Santa Monica, Calif.

This is a definite case of vertical blanking buzz. The picture-tube coating operates as a high-voltage filter capacitor. If disconnected, high-voltage regulation is poor. The voltage kicks up and down as the vertical blanking pulse passes. Stray fields from the picture tube or from the high-voltage wiring affect the audio input system because of poor high-voltage regulation. The buzz disappears when the brightness control is turned down, because the beam current then remains constant, and the poor high-voltage regulation

TELEVISION

does not cause a high-voltage transient. Adequate high-voltage filtering capacitance acts as a storage tank for beam current, and gives better high-voltage regulation.

Width problem

I am working on an RCA KCS-47 which is puzzling. A 50-volt 2-μf age filter was shorted. Replacement gives fair pix and sound on all channels. There is a slow buildup of width when the receiver is first turned on. The raster is about 6 inches wide at first, and builds out to nearly full-screen in about a minute. The waveforms are unusual (see Fig. 6). They show tilt, loops and kinks, which I cannot find explained in any book or magazine. I note that the scope is sensitive to hand capacitance near the input terminals when a low-capacitance probe is used.—M. W. D., Canoga Park, Calif.

I would suggest, first, that the faulty electrolytic you replaced is not the only offender in this chassis. I suspect that the plate-supply voltage to the flyback system is coming up slowly because of unformed electrolytics, which re-form slowly after the receiver is turned on. The faulty electrolytics are probably running hot. They should be replaced. The tilt, curls and loops in the waveforms are caused by pickup of stray sweep and high-voltage fields by the scope's vertical and horizontal input terminals. This is a common but often overlooked cause of this form of distortion. The scope input terminals should be shielded for use with a low-capacitance probe. The higher-priced scopes usually have coaxial input connectors instead of binding posts.

Collapsing picture

I recently replaced the yoke in a Motorola TS-118B. The 100,000-ohm resistor in the old yoke was burned out. I have found a variation in the voltage divider. Occasionally the picture collapses horizontally and then expands to normal, with a clicking sound.—H. C. M., Oak Park, Ill.

This report indicates the continued presence of yoke trouble. The modified voltage-divider circuit would not be expected to be the cause of these symptoms. I have seen similar cases in which the windings in the vertical yoke section opened and burned out the shunt resistor (see Fig. 7). In your instance, the symptom is intermittent horizontal collapse, pointing to a transient open in the horizontal yoke winding. Evidently, the open does not persist long enough to burn out the resistor. The yoke should be checked. Even though it is new, it may be bad.

Aluminized tube?

A customer has asked us to install an aluminized picture tube in a Muntz 17B2. If this is practical, what type tube should be used? There is 14.5 kv available now. Should the high voltage be increased?—A. K. P., New York City

It is possible to use either a 20CP4 or

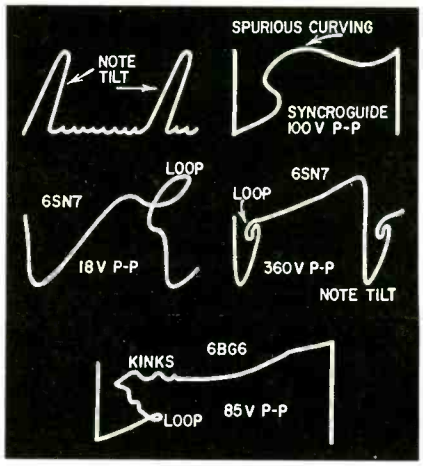


Fig. 6—Tilted, kinked and looped waveforms that result from pickup of stray horizontal circuit fields by the scope input terminals.

a 20CP4-B, but adequate scan may require a change of flyback, and possibly the yoke. If you have marginal width now, scan will be insufficient with the new tube. The 14.5 kv is in a range of voltage which could give a brighter picture with a 20CP4 than with an aluminized 20CP4-B. With more high voltage, it can be definitely stated that the 20CP4-B will give more brightness.

Poor pix and sound

What causes poor picture and sound reception in an Olympic 4CG26 when both sides of the lead-in are connected to the tuner? If one side of the lead-in is disconnected, reception is good.—J. J. B., Paterson, N. J.

This is a typical case of tuner regeneration. It could also be caused by reflected if regeneration. The usual cause is failure of a bypass or decoupling capacitor, either inside or outside the tuner. The best approach is to check the rf, if and overall rf–if response with a sweep generator. This will help localize the trouble. When regenerative

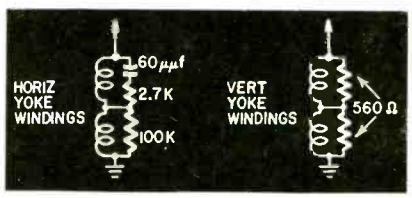


Fig. 7—Intermittently open yoke windings can cause failure of the shunt resistors.

voltages get back to antenna input terminals, response becomes unstable and changes with the input source impedance.

Pix-tube substitution

Is it practical to substitute a 17CP4 picture tube for a 17BP4-A?—B. J. G., Van Buren, Ohio

This conversion can be made, although there are mechanical considerations to be taken into account. The mounting for the tube must be modified, and the rim of the 17CP-4 must be insulated from the chassis. The

anode lead and connector will have to be changed. You can get the necessary insulating ring for the tube rim from an RCA supply depot.

Fading sound and picture

I was called to service an RCA KCS-81B with fading sound and picture. However, the chassis works OK in the shop. On a callback, I took a line-voltage reading at 115 volts, which dropped to 110 volts when a toaster was turned on. Then the fading occurred.—LeR. R. W., Jefferson, Wis.

Rather than attempting to rework the power supply to operate the chassis at 110 volts, I would suggest that the customer install an automatic line-voltage regulating transformer. If line voltage drops 5 volts on a toaster load, the problem becomes greater when a refrigerator or other heavy appliance switches into the line. An automatic transformer is the best answer.

Which sweep generator?

One of my friends recently purchased a medium-price sweep generator, but is not satisfied with its performance. What type of generator do you recommend?—R. C. W., Finksburg, Md.

The best basis of selecting a sweep generator is to balance the desired performance against price. This is usually a matter for individual judgment. Few shops can afford very expensive lab type generators, which, of course, provide the best performance. You can check the linearity, flatness and purity of signal output on a generator for comparative purposes. The tests shown in Fig. 8 are basic, and will give quantitative data on which to make a selection. END

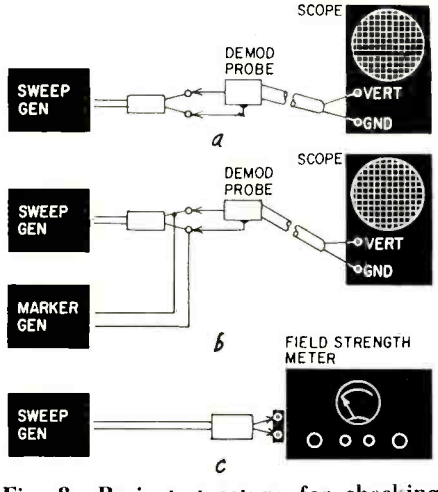
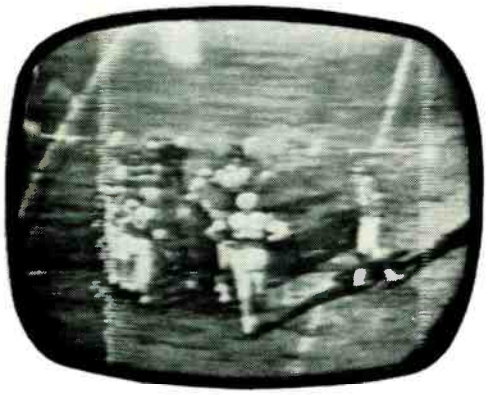


Fig. 8—Basic test setups for checking sweep generator output: a—Demodulator probe and scope check for flatness. Operate generator at 10-mc sweep width. Trace should be reasonably flat. b—Test setup to check sweep linearity. Marker should move the same distance on the scope trace for each megacycle increase of marker frequency. c—Field-strength meter shows microvolt output on each channel. Meter also shows presence of spurious outputs at off-channel frequencies.

DIAGNOSE COMMON TV FAULTS

Still more TV troubles presented in the way you run into them—as a picture on the TV screen

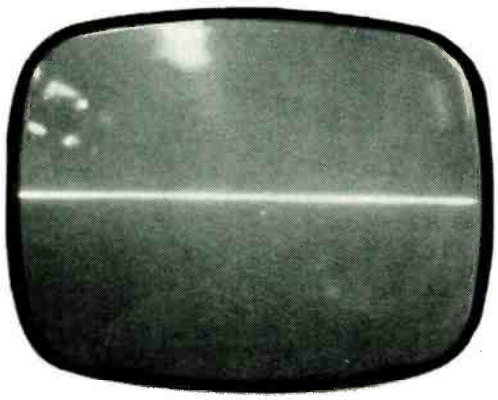
By A. V. J. MARTIN



Symptoms: One or two vertical white bars across the picture. They can be straight or ragged, and are generally narrow.

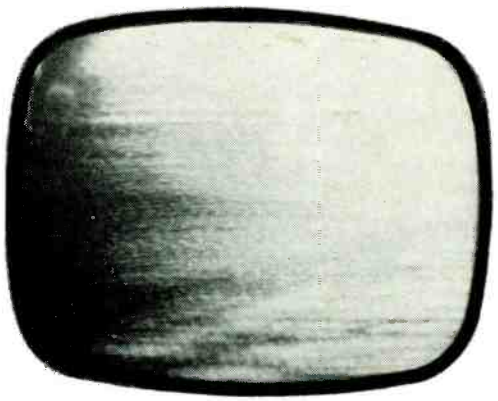
Diagnosis:

1. **Parasitic oscillation in the horizontal output tube.** Change the tube. Insert an rf choke or a 100-ohm resistor in the control-grid and screen-grid connections, at the tube socket. Sometimes, taping a small magnet to the tube will eliminate the oscillation.
2. **Incorrect horizontal adjustment.**
3. **Induction.** If the bar is wider and has ragged edges, it may be due to 15,750-cycle induction, for example on the picture-tube cathode or grid leads. Redress the leads. If necessary, replace the wire from the video output to the picture tube with a *short* length of coaxial cable and ground the outer braid at chassis.



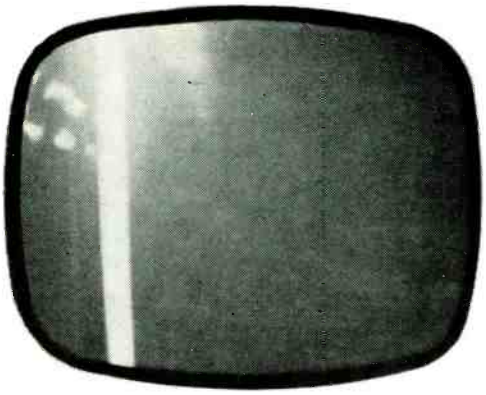
Symptoms: Single horizontal white line across the screen.

Diagnosis: **No vertical sweep.** The defect can be anywhere in the vertical sweep section. To identify the stage, use headphones or a scope to trace the characteristic 60-cycle sawtooth signal. If signal appears on the plate of the output tube, look for a defective output transformer, yoke or associated components. Check shunt capacitor. If there is no signal on the plate but there is signal on grid of output tube, look for a defective tube, incorrect supply voltages or defective components. If no signal on plate of vertical oscillator, look for defective tube, wrong voltages or defective components. Check blocking oscillator transformers and resistances in shunt across it.



Symptoms: Tearing up of the picture or raster.

Diagnosis: **Oscillation.** Short detector load. If defect disappears, rf or if stages are guilty. If defect persists, video stages are at fault. Change tubes. Check lead dress, particularly grid and plate connections and the lead carrying the video signal to the picture tube. Check correction coils and shunting components by shorting them out. Check decoupling capacitors by bridging them with a good unit. Check voltages. If trouble still persists, look for faulty rf or if stages. Short the grids to ground through a capacitor until defective stage is found. Change tube. Check screens and lead dress. Verify tuning. Check decoupling components. Check voltages. Disable agc. If defect disappears, check agc system, particularly decoupling components.

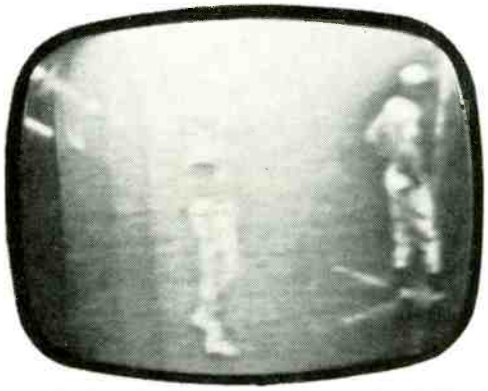


Symptoms: A single vertical white bar across the screen.

Diagnosis:

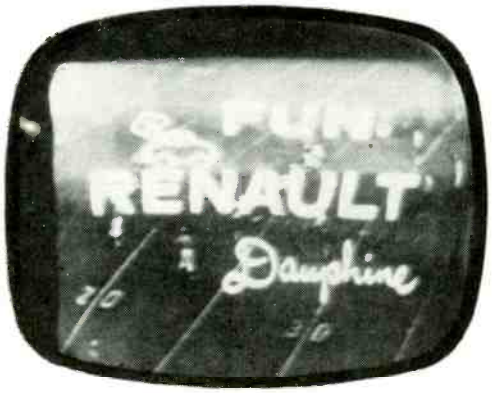
1. **Lack of horizontal sweep.** Pattern does not change if brightness is increased, except for blooming. Defective horizontal coils or shunting components. Defective output transformer or associated components. Defective output or damper tubes. Incorrect grid drive on the output tube. Check grid voltage, which should be strongly negative. Components may be faulty or the horizontal oscillator does not function properly. Check tube, voltages and components.

   The best method here is to use a scope and observe and measure waveforms.
2. **Horizontal foldover,** always occurring in the left half of the screen, and due to damper tube or associated components. When brilliance is advanced, the sweep appears on the remaining portion of the screen. In other words, the bar is simply a more brilliant part of the raster. Change the tube, check components, including horizontal linearity circuit.



Symptoms: Black vertical bars, degrading to the right, on the left side of the screen.

Diagnosis: **Parasitic component in vertical sweep.** On close inspection, scanning lines appear wiggly but do not show velocity modulation. Check deflection yoke, particularly the components across vertical coils. Shunt a 0.5-μf capacitor across vertical yoke coils and across secondary of vertical output transformer. Rarely, the parasitic signal will enter the vertical sweep circuits directly. Best way to check and to identify point of entry is to use a scope. The culprit is probably a defective decoupling component or loose shield, or a lead improperly dressed.



Symptoms: Vertical lines wiggle.

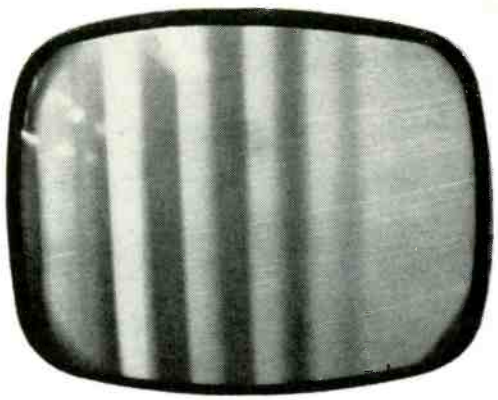
Diagnosis:
1. **Brigitte Bardot effect.** Horizontal sweep is modulated by a parasitic signal. Check deflection yoke for shunting components. Check horizontal output tube and stage. Check phase comparator; particularly time-constant circuit in control-voltage line.
2. **Poor filtering.** Shunt decoupling capacitors with unit known to be good.
3. **Excessive signal or saturation.** Check agc system. *Note:* In the photograph, the picture has been purposely uncentered to show the defect on the left-hand vertical side clearly.

Symptoms: Low brilliance. Picture too large, can't be reduced.

Diagnosis: **Defective high voltage.** Change high-voltage rectifier. Check associated components and circuitry, particularly filter capacitor (if used) and high-voltage lead. Check, readjust horizontal sweep section. Check tube, preferably by substitution.

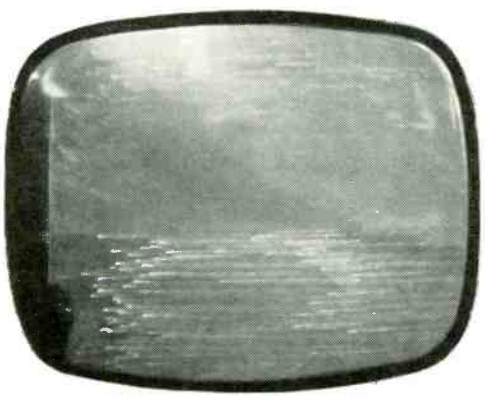
Symptoms: Picture does not fill screen; vertical linearity poor.

Diagnosis:
1. **Insufficient height.** Adjust height and vertical linearity controls. Check vertical output and oscillator tubes and circuit components.
2. **Poor vertical linearity.** Adjust vertical linearity controls. Check vertical output tube and components.



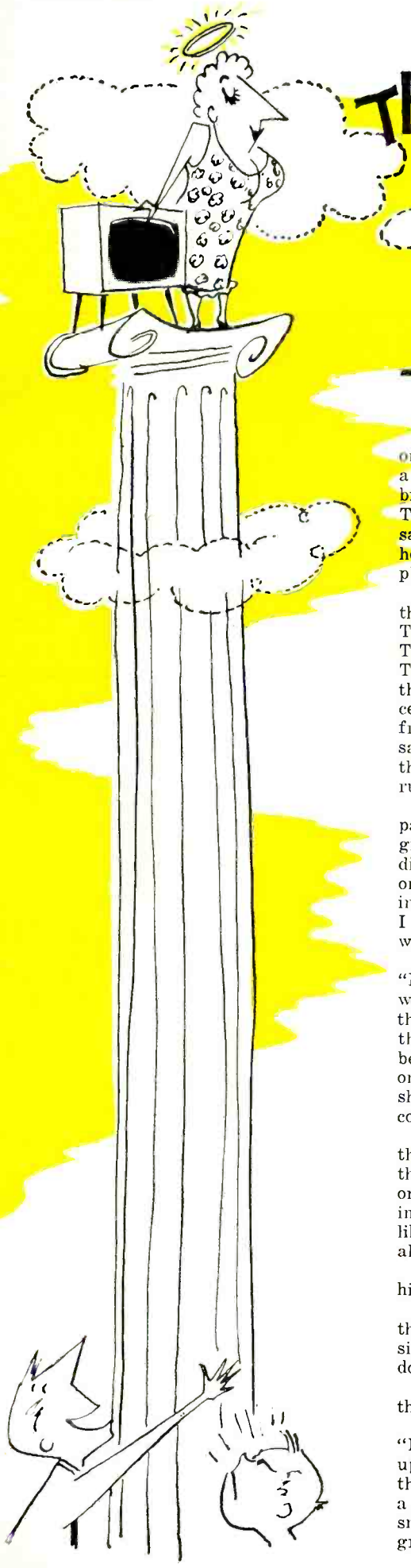
Symptoms: Black vertical bars, degrading to the right, on the left side of the raster.

Diagnosis: **Horizontal sweep transient.** Looking closely at the raster, note that the scanning lines are straight, but of varying brightness. This indicates velocity modulation. Check deflection yoke, particularly the components across horizontal coils. Look for defective horizontal output transformer. Change damper tube. Check associated components including horizontal linearity circuits.



Symptoms: Erratic variations of brilliance, eventually with tearing of the raster and jittery picture.

Diagnosis:
1. **Bad contact.** Can generally be confirmed by jarring the receiver. May be at the picture tube. Check socket and high-voltage connection. Look for an intermittent short in the picture tube. Poor or intermittent contact in the video stage or defective video tube or a loose wire or bad soldering joint in the wiring associated with the tube might also be the trouble.
2. **Defective high-voltage rectifier or associated components and circuitry.** Change bad part. END



The Old Timer and the Young Ham fix some TV sets while the Young Ham learns something about customer relations

The CUSTOMER is RIGHT!

By JACK DARR

THE Old-Timer came out of the door of a neat ranch-type, accompanied by the Young Ham with the tube caddy. The two were followed onto the porch by a pretty woman in a housedress and a cute teenager in bright pink Bermuda shorts. The Old-Timer tipped his cap to the lady and said, "Well, there you are, ma'am. Sure hope it works to suit you. If it doesn't, please let us know immediately."

"Yes, I will, dear," said the woman, throwing her arms around the Old-Timer's neck and kissing him soundly. This was repeated by the teenager. The Young Ham puckered up and thrust his face forward also, but received only a smart slap in the face from the young girl. "Well, 'bye now," said the Old-Timer, trotting off down the walk. The Young Ham followed, rubbing his cheek.

As they got into the little black panel truck, the Old-Timer was still grumbling. "That's a dirty trick! You did that! Putting my own address down on the service-call sheet and then keeping me so busy arguing with you that I didn't know where it was until we were on the porch!

The Young Ham grinned at him. "Don't look at me! It was all your wife's idea. She called me at the shop this morning and fixed it up. She said that if she didn't get that set fixed before the kid's favorite program came on this afternoon, she didn't know what she'd do and this was the only way she could get you to work on it!"

"Well, I *was* gettin' kinda tired of that vertical jittering, at that," grinned the Old-Timer. "That oughta ease up on some of the QRM around the house in the evenings, anyhow. Guess that's like the shoemaker's children that are always going barefoot, huh?"

"Sure! TV man never has time to fix his own set. Where are we going now?"

"Where's your dern job list?" asked the Old-Timer. "Oh, here it is. I was sittin' on it. Old man Burns. Right down here a block or two."

"Oh gosh! Not him again!" groaned the Young Ham.

"Yep, him," said the Old-Timer. "Here we are now." The truck pulled up in front of a small white house and they got out. The door was opened by a chunky old man with a fringe of snowy hair around a red face. He greeted them warmly, and they went into the living room where a 21-inch TV set displayed an amazing pattern—the pictures floated up, down and sidewise, all at the same time. The old man pointed to it and said in a high voice, "There she is. See? I left it on so's you could see what it was doing."

"Fine. Thank you," said the Old-Timer, pulling the set away from the wall and beginning to remove the back.

"Looks like a tube, eh? Tuner tube, I'll bet a cookie. Looked at them symptoms and said to myself, 'That's a tuner tube.' How about it? Think it's a tuner tube?" chattered the old man. The Old-Timer agreed with him and continued removing the back of the set. Plugging in the cheater cord, he thumped several tubes. "Hand me a 6U8, willya?" he asked. The Young Ham fished the tube from the caddy and gave it to him. He reached into the set and pulled the old tube. "Ouch! These little stinkers sure do get hot!" he complained, plugging the new tube in. As it warmed up, the picture steadied and snapped into place. The Old-Timer came around in front of the set and checked the range of the hold controls.

The owner, meanwhile, had kept up his steady stream of advice, comments and suggestions, mostly concerned with the "tuner tube." The Old-Timer politely answered each time he paused for breath. He checked the set on each channel; pictures were sharp and clear, and he grunted in satisfaction.

"There. That oughta do it." The Old-Timer replaced the back and tossed the cheater cord to the Young Ham. "Looks fine now. When did this happen, this morning?"

"Yep, sure did," said the old man. "Picture just started floatin' off in all directions all of a sudden. Said to myself right then and there, that's a tuner tube! I remember my son-in-law's set acted just like that once, and he told me it was a tuner tube. Thought I recognized the symptoms."

"Yes, sir, you can sure tell when one of those goes out." He figured out the bill, filled out the job ticket, the old man paid him and they left him, chattering agreeably.

As they rounded the corner, the Young Ham wiped imaginary sweat from his forehead and cried, "Whew! What a blast! If it was wintertime, he could heat the house with all that hot air! I don't see how you put up with

it! He drives me nuts!"

"Junior, that's not a drive; that's a short putt!" said the Old-Timer, straight-faced. "Besides, if old man Burns was the worst customer we had, we'd be doing fine!"

"But all that chatter! And a 'tuner tube!' He wouldn't know a tuner tube from the picture tube!"

It makes him happy?

"Junior!" said the Old-Timer severely. "It's his set, and he paid me for the tube. If it makes him any happier to think that he diagnosed the trouble correctly, who am I to tear down his playhouse? Besides, it ain't nice to poke fun at people. Chances are you wouldn't look too good if you tried your hand at his specialty, which happens to be accounting! That ol' boy was one of the smartest CPA's in this town, before he retired last year! I'd like to see *you* balance a set of double-entry books! My wife don't know too much about TV, but did you ever taste an apple pie that *I* baked?"

"No, and I hope I never do," said the Young Ham.

"Good. I hope so. Point is, you gotta do some things that look a mite silly, now and then, to keep your customers happy. Happier they are, the longer they'll be with us. Longer they're with us, th' happier *we* are!"

"That's so, but some people get on my nerves," said the Young Ham. "Especially when they hang over me when I'm workin'."

"Well, sir, you've just got to get used to a certain amount of that," said the Old-Timer philosophically, "because you're gonna git it. And after all, you can't blame the customers for wantin' to know what's goin' on. It's their sets. They paid a lot of money for the dern things, and they want to know what you're doin' with 'em. Besides, I know a certain character with a flat-top haircut that's pretty much the same way whenever he sees a new process or gadget!"

"Aww! It's different with me. I'm goin' to be an electronics engineer. I'm naturally interested in new equipment and stuff."

"So are the customers," said the Old-Timer, "electronics engineers or not. Junior, that's simply a manifestation of the most human of all traits. Curiosity! Did you know that that accounts for all the progress this world's made? Curiosity! Guy wants to find out how somethin's made and then he wants to find out if there ain't a way it can be made better! So, curiosity's a great thing, applied in the right direction."

"Well, you're right there," admitted the Young Ham. "I never thought of that."

"Speakin' of curiosity," said the Old-Timer, "I'm gettin' a mite curious about something myself."

"What's that?"

"Where in the heck we're goin'!" said the Old-Timer. "We've been drivin' down this street for quite a while now, arguin', and it seems to me like it'd be a good idea if we found out where we was supposed to be!"

"Here's the list. I was sittin' on it this time," said the Young Ham. "Doc Williams. Mrs. Thompson."

"Well, we passed Doc's house some time ago," said the Old-Timer. "Let's see. Let's take Mrs. Thompson's set now, and then get Doc on the way back. Right around the corner here I think." He wheeled the little truck to the left at the next intersection and announced, "Yep. There it is, right over there."

This set's out again!

They pulled up in front of a duplex apartment, got out and rang the bell. They were greeted by a middle-aged woman with a very suspicious look on her face. Curtly, she invited them in. As they came into the living room, she began. "This TV set's out again! It hasn't been over two weeks since you worked on it, and now it's doing the same thing again!"

The Old-Timer went to the TV set and pulled it away from the wall. "Well, now," he said sympathetically, "that's too bad. Let's see what the trouble is. When did it happen, and what's it doing now?"

"Nothing!" snapped the woman. "Not a thing!"

"Is there any sound?" asked the Old-Timer calmly, continuing to dissect the set.

"Yes, the sound's all right, but there's no picture at all and that's what happened last time! I thought you guaranteed your work! If you can't do better than that, we'll have to call someone else next time!"

"Well, we'll soon see what it is," said the Old-Timer, kneeling behind the set. He gave a warning shake of his head at the Young Ham, who was getting very red in the face. Plugging in the cheater cord, he turned the set on. Sure enough, the screen remained dark although the sound came in clearly. He flipped the doghouse lid open, pulled an arc from the tube plate cap, and replaced the 1B3 tube. When he replaced the cheater cord, the screen lit up brightly. The picture was out of sync in all directions, but a few turns of the hold controls fixed that. The Old-Timer squatted on his heels in front of the set, checking the controls. The housewife continued to glare at him with a very sour look on her face.

"There it is," said the Old-Timer cheerfully, checking the set on all channels. "Looks better, doesn't it?"

"Yes," grudgingly admitted the woman, "but how long will it last?"

"Gosh, lady, I couldn't tell you and neither could anyone else." The Old-Timer grinned. "Nobody's ever been able to figure out how long any given tube'll last! That tube I just put in may go out tomorrow or it may last for years! That's why we guarantee our new tubes. Once in a while we do find a new tube that goes bad within a few days, even though we test them before we install 'em. If we do, we'll cheerfully replace it, absolutely free. That's why we keep a record of every tube and part we replace in your set; so that we can tell if one of 'em goes out within the warranty period. See here," and he pulled a pack of job cards from the tube caddy. "Here's your set, and here's the last call we made. Replaced this little tube right here." He turned the set around so that she could see into the open back. "See?" pointing to the second video if tube, "where we wrote the date on the chassis, to save lookin' it up? Now, I'll date this one," and he pulled a grease-pencil from his pocket, to write the date on the doghouse in heavy black letters. "What's today?"

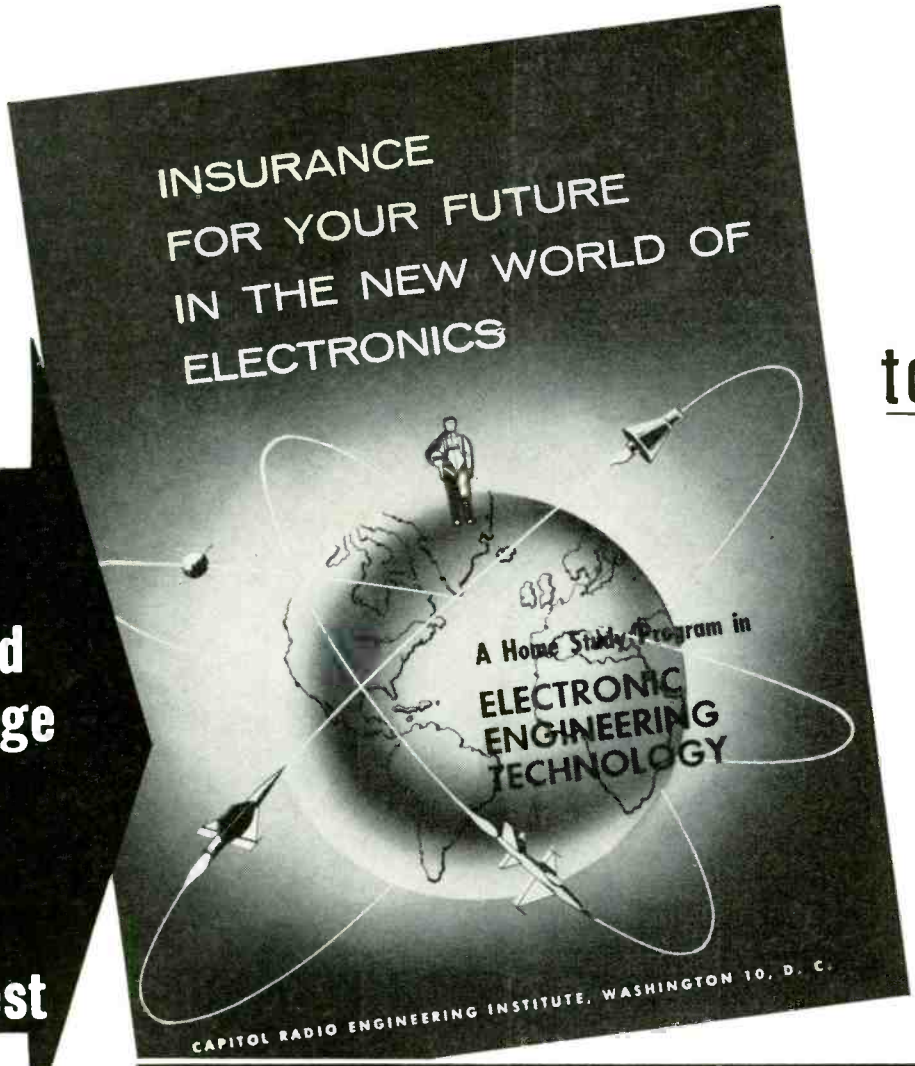
"The 5th," said the Young Ham.

"Thanks. There. Now if that tube goes out within 90 days, you just let us know and we'll replace it without charge. You see, our distributor replaces them for us when they go out within the warranty period so we're not out anything except the time it takes and we don't mind that, much. That's why we buy only the best tubes we can get. If we used cheap tubes, we'd be running all the time replacing 'em!" and he grinned at her. The woman, meanwhile, had studied the service record card carefully and the very obvious date on the chassis. "My," she finally said, "was it that long ago since you were here? I thought it was just a couple of weeks!"

"Well, lots of folks do that," said the Old-Timer, "and we can't remember ourselves half the time when it was

(*Continued on page 96*)

YOUR FUTURE MAY REST BETWEEN THIS PAGE AND THE NEXT!



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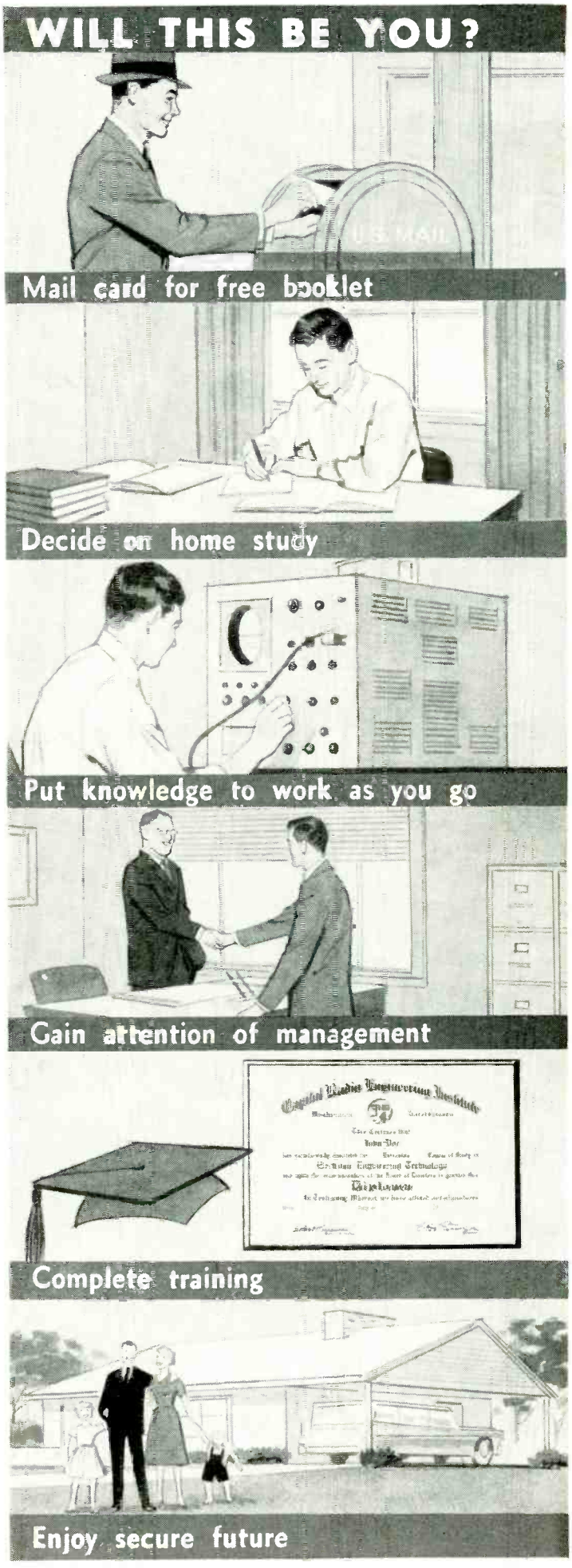

TELEVISION

(*Continued from page* 91)

we did a certain job. That's why we keep up these records. That's the only way we can be sure you're getting your money's worth!" He smiled at her. This time the smile was returned.

Thawing perceptibly, she asked, "That's a pretty good set, isn't it?"

"You bet it is," said the Old-Timer enthusiastically. "That's one of my favorite makes. They're well built and they've been giving good service around here. We like 'em because they're easy to work on, too."

"Well," said the housewife, "thank you for coming over so quickly. My husband would be in a terrible temper if he missed that fight tonight!"

"I'll bet he would!" agreed the Old-Timer. "I would, too. That's gonna be a good one, and I want to see it myself. If my set won't work, how about comin' over and watching it here?"

The housewife laughed heartily and invited him over, if it became necessary, which the Old-Timer gravely assured her that it might. She asked how much the bill would be.

The Old-Timer fished a battered price list out of his well-packed shirt pocket. "Lessee. 1B3—$2.40, service—$4.50 Total, $6.90." He filled in the job card.

"I'll make a note of it here," reaching for the telephone scratch pad, "and my husband will write you a check tonight when he gets home."

"Thank you, ma'am, that'll be fine," said the Old-Timer, picking up the tube caddy. They hopped into the truck and left. Once safely out of sight, the Young Ham exploded.

"Of all the unreasonable people! Wow! That woman's the worst I ever saw! Why, she didn't have any reason for being so mad at us! Two weeks ago! I saw the date on the chassis, and it was over two *months* ago! I saw it!"

"*She* did too, Junior," grinned the Old-Timer. "Why do you think I turned the set around so she could see in the back after I gave her that job card? Notice how she kinda began to cool off right after that?"

"Well, you've certainly got a lot of control over your temper," said the Young Ham. "I'd have told her where she got off *so* quick! You just sat there and took it!"

Gotta put up with it

"Young sprout, lemme tell you about the birds an' bees of business life," said the Old-Timer. "You're gonna have a certain amount of that stuff to put up with and when you've been around as long as I have you'll learn to not let it bother you. She was just blowin' off steam, that's all. And, still more important, if you argue with 'em, you not only get 'em madder, you make 'em more firmly convinced that they're right! What good is winning an argument if you lose a customer? Let them have a chance to cool off; to find out that they're wrong and give 'em a chance to back down gracefully, like I gave Mrs. Thompson. Soon as she

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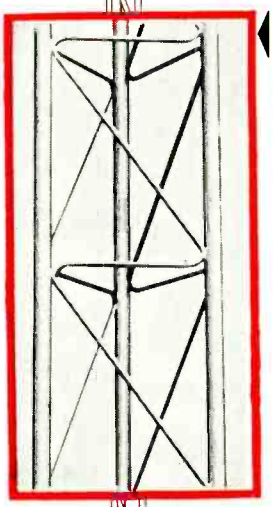

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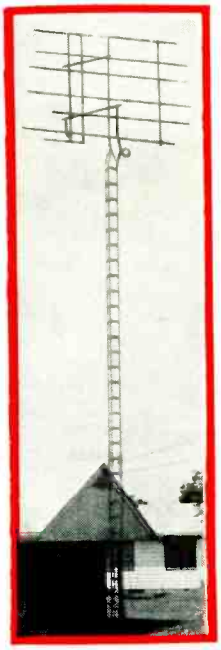

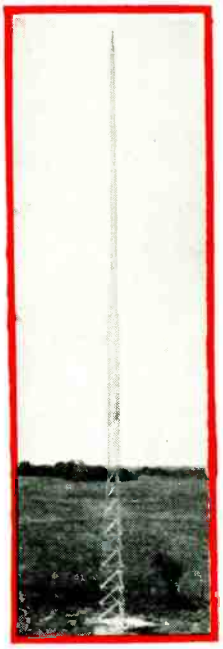

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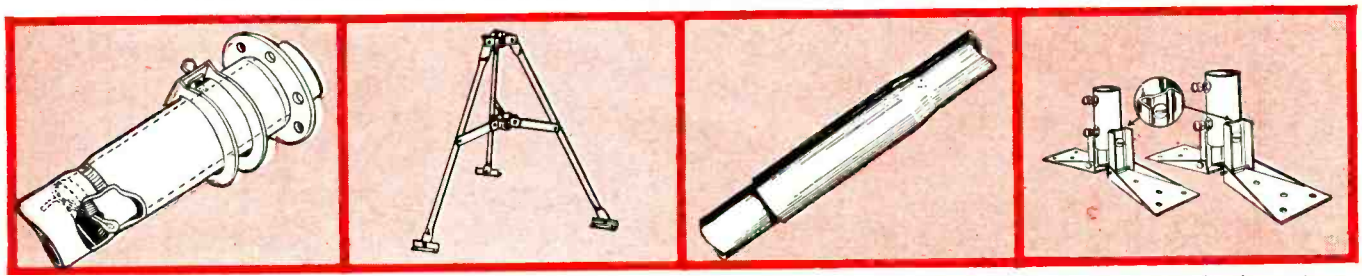

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TELEVISION

found out what the score was she cooled off, didn't she?"

"Yes, but she acted like it hurt her," said the Young Ham.

"Well, it hurts to admit you're wrong anyhow, don't it?"

"Yes, it does," admitted the Young Ham, remembering an argument he'd lost to the older man the day before. "Especially if you're convinced you're right!"

"Well, all's well that ends well, and that's a lot of wells. Speakin' of ending well, lemme warn you about something right now. You're gittin' a habit of kinda arguin' with th' customers in th' shop, and I'd rather you didn't. If they git uppity, just holler for me, and I'll take 'em on. But, you just remember this, young feller. Don't let me catch you bawlin' out any customers around *my* shop, or you'll regret it! The rule of this here establishment is patience and politeness, no matter what a customer says to you!"

"For gosh sakes', what are you supposed to do?" said the Young Ham in an aggrieved tone. "Just stand there and let 'em bawl you out?"

"That's just about the idea," said the Old-Timer. "Let 'em git it off their chest before you say too much. You've got to consider one indisputable fact: when a person calls us, you know they're *in trouble!* We're just like doctors. We never see anybody when they're in good health! Unless they're in trouble they don't call on us at all! So they're pretty apt to be in a bad humor before they ever git to us, and we've got to handle 'em with kid gloves until we can git 'em cooled off. Any little remark at th' wrong time can set 'em off like a firecracker! So it behooves us to walk pretty softly and not say too much until we find out what the score is. In the meantime, if they want to blow off steam, let 'em; just kinda let it go in one ear an' out th' other!"

"That's awful hard to do sometimes," complained the Young Ham.

"Yeah, I know, but you might as well begin learnin' to do it. If you're going to be in any kind of business dealin' with th' general public, you're gonna have to learn that skill first! There's two things you've got to learn if you're gonna be a successful TV technician, and only *one* of 'em is learnin' how to fix TV sets! The most important one is learnin' how to handle *people!*"

"Me, I'd rather have the TV sets," said the Young Ham.

"Sometimes I would too," admitted the Old-Timer. "But, howsomever, you'll find that there's only about 5% of your customers that ever give you much trouble, thank goodness. The rest of 'em are just as nice and obligin' and reasonable as they can be. It's that 5% that gets the most attention though. They're the ones that give you all the trouble! Unfortunately, there's a law against poisonin' 'em!"

"Maybe we could get it repealed, huh?" asked the Young Ham. END

ELECTRONICS

Danger!

Some electron tubes are radioactive!

By EDMUND H. MARRINER

SOME of the everyday tubes used in receivers and transmitters contain radioactive materials. The more common of these are regulator tubes—the 0A2 and 0B2. Caution in handling cannot be overemphasized.

The danger is similar to that experienced with early fluorescent lamps. When intact, bulb unbroken, there is no real hazard. The amount of radioactivity is below the level that is considered dangerous. But should the bulb be broken, the radioactive material (cobalt 60 and nickel 63) may be picked up and get into your body—through breathing, eating, drinking or wounds in the skin. These radioactive isotopes — they emit alpha, beta or gamma particles—can injure or destroy blood-forming organs and other tissue. Internal radiation of this type may show up in a few weeks or it may take a few years, because the material fixes itself in the tissue, and its removal from the body is very slow.

If you should break one of these tubes, remember:

- Don't let any part of the broken tube touch the body. Use rubber gloves.
- Don't bring any food or drink into the contaminated area.
- Wash thoroughly.

Also, since these tubes can be dangerous, don't let children play with old ones, or break them open to see what's inside.

A detailed listing of all tubes that contain radioactive substances can be found in the *Bureau of Ships Journal* for December 1957, published by the Department of the Navy. Aside from the regulator tubes—that section of the listing is presented here—only uncommon types are found (microwave, radar, special-purpose). However, some of these are extremely dangerous, containing much larger amounts of radioactive isotopes. Some have to be marked with a seal showing that they are radioactive, and special disposal precautions must be taken. But the only types you are likely to encounter are regulator tubes. The table shows a listing of these units as shown in the *Journal*. END

Type	Manufacturer	Isotope	Amount (microcuries)
0A2	Raytheon	Cobalt 60	.0067
0A2-WA	CBS-Hytron	Nickel 63	.01–.05
0A2-WA	Raytheon	Cobalt 60	.0067
0B2	Raytheon	Cobalt 60	.0067
0B2-WA	CBS-Hytron	Nickel 63	.01–.05
0B2-WA	Raytheon	Cobalt 60	.0067

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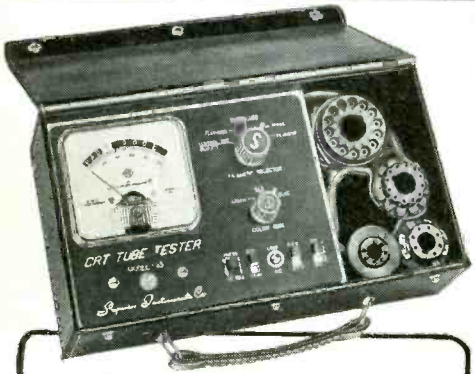

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C.R.T. TESTER

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ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types—from 8" to 30" types

- Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes.
- Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types.
- Model 83 employs a 4" air-damped meter with quality and calibrated scales.
- Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode.

ALL COLOR TUBES

Test ALL picture tubes—in the carton—out of the carton in the set!

- Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition.
- Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Model 83—C. R. Tube Tester. Total Price $38.50 Terms $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

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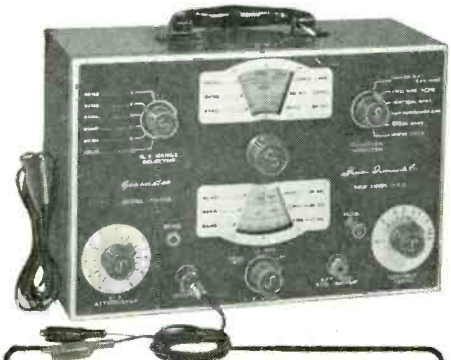

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Model 77—Vacuum Tube Voltmeter, Total Price $42.50. Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

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The Model 77 will measure DC with negligible loading AC of ANY FORM WAVE; whether sine wave, pulse wave, spike wave, square wave or other complex wave forms. It will measure all AC from 30 cycles to over 5 megacycles and will do so without additional accessories or cables.

SPECIFICATIONS

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- AC VOLTS (RMS)—0 to 3/15/75/150/300/750/1500 volts.
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ELECTRONICS does the COUNTING

People, cars, or packages . . . you can find out how many go by with this compact 1-transistor unit

The combination on–off switch and sensitivity control is on the readout end of the case.

By ELLIOTT A. McCREADY

ELECTRONIC counting devices record a great variety of events: the number of persons viewing displays, the flow of traffic on a city street, objects passing through an assembly line and other occurrences too numerous to mention. The versatility of these devices seems limited only by human imagination.

The simplest electronic counter is electromechanical and operates on the same principle as a stepping relay. Each pulse delivered to the counter actuates a ratchet and advances the unit one digit. Such a device requires a rather sizable pulse of current, so the counter is usually operated in conjunction with a sensitive relay. The trigger pulse that keys the sensitive relay (and in turn the counter) may be generated in a number of ways: pressure switches, capacitance relays and photocells to name a few.

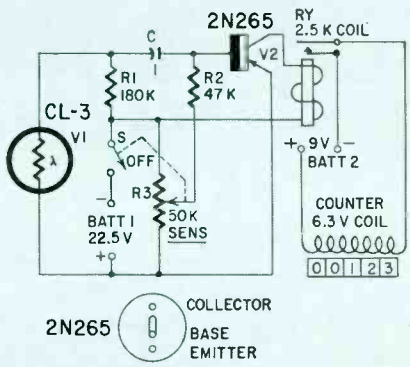
The electronic counter described in this article is small (3 x 4 x 5 inches), light (under 2 pounds) and entirely self-contained and self-powered. Sensitivity is so high that the unit need only be aimed toward a window, lamp or light-colored wall. Just about the only auxiliary equipment required is a shelf or box on which to set the thing.

Counter circuitry

The heart of this electronic counter is an extremely sensitive cadmium selenide photocell, the Clairex CL-3. This photocell is so sensitive that a very small, abrupt variation in light intensity produces a sizable output pulse. This output pulse is amplified many times by a 2N265 transistor (see schematic) which has a beta, or current gain, of *110*. To develop maximum gain and supply the largest possible bias to the photocell, the transistor is operated at close to its maximum voltage rating. Of course, the photocell could be biased separately with a much higher voltage. However, its sensitivity at 22.5 volts is adequate, and the need for a separate battery and switch is eliminated.

A sensitive relay in the transistor's collector circuit responds to each light pulse at the photocell and operates a standard electric counter.

The instrument's maximum counting rate is determined by the top speed at which the relay and counter will respond, and the time constant of R1–C.



R1—180,000 ohms, ½ watt
R2—47,000 ohms, ½ watt
R3—pot, 50,000 ohms with spst switch
C—1 μf, 200 volts
BATT1—22.5 volts (Burgess U15 or equivalent)
BATT2—two 9-volt units in parallel (RCA VS305 or equivalent)
RY—5-mw sensitivity, 2,500-ohm coil (Sigma 5F-2500-S/SIL or equivalent—see text)
S—spst on R3
V1—photocell, Clairex CL-3
V2—2N265
Counter, electromechanical, 6.3-volt ac coil (Mercury MEA-N5-6A or equivalent)
Chassis box, 3 x 4 x 5 inches
Socket, for transistor
⅜-inch threaded control grommet
⅜-inch Bakelite control protector cap
Miscellaneous hardware

Circuit of the electronic counter.

The relay and counter operate at about 10 pulses per second. The time constant (R1–C) was purposely made rather long to develop a large pulse at the output of the photocell. This long time constant results in an overall maximum counting rate of approximately five pulses per second. Shortening the time constant of R1–C by lowering the value of either component will speed up the response of the instrument, but results in lower overall sensitivity.

One thing that may puzzle the reader is the 6.3-volt ac counter. The reason

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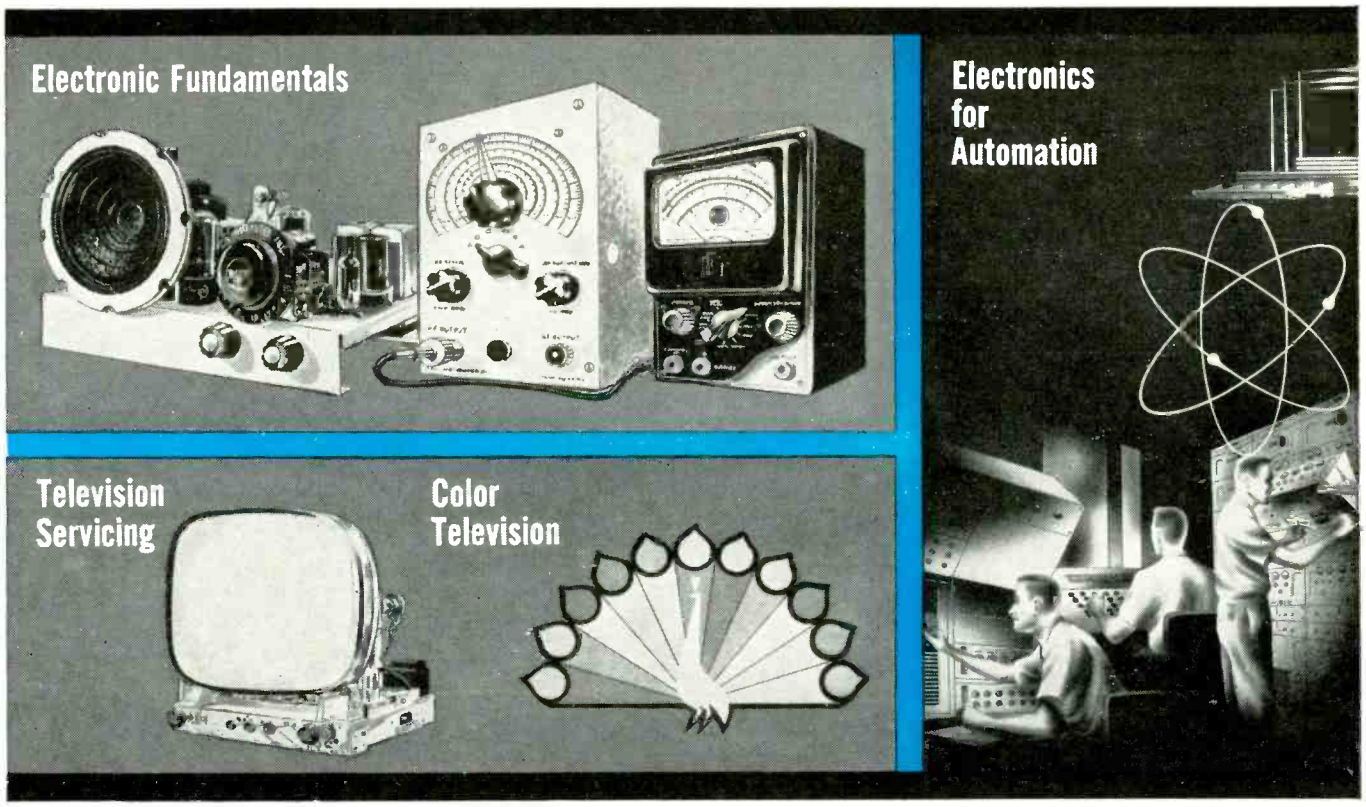

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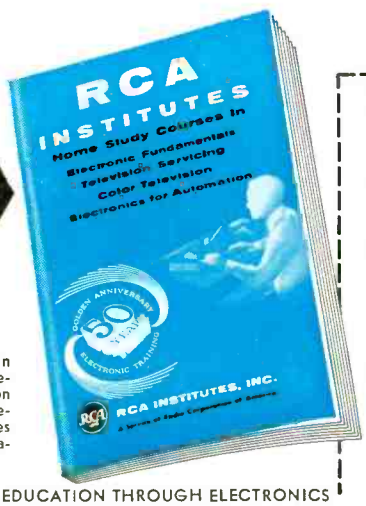

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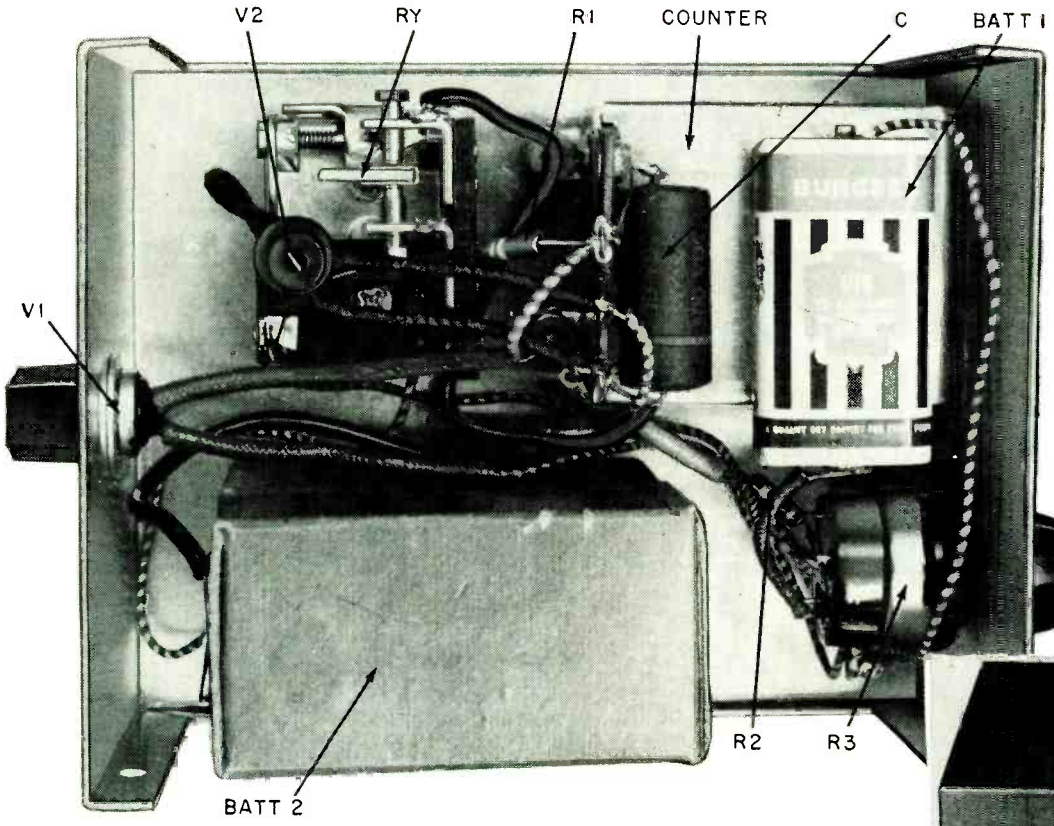
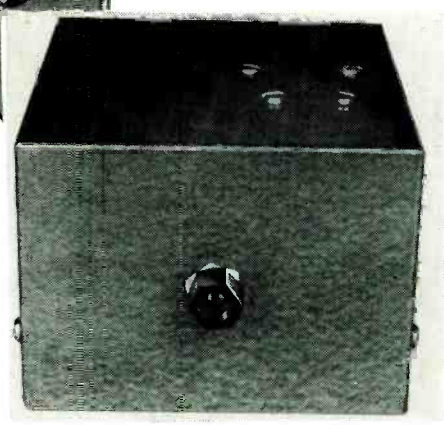


Under the chassis. For longer life before changing batteries use larger units for BATT2. Of course, this means the case will have to be larger.



Looking like a one-eyed monster (below), this is the business end of the electronic counter.

is that a counter with a dc coil couldn't be found. The ac unit operates very nicely at 9 volts dc. As the counter draws a large amount of current, its power supply (BATT2) is made up of two fairly large 9-volt batteries, parallel-connected.

Parts substitutions

If you are anything like me, you are probably reluctant to buy a new component when you have an almost identical one in the spare-parts box. Here are a few pointers on substituting components used for the counter:

The CL-3 photocell may be replaced with a CL-2 or CL-1, **but sensitivity will suffer.** The CL-3 is about six times as sensitive as either of the other two.

The 2N265 may be replaced with a transistor with like characteristics. I have one or two hand-picked CK722's which perform almost as well as the 2N265.

When substituting relays, several points should be remembered. The life of BATT1 depends on the operating current of the relay. For battery economy, use a sensitive relay.

Construction

The unit is housed in a 3 x 4 x 5-inch, two-piece aluminum chassis. All components are mounted on the flanged portion of the chassis, as shown in the photo.

The two metal tabs on the upper surface of the electromechanical counter are bent horizontal and fastened to the case. A ⅞ x 1¾-inch hole is cut in one end of the chassis for the readout end of the unit.

BATT1 is cemented to the top inside of the counter with service cement. The two units that make up BATT2 are cemented together and the entire battery secured to the chassis with more cement. You may prefer to use a clamp, but space is rather limited.

The photocell is cemented inside a ⅜-inch threaded control grommet (ICA 1250, E. F. Johnson 115-255 or equivalent) and mounted at the front of the chassis. Saw the solid end off a ⅜-inch bakelite protector cap of the type used to prevent tampering with TV back-of-chassis controls (D&M Control Guards) and screw the remaining portion onto the control grommet. This tube extends ½ inch or so beyond the photocell and limits the field of light.

When wiring sensitivity control R3, make sure that clockwise rotation of the control increases the negative bias at the transistor's base.

A miniature hearing-aid socket was used for the transistor. However, it can be soldered directly into the circuit. Just be careful—don't let heat from the soldering iron do any damage. The photocell can also be damaged by heat, and a heat sink should be used when soldering to its leads.

Operation

Place the counter so the photocell faces a light source in such a way that objects to be counted will pass between it and the light. As the unit is extremely sensitive, a lamp, window or the light-colored wall of a well lighted room should be adequate light sources.

Switch the instrument on (one count will register). Advance the sensitivity control (R3) until the counter pulls in. Now back off R3 until the counter releases. The unit is now ready to operate, and objects passing between the photocell and light source should register on the counter.

A little experimenting will quickly determine the maximum distance the counter can be placed from the object to be counted. Factors such as light intensity or area, and the size of the object, will vary the effective distance. I have found that, in a normally lighted room, the counter will register when a person passes within 6 feet, if the photocell is directed at a shaded lamp 10 to 12 feet away. Small objects must be closer to the counter to register.

As I stated earlier, the basic electric counter requires a considerable amount of current. For this reason the largest practical batteries (BATT2) were selected to operate the electromechanical counter. After the instrument was completed, over 20,000 counts were registered in fairly rapid succession and the batteries were still going strong. This leads me to believe that one set of batteries should be good for quite some time. BATT1, with only negligible current drain, should approach shelf-life. END

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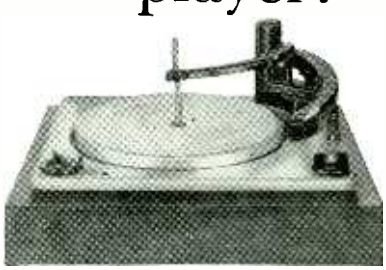
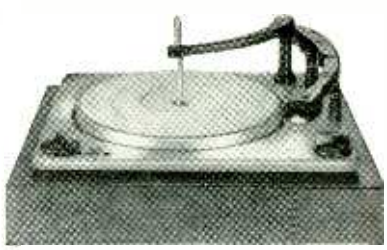
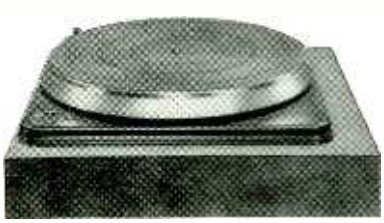


The Continental II, Model TSC-840—$49.50



The Coronation II, Model TSC-740—$42.50
*The Conquest II, Model TSC-640—$38.50



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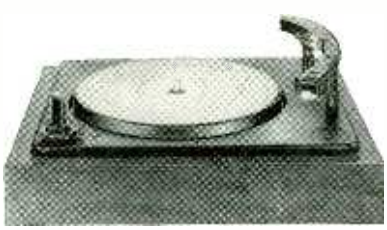

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RC-13

Relayless alarm circuit is keyed by light, temperature, sound or rf signals

Sensitive Signaling Circuit

By NATHANIEL RHITA

A SENSITIVE relay is generally used when a weak electric signal must set off a visual or audible alarm, turn on a motor or accomplish some kind of control. Such a relay is quite expensive. For example, in the 10–20-μa range, it may cost $30 or more. If the relay is needed only to set off an audible alarm (to indicate that an electrical signal is being received), it may be replaced by a simple transistor circuit.

This transistor device sounds a warning when an 8-μa signal is fed to it. Since it is so easy to convert light, sound, temperature change or rf power into electricity, this unit has unlimited possibilities. For example, a humidity sensor plate can be used to produce the electric signal, turning the signal circuit into a rain detector. When coupled with a lamp and photocell, it can indicate a customer entering the shop, and so on. The instrument will sound off whenever a suitable input is fed to it.

Fig. 1 shows a block diagram of the unit. The electrical signal from a transducer or battery is amplified, after which it triggers a p-n-p power transistor into audio oscillation. The af energizes a small speaker and produces a tone which is audible over a range of 10 feet or more.

The transistor oscillator is many times more efficient than a mechanical buzzer. Besides, its tone is more pleasant. Very little equipment is needed, and the power supply may be any low-voltage battery. I used 4 volts in this particular unit, but higher voltage may be used if a louder alarm is needed. Standby current (during absence of the alarm) is but a fraction of a milliampere.

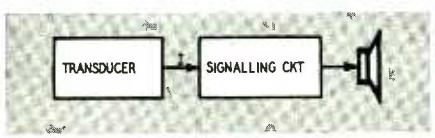
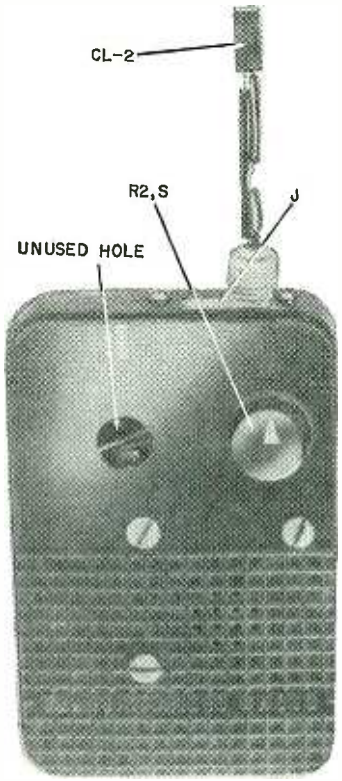
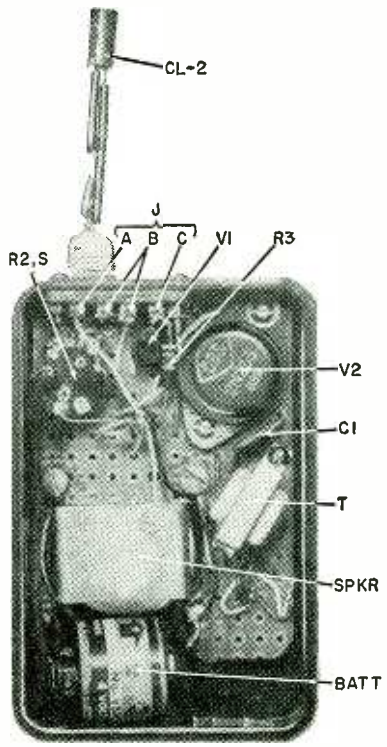


Fig. 1—Block diagram of signaling circuit.



The finished unit fits into a pocket-sized case.



Parts layout inside the case.

The circuit

It is easier to analyze the circuit of Fig. 2 if we assume V1 is temporarily shorted between emitter and collector. Then V2 may be recognized as a conventional Hartley type audio oscillator. Note that the transformer's center tap returns to V2's emitter through the battery. Its base is biased through a volt-dropping string, R1, R3, R4. This circuit will oscillate at about 3,500 cycles when the battery is switched on. Frequency may be lowered by adding capacitance across the transformer primary, but this may reduce the instrument's sensitivity.

When V1 is added as shown, it affects the oscillator's base bias. Normally the transistor's internal resistance is high. This leaves only a small voltage across R1 to bias V2. Under this condition there is no audio tone. However, when

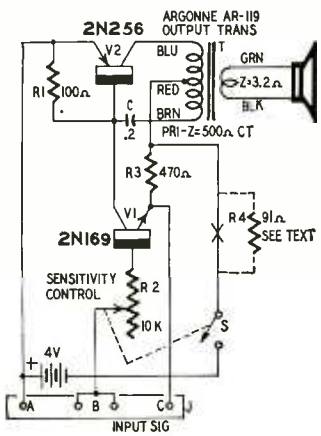


Fig. 2—Circuit of the all-electronic alarm.

R1—100 ohms
R2—pot, 10,000 ohms with spst switch (Lafayette VC-28 or equivalent)
R3—470 ohms
R4—91 ohms, 5%
All resistors ½-watt 10% unless noted
C—0.2 μf ceramic
J—4-terminal jack (Lafayette MS-285 or equivalent)
S—spst on R2
T—output transformer: primary, 500 ohms, ct; secondary, 3.2 ohms (Argonne AR-119 or equivalent)
V1—2N169
V2—2N256
BATT—4 volts, RCA VS-308
Connectors for battery
Case, plastic, 4⅛ x 2⅝ x 1⅛ inches (Lafayette MS-302 or equivalent)
Bakelite board, cut to size (Lafayette MS-304 or equivalent)
Socket, 3-pin, for 2N169
Socket, 9-pin miniature, for 2N256
Knob
Miscellaneous hardware

forward bias is fed into V1, its internal resistance is lowered and a greater voltage appears across R1. If the bias is sufficient, V2 will oscillate.

Forward bias of only 8 μa starts the oscillator. It may be applied between terminals B and C. B must be connected to the *positive* side of the external signal source since V1 is an n-p-n unit. R2 may be used to control the signal input. In general, however, an external resistor will need to be added in series to cut down the signal to only a few μa.

The audio tone may be stopped by reducing the input to about 2 μa or less, or by switching off the battery circuit.

The most obvious application of this device is as a sensitive electronic relay which will sound an audio tone when

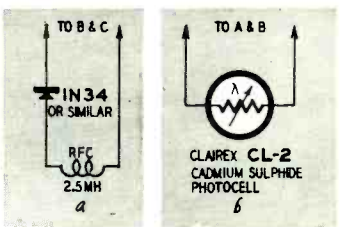


Fig. 3—Two accessories: a—rf detector; b—light sensitive probe.

its signal input exceeds 8 μa or so. The signal source may be a sensor plate to detect moisture, for example. Other signal inputs to key the alarm are listed below:

1. A network made up of an rf coil in series with a crystal diode may be connected between terminals B and C. Any rf picked up from a nearby transmitter is detected and fed to V1. The device becomes a CW monitor, giving a loud, pleasant tone every time the key is depressed. A distance of 2 or 3 feet from a 35-watt-transmitter antenna is about right. The coil need not be tuned—a 2.5-mh choke has been found suitable. The diode must be poled with its cathode toward terminal B (see Fig. 3).

2. The internal battery (4 volts) may be used to supply the control signal. When a resistor is connected between terminals A and B, current flows through it from the positive battery terminal. Thus V1's base goes positive. The emitter is already tied to the negative terminal through a pair of resistors. If the added resistor (between A and B) is small enough (270,000 ohms or less), oscillation will start.

This added resistance may be a cadmium sulphide or similar photocell, which has a high resistance when no light falls on it. The resistance then drops as light intensity increases. For example, a Clairex CL-2 cell will set off the audio alarm when placed about a foot from a 30-watt fluorescent lamp. Light from a cloudy sky will also work. A thermistor will do the same job for temperature changes.

3. The alarm may be set off by a combination of signals. If approximately 6 or 7 μa is fed in between terminals

(*Continued on page* 110)

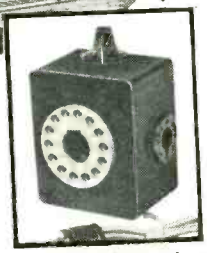
SHIPPED ON APPROVAL

NEW

CRT TESTER-REACTIVATOR Model CRT-2

NOW . . . a TESTER-REACTIVATOR really designed to test, repair and reactivate EVERY PICTURE TUBE MADE — whether black and white or color . . . with exclusive features never before found in picture tube testers.

Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD*



Model CRT-2 $57.50 Net

TERMS: $13.50 within 10 days. Balance $11 monthly for 4 months.

The CRT-2 steps in and solves the limitations and shortcomings of present day CRT Testers. Unlike ordinary CRT testers that keep entering the field with a limited range of operation, the CRT-2 employs a new brilliantly engineered circuit designed to test, repair and reactivate every black and white or color picture tube made. The CRT-2 eliminates the guesswork and risk that until now, has always been present when a picture tube is reactivated. It accomplishes this by providing perfect control of either the 'Boost' or 'Shot' method of reactivation.

THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

TEST

- ✓ for quality of every black and white and color picture tube
- ✓ for all inter-element shorts and leakage up to one megohm
- ✓ for life expectancy

REPAIR

- ✓ Will clear inter-element shorts and leakage
- ✓ Will weld opens between any two elements in the tube gun

REACTIVATE

- ✓ The unique controlled 'SHOT' (high voltage pulse) method of reactivation provided by the CRT-2 will restore picture tubes to new life in instances where it was not possible before. Furthermore the high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- ✓ The 'BOOST' method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will improve definition, contrast and focus greatly and add longer life to the picture tube.

1. THE MULTI-HEAD (patent pending) . . . A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD — A tremendous advance over the maize of cable and adapters generally found with other testers. Enables you to test, repair and reactivate every type of picture tube with greater convenience than ever before . . . 50 degree to 110 degree types from 8" to 30", whether 12 pin base, 8 pin base, 14 pin base . . . even the very latest 7 pin base. A special color switch on the MULTI-HEAD enables you to test, repair and reactivate each of the red, green and blue color guns separately.
2. WATCH IT REACTIVATE THE PICTURE TUBE — You actually see and control the reactivation directly on the meter as it takes place, allowing you for the first time to properly control the reactivation voltage. This eliminates the danger of stripping the cathode of the oxide coating. It enables you to see the speed of reactivation and whether the build-up is lasting. You will see if the cathode contamination is too great and if the picture tube is too far gone to be reactivated.
3. CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION — Stronger than any found in other testers . . . high enough to really do the job — yet controlled to avoid damage to the picture tube.
4. UNIQUE HIGH VOLTAGE PULSE CIRCUIT — Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.
5. VISUAL LIFE TEST — Enables both you and your customer to see the life-expectancy of any picture tube right on the meter. The fact that your customer can see the results of your tests as you make them virtually eliminates resistance to picture tube replacement when necessary.
6. TESTS, REPAIRS AND REACTIVATES SPECIAL LOW SCREEN VOLTAGE TUBES — Many new type picture tubes use special low voltage of approximately 50 volts. The CRT-2 will test, repair and reactivate these types with the same thoroughness as the regular types with complete safety.
7. SEPARATE FILAMENT VOLTAGES — Including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.
8. TESTS, REPAIRS AND REACTIVATES 'SF' PICTURE TUBES — found in the newest Sylvania and Philco TV sets. These picture tubes have different base pin connections than standard picture tubes and there is always an element of risk that the tube may be burned out when tested with ordinary picture tube testers. The CRT-2 is designed to accommodate this new base pin arrangement and will test the tube with no danger of damage.

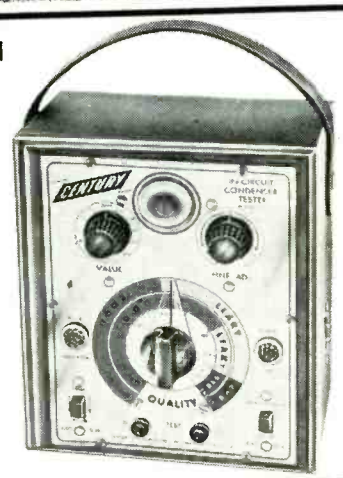
ADDITIONAL FEATURES

• Employs the time proven dynamic cathode emission test principle • Large 4½" meter with heavily damped movement for smooth action, accuracy and long life • Provides separate shorts test for each element in the picture tube • Filament continuity is shown on a separate glow indicator • An easy to read instruction manual contains all the latest testing information on old and new type picture tubes • Housed in handsome hand-rubbed oak carrying case with special compartment for MULTI-HEAD and line cord.

* patent pending

IN-CIRCUIT CONDENSER TESTER Model CT-1

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condenser fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.



in-circuit checks:

- ✓ Quality of over 80% of all condensers even with circuit shunt resistance . . . (This includes leakage, shorts, opens, intermittents)
- ✓ Value of all condensers from 200 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- ✓ Quality of 100% of all condensers . . . (This includes leakage, shorts, opens and intermittents)
- ✓ Value of all condensers from 50 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ High resistance leakage up to 300 megohms
- ✓ New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for every greater accuracy
- Isolated power line
- Housed in sturdy hammertone finish steel case . . . comes complete with test leads

Model CT-1 $34.50 Net

TERMS: $9.50 within 10 days. Balance $5 monthly for 5 months.

EASY TO BUY IF SATISFIED — *see order form on facing page*

FOR 10 DAY *FREE* TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . . try them for 10 days before your buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NEW Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

featuring the sensational new MULTI-PROBE * Patent Pending

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

❶ DC Probe ❷ AC-Ohms Probe ❸ Lo-Cap Probe ❹ RF Probe

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying additional probes. No longer do you have to cart around a maize of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

Housed in hammertone steel-case — complete with MULTI-PROBE

FUNCTIONS

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

OUTSTANDING FEATURES

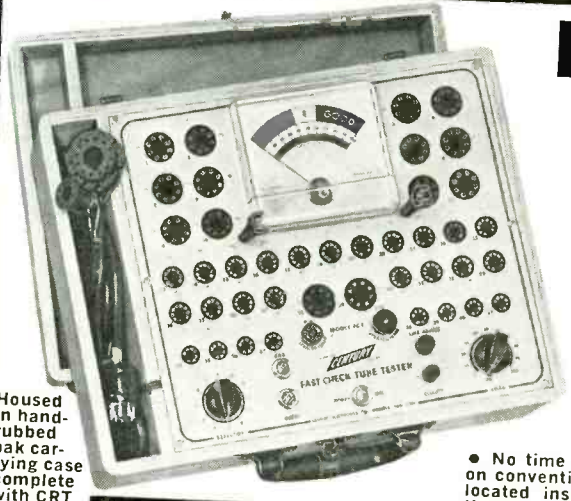
● Completely portable — self powered with long life batteries — permits use everywhere ● New advanced pentode amplifier circuit assures amazingly low battery drain ● Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s ● Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC ● Simplified multi-color easy-to-read 4-scale meter ● No heat operation assures rigid stability and accuracy ● Immune to power line fluctuations ● Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments ● Meter completely isolated — practically burn-out proof ● Hand-crafted circuitry eliminates the service headaches of printed circuitry ● 1% resistors used for permanent accuracy ● Separate RF ground return for low-loss RF measurement ● Microphone type co-axial connector ● Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
- AC Volts (RMS and Peak-to-Peak) — 0 to 3/12/60/300/1200 volts
- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- RF — Peak reading demodulator supplied for use on all DC ranges
- Zero Center — available on all DC volt ranges with zero at mid-scale
- Decibels — from —10 Db to +10/22/36/50/62 based on the Dbm unit: 0Db-1MW in 600 ohms
- Impedance — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- Input Capacity — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model VT-1 $58.50 Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.



Housed in hand-rubbed oak carrying case complete with CRT adapter

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls . . . insert tube . . . and press quality button to test any of over 700 tube types completely, accurately . . . IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- ✔ Checks quality of over 700 tubes types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. 0Z4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✔ Checks for inter-element shorts and leakage.
- ✔ Checks for gas content.
- ✔ Checks for life-expectancy.

SPECIFICATIONS

● No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers ● No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement ● Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale ● 41 phosphor bronze beryllium tube sockets never need replacement ● 7-pin and 9-pin straighteners mounted on panel ● Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out ● Special scale on meter for low current tubes ● Compensation for line voltage variation ● 12 filament positions ● Separate gas and short jewel indicators ● Line isolated — no shock hazards ● Long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

Model FC-2 $69.50 Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 5 months.

CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

The extremely low prices are made possible because you are buying direct from the manufacturer.

CENTURY ELECTRONICS CO., INC.

CHECK INSTRUMENTS DESIRED

- ☐ Model CRT-2 CRT TESTER REACTIVATOR ..... $57.50 — $13.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model CT-1 In-Circuit Condenser Tester ..... $34.50 — $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter ..... $58.50 — $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester ..... $69.50 — $14.50 within 10 days. Balance $11 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

111 Roosevelt Avenue, Dept. 110, Mineola, New York

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name .....

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Address .....

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ELECTRONICS

(*Continued from page* 107)

B and C, the instrument becomes very sensitive and only 1 or 2 more μa will set off the electronic relay. Under this condition even a slight acoustic shock is sufficient. For example, tapping the speaker or blowing onto its cone will start oscillations.

This instrument has been described as a trigger device that has only two states, on or off. It is also useful as an amplifier as shown below. This is a table of input signal (across B and C) vs. total battery current.

Signal (μa)	Battery (ma)
0	0.3
2.2	0.4
7.0	0.8
8.2	1.0 which triggers to 5.0
25.0	10.0

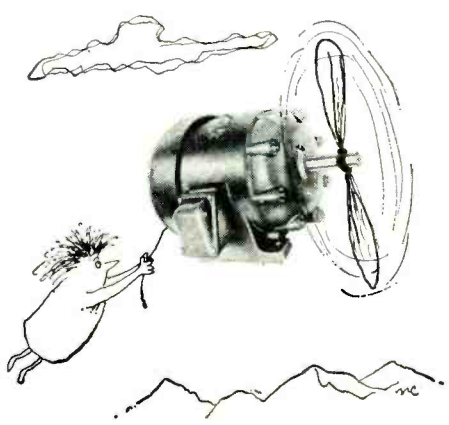
Note that small changes of input may be measured until about 1 ma when the oscillator is abruptly triggered to 5 ma. Battery currents between these values are not observed. After oscillations start, increasing the signal increases battery drain still further (and of course produces louder sounds).

Resistor R4 has an important job. Although it greatly reduces the circuit's sensitivity, it makes it possible to stop the tone by reducing the input signal. Without R4, the tone can be triggered by as little as 2 μa, but it will not cease even when the signal is removed. Only switching off the battery will stop the alarm. (R4 was not used in the model shown in the photo.)

Construction kinks

The electronic relay alarm is built into a plastic case (Lafayette MS-302) which has become popular with experimenters. Only one control appears on the front. This is the on–off switch combined with a potentiometer. All parts except the battery are mounted on a perforated bakelite board. See photo for layout.

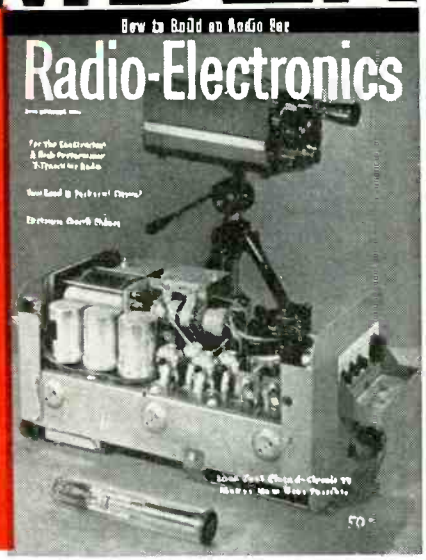
Jack J (Lafayette MS-285) has four contacts. The inside contacts are tied together. Then a plug (MS-283) can be inserted into the desired pair. The inner contacts (which are connected together) are shown at B in Fig. 2. Therefore the plug can contact either A–B or C–B, as desired. The photo shows a photocell (CL-2) hooked up for a light-operated alarm circuit or for measuring light intensity. END



NEW in NOVEMBER

INDUSTRIAL ELECTRONICS — a new section devoted entirely to electronic applications in industry. Practical articles on new equipment, developments, techniques, servicing problems and opportunities in this vast new field which is rapidly opening up so many new opportunities for the technician.

Here's a preview of the November edition of the new Industrial Electronics Section.



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SERVICING ELECTRONIC WHEEL BALANCERS — Even your local garage is feeling the touch of electronics — a look at the equipment your neighborhood automobile mechanic is using — and how to maintain and repair it.

PRINTED CIRCUITS IN NEW FORMS — Challenging problems and special techniques of printed circuitry in computers, industrial control systems, high-temperature equipment, etc.

ELECTRONICS WORKS ON THE RAILROAD —The wedding of America's oldest and newest industry! How electronics makes reservations, sells tickets, supervises yard operations, improves communications, cuts costs.

BUT THE BALANCE REMAINS

The new section will not disturb RADIO-ELECTRONICS finely balanced and neatly diversified lineup of articles on Electronics, High Fidelity, Television, Radio, Test Instruments — and the usual departments. See . . .

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SEVEN-TRANSISTOR RECEIVER — A pocket-size portable for the constructor.

STEREO IN A PACKAGE — Fancy furniture or fine equipment? This article weighs the evidence.

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ELECTRONICS

Technicians look at ELECTRONIC WEIGHING SYSTEMS

Part II—How to service the electronic scale

By EDWIN BOHR

LAST month we saw the how and why of electronic weighing—how it works, what electronic circuits are used, etc. This month we will see how various operating faults can be diagnosed for rapid servicing.

Operation and service

Any competent electronic technician can spot a burned-out tube in the amplifier of an electronic weighing circuit. However, for any other maintenance or adjustment, insist upon a complete system wiring diagram and instruction manual. Read and study it carefully.

Almost every weighing system is custom designed in at least one respect and a good look at the diagram is worth several hours of fumbling in the dark. Furthermore, if you make changes without knowing what you are doing, the system will probably wind up in worse shape than if it had been left alone.

The amplifier is generally a straightforward audio type. The majority have a dual-triode output stage that, instead of driving a speaker, supplies power to a motor winding. (This is called the control winding). Most are Minneapolis-Honeywell-Brown units without a chopper.

The Cox & Stevens weighing system, however, is quite different. It supplies the load cells with approximately 400-cycle power from an electronic oscillator power amplifier. The null amplifier amplifies the 400-cycle error signal to a level of a few volts. At this point, the 400-cycle error signal is converted to a plus or minus dc signal by a phase-sensitive detector. Next, the dc is mixed with the output from a small dc rate generator connected to the weight-indicating pointer.

The generator measures how fast the pointer is moving and tends to keep it from overshooting, if the weight change should stop abruptly.

The dc signal is then changed to a 60-cycle signal by a phase-sensitive modulator and the 60-cycle signal is amplified by a couple of beam power tubes that drive the control winding of a 60-cycle motor.

In some ways, the unit can be compared to a double-conversion receiver, since amplification occurs at two carrier frequencies.

Also interesting is the fact that all these null-balance units are suppressed-carrier double-sideband systems. With the system at rest, the excitation frequency is cancelled (suppressed) and does not appear at the amplifier input. Only when there is some change (modulation) does a signal appear and it is the excitation (carrier) frequency, plus or minus the frequency of the error signal.

The dual-conversion feature of the Cox & Stevens unit allows the 400-cycle amplifiers to discriminate against 60-cycle noise and harmonics. It also allows the use of a somewhat less expensive dc type rate generator. The generator is absolutely necessary, considering the lightning speed with which the Cox & Stevens unit can move.

Sluggishness and hunting

Aside from the usual tube replacements, the most frequent complaints are sluggishness and hunting (oscillating back and forth). More often than not, the solution is to readjust the amplifier's gain control carefully.

The system is sluggish if the indicator wheel or pointer can be pushed either way more than one significant figure without its immediately returning to its normal position when the push is removed. Either too much or too little gain can produce this condition. Too little gain means there is not enough amplification to turn the motor and too much gain causes the error signal to be lost in a background of excessive noise and stray pickup.

The gain control is usually recessed in the amplifier chassis. However, if at all possible, mark the original gain-control position for reference. Now, turn it all the way down and then *slowly* increase it. As the control advances, the pointer at first will be limp in response to a finger push. Then, it will begin to push back with more and more stiffness. Next, the pointer will begin to oscillate wildly, finally becoming sluggish again.

The optimum gain point is *just below* the zone in which the pointer *oscillates*. Proper adjustment is rather critical and backlash in the screwdriver slot may make adjustment even more difficult. Use a screwdriver with a blade that completely fills the slot. If necessary, blunt the screwdriver tip on a piece of masonry or heavy metal.

Wild oscillation, or hunting with too much gain, is caused by souped-up acceleration which makes the indicator overshoot the balance point by a wide margin. As the pointer backs up to the point of balance, it continues to overshoot.

If the system is still sluggish, despite careful adjustment of the gain control, the trouble is probably caused by capacitance unbalance. Although we usually

Digital number-wheel type electronic weight indicator. *Strecter-Amet Co.*

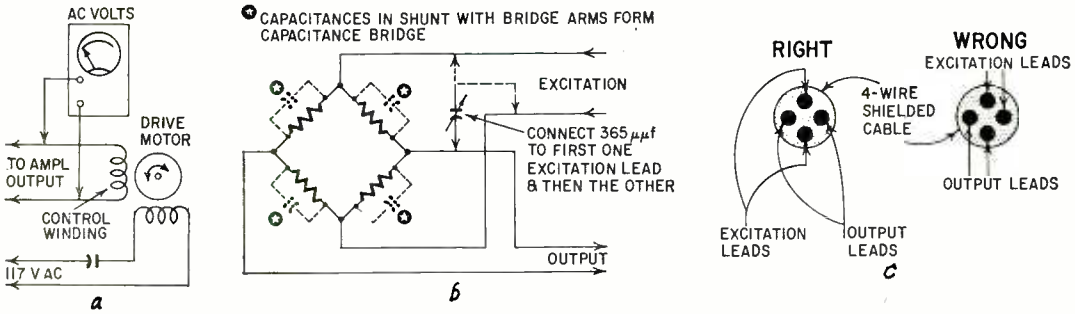


Fig. II-1—Service hints: a—connect ac voltmeter across the motor's amplifier (or control) winding to measure quadrature voltage; b—method of using variable capacitor to balance stray capacitances; c—stray capacitances in load-cell cable balance best if cable is wired right.

think only of the output voltage from the load-cell resistors, there are also capacitances everywhere in the circuit and they are especially high in the cables feeding the load cell.

If these capacitances are not adequately self-cancelling, they introduce out-of-phase signals (called quadrature currents) that overload the amplifier and mask the signals from the load cells. Besides masking the resistive signal, they cause the true instrument zero to shift somewhat.

First, diagnose the excess quadrature by connecting an ac voltmeter across the motor's control winding, as in Fig. II—1-a. (For the Cox Stevens unit, measure the output of the 400-cycle amplifier with an oscilloscope and follow the instruction manual.) If the meter reads more than about 35 volts with the motor at rest, you can be almost certain the quadrature is excessive. (The motor does not turn with even this much voltage across the control winding because of the phase difference.)

Reduce the capacitance unbalance by connecting a 365-$\mu\mu$f tuning capacitor (Fig. II—1-b from one output lead to first one excitation lead and then the other. Watch the motor volts as the capacitor is rotated. (Do not touch the capacitor directly. Use a large nonmetallic knob.) The connection and capacitance that give lowest motor volts should be noted and a fixed capacitance substituted and wired in permanently across a suitable terminal strip in the instrument. The capacitor should be mica or, even better, silver mica. When it is installed, check the motor volts again to be sure the reading is still as low as possible.

For multiple load cells, series-connected, it may be necessary to juggle capacitor values on all load cells for a really low motor-volts reading.

It is sometimes possible to balance the capacitance so close that the motor-volt reading is almost zero. This is excellent for the moment, but the balance will vary as cable and instrument capacitances change with temperature and time. Therefore, you may be called to rebalance the capacitances perhaps a year or so later.

Fig. II—1-b shows how the stray capacitances form a capacitor bridge around the load cell. The capacitances can be kept more closely balanced if the cables to the load cell are connected as in Fig. II—1-c.

Dirty slide-wire

Another common trouble is a dirty slide-wire. It usually shows up as erratic or jumpy action at particular positions of the indicator dial or wheels. If the slide-wire is exposed, clean it with a *Pinkpearl* type eraser available from drawing-supply stores. *Use nothing else.* Abrasion may damage or ruin the calibration.

A thin film of petroleum jelly may be used as a slide-wire lubricant.

Often, the slide-wire is a 10-turn type sealed potentiometer. It may sound like a quack idea, but often these expensive potentiometers may be completely cured of noisy spots by applying Quietrole around the shaft bushing slowly, but liberally, with the shaft in a vertical position. Then, rotate the pot and tip it in several directions to distribute the few drops of cleaner–lubricant inside.

If you have to remove any wires, always tag their original positions clearly. The precision resistors in the measuring circuit must be protected from excessive soldering temperatures by holding their terminals with long-nose pliers. Any replacement of the slide-wire, a precision range resistor, the distribution transformer or a load cell make it necessary to recalibrate the instrument range with dead weights. This is expensive and time-consuming. *So stay away from changing these components.*

However, be on the lookout for moisture or water in cable connectors and junction boxes. Leakage of 100,000 ohms from an excitation lead to an output lead can push the system completely off range. Furthermore, look for intermittent or corroded connections and even a broken or cut cable.

If you enjoy working on new types of electronic equipment, you will certainly get a kick out of electronic weighing systems. (Some technicians, in fact, feel they have been kicked once too often by electronic weighing.) It is undoubtedly one of the most interesting pieces of new electronic equipment to appear in industry.

A few companies active in this field are listed below.

Baldwin, Lima, Hamilton
Electronics & Instrumentation Div.
Waltham, Mass.

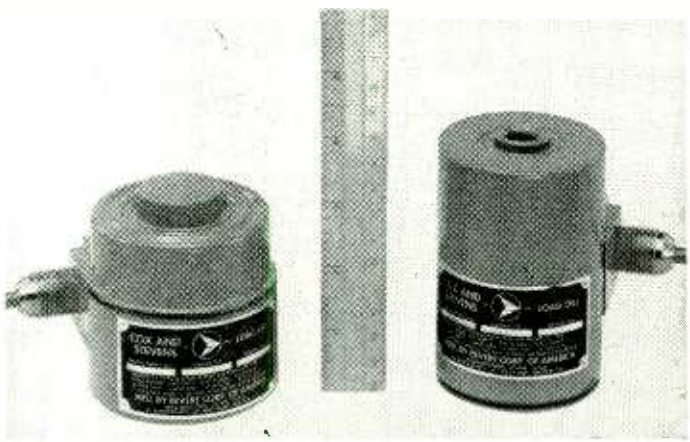
Cox & Stevens Weighing Equipment Revere Corp. of America
Wallingford, Conn.

Gilmore Industries
5713 Euclid Avenue
Cleveland 3, Ohio

Streeter-Amet Co.
Grayslake, Ill.

Tatnall Measuring Systems Co.
P.O. Box 245
Phoenixville, Pa.

END



Precision load cells. Compression type unit on left (about 3 inches high) has rated capacity of 50,000 pounds. Tension type load cell on right.

Cox & Stevens Weighing Equipment Photos

Portable aircraft weighing kit has guaranteed accuracy of 0.1% of applied load.

ELECTRONICS

SIMPLE TRANSISTOR TIMER

Simple unit for home or shop uses only one transistor

By JOSEPH BRAUNBECK

BUILDING an electronic timer is a satisfying project for every electronic hobbyist. A good timer can be used for cooking eggs, enlarging photographs or hundreds of other purposes. It should not be a bulky piece of equipment with a big appetite for power, but a neat little self-contained unit. A junction transistor makes this possible.

To understand the transistor circuit it helps to discuss an equivalent vacuum-tube circuit first.

Fig. 1 shows a capacitor connected between grid and cathode of a triode, parallel to the grid resistor. If switch S is momentarily closed, the capacitor will be charged and V's grid becomes negative.

If the BATT 1's voltage is high enough the tube will be blocked for

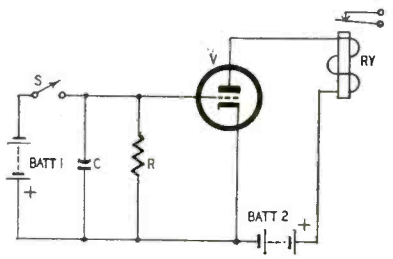


Fig. 1—Basic vacuum-tube timer circuit.

some time—until the capacitor has discharged through resistor R. The length of time the tube remains blocked depends on the values of R and C. The greater R and the greater C, the longer the time.

If a relay is connected in the tube's plate circuit, it switches any device on or off for the time determined by R and C.

Transistor circuit

The tube circuit is easy to transistorize. A p-n-p junction-transistor behaves very much like a vacuum tube with reversed polarities. Think of the emitter as cathode, the base as grid and the collector as plate. Consequently

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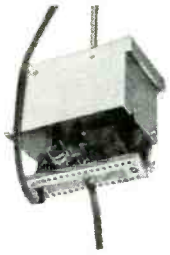

Brilliant, clear reception in fringe and weak signal areas — more than 10 db gain on all VHF channels. Utilizes advanced RF amplifier circuit with frame-grid tube for maximum signal-to-noise ratio. Can be mounted up to 500 feet from remote control unit. 53.95 list

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300 ohm coupler provides low-loss, matched installation for superior two-set performance. Delivers more signal to each TV or FM set, with greater inter-set isolation than other couplers. No ghosts, no smears. Ideal for outside or indoor mounting, color TV, FM. 3.50 list

Model A-104 — 4 set coupler, list 4.50; Model A-105 high-low antenna list 3.50; A-107 UHF-VHF Mixer, list 3.50; A-100 Outdoor Mounting Kit, list 90¢

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Powerful all-channel amplifier ideal for small TV systems (garden apartments, motels, TV showrooms), provides 8 isolated TV outlets from 75 or 300 ohm input and delivers more than 10 db gain on all VHF channels. Requires no tuning or other special accessories. 94.50 list

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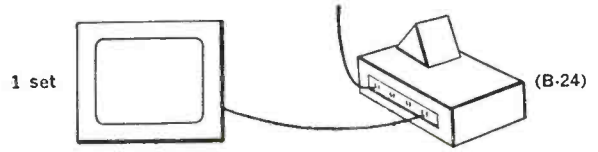
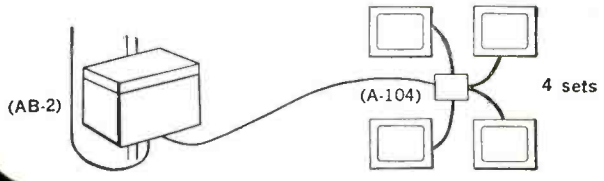
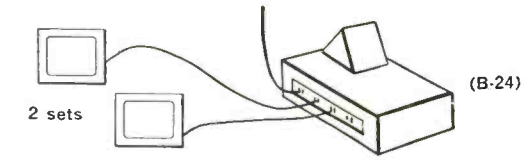
WEAK SIGNAL AREAS

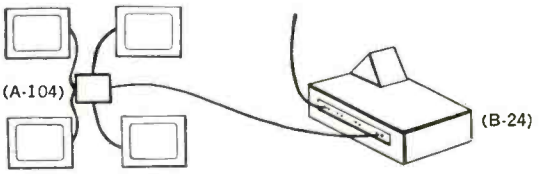
INTERMEDIATE SIGNAL AREA





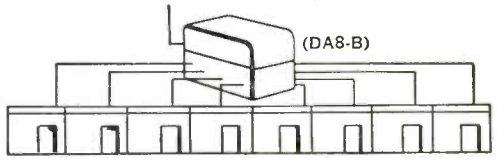
PRIME SIGNAL AREA





WEAK, INTERMEDIATE, PRIME SIGNAL AREAS

Small TV System — 8 sets



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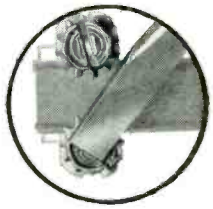

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ELECTRONICS

a positive base voltage will block the transistor, as a negative grid voltage blocks a tube.

Fig. 2 is the transistor version of Fig. 1. If you close switch S, capacitor C is charged and the transistor is cut off. Capacitor C discharges through resistor R. After a certain time, which depends on the values of R and C as well as on the electrical properties of the transistor, collector current starts flowing again and the relay is energized.

A difference between the tube and transistor circuit is that the transistor is not blocked completely. Collector current of a few microamperes remains. Without a blocking voltage, the

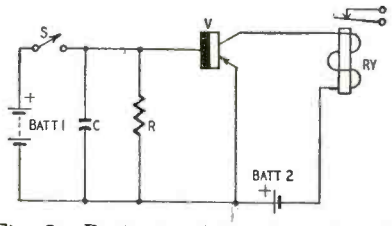


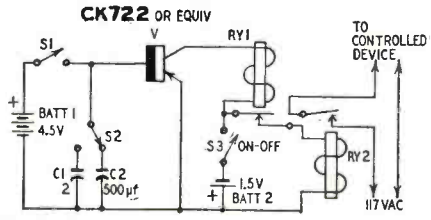
Fig. 2—Basic transistor timer circuit.

collector current is several hundred microamperes.

Another difference between tubes and transistors lies in the fact that there is not as perfect isolation between base and emitter as there is between a tube's grid and cathode. In fact, an appreciable part of the discharge current flows through the transistor's input circuit. It is even possible to omit resistor R and discharge the capacitor through the transistor input. We used this method in our experimental models.

Discharge time is proportional to the capacitor value, as larger capacitors take longer to discharge. Discharge time also varies with transistor type and slightly with different transistors of the same type.

A practical circuit for a transistor timer is shown in Fig. 3. A CK722



C1, 2, 3—see text
RY1—spst, sensitive plate relay, 0.1 ma, normally closed, 5,000 ohms or less
RY2—spst, power relay, normally open, operate from battery or ac line
S1—spst, momentary contact, pushbutton normally open
S2—single-pole rotary, as many contacts as necessary to supply desired delays
S3—spst, toggle
V—CK722
BATT 1, 4.5 volts, 3 penlight cells in series
BATT 2, 1.5 volts, penlight cell.

Fig. 3—Circuit of a practical transistor timer. Delay capacitors discharge through transistor.

p-n-p junction transistor is used. Collector supply voltage is 1.5 (a single flashlight cell). Blocking voltage is 4.5 (three penlight cells). Charging capacitors for different delays may be selected with a single-pole rotary switch. Elec-

trolytic capacitors are preferred because of their smaller size. Many low-voltage miniature electrolytics are now available.

In the transistor's collector circuit there is a relay which actuates contacts at a current of 0.1 ma. As the delicate contacts of the relay (RY1) would burn if you switched power on and off with them, a second relay (RY2) is triggered by RY1.

As the transistor is blocked during the timing, RY1 must be a normally closed type. If a signal is desired after a certain time, RY2 may be replaced by a buzzer or pilot light.

Calibration

With the help of a stop watch or a similar timekeeper, calibration is easy. For each delay the capacitor's value may be determined by trial and error, either selecting the capacitor from a large stock or by combining smaller values.

Once calibrated, the timer will stay fairly constant, though there is a small temperature sensitivity. END

PREDICTS END OF SERVICE

NATESA Scope reports, in an item signed by Frank Moch, "The other day in Chicago Robert Galvin, president of Motorola, made a number of statements which I believe should be taken to heart by all independent home electronics service people. What he said was not really news; NATESA has been saying it for years. The important thing here is that it came right from the horse's mouth as a statement made by a man who is in a position to know and as one who will play a definite role in making these predictions come to pass. Mr. Galvin said in part:

"'There's a direct relationship between the number of tubes in a radio or TV set and the frequency with which the repairman comes to your house.

"'In about 5 years, there's no reason why radio and TV receivers shouldn't be virtually service-free. As an intermediate step, there's a good chance TV's may be self-serviced. You merely unplug a unit and replace it with another.

"'Our goal is to leapfrog this and go right to service-free units.'

"I hope that the full implications of the above hit a responsive chord in your mind. Here is a man who knows whereof he speaks, who has seen the development of the changes that will at long last free you of the nasty problems of fixing those 'lousy' sets. Such engineering achievements as perfected snap-in printed boards, stabilized superminiature components, modules, transistors and other solid-state devices, plus other developments already on the drawing boards waiting for the right moment to break through, will change your life.

"They will free you of today's urgent need to fight like hell against such things as captive service, unfair distribution practices, drugstore tube peddlers, phony trade schools, adverse publicity and other ills of the industry. One consolation, if service people who too often are lethargic about their own welfare want one, is that when trouble-free home electronic devices do become a reality, captive service, unfair distributors, drugstore tube peddlers, phony trade schools, unfair competition and other things which now hurt you will also be out of business. Won't that be wonderful?"

ELECTRONICS

Hints from a Transithusiast's Workshop

By MARTIN KLEIN

I HAVE worked with transistors for several years. During this time I have had to resort to many tricks and kinks to solve various problems. As I have found them useful, I am sure that many other experimenters and hobbyists will also find them helpful and time-saving.

Mercury batteries: To prolong the life and facilitate the use of mercury or other transistor batteries, try this trick. Clean the ends of the battery and strip the end of a piece of red wire and a piece of black wire (any colors will do so long as you know which is plus and which is minus). Now place these ends alongside the ends of the battery and tie them tightly with enamel wire or heavy thread. Check with a meter to see that the leads are making contact. Next, holding the wires, dip the whole battery in In-sulex or a similar heavy plastic tool dip. Remove the battery and let the plastic harden. When it does, the battery will be sealed in a moisture-proof case with handy color-coded leads. This is especially useful for the tiniest mercury batteries which are easily ruined by the heat of soldering.

Transistor sockets: If bent properly, transistor sockets fit into each other to form excellent subminiature plugs and jacks. The jack is wired exactly as an ordinary socket. The plug is another transistor socket with leads soldered carefully in place. These sockets are sold with as many as eight leads. They can also be used as subminiature switches by bringing the switch leads to the socket and shorting the corresponding pins (see Fig. 1). Here, plugging in the headphones turned on the unit. A little improvising could probably devise many other uses for these little sockets.

Saving transistor leads: If you have a transistor with fragile leads (this includes most of them) which you frequently push in and pull out of its socket, here's how to save yourself worry, money and trouble caused by broken leads. Using the previous kink,

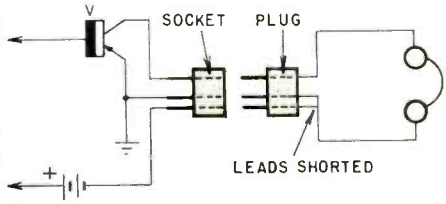


Fig. 1—How transistor sockets can be used as plug, jack and switch.

you can insert the transistor in a socket and tape it in place. Now the socket becomes the bottom of the transistor, and you can unplug and plug the unit to your heart's content without worrying about breaking the transistor leads.

Another way to protect transistor leads is to shape a small wooden block to the same size as the bottom of the transistor and about ¼ inch thick. Next drill three thin holes spaced as the transistor leads are spaced. Place the leads through the holes and glue the block in place with a nonpermanent glue such as rubber cement. Now if a lead breaks, it will break flush with the wood instead of the transistor. If this happens, remove the block and trim all the leads to the length of the shortest one. The transistor leads are still long enough for use in a socket.

Current measurements: Measuring the current on each transistor electrode in a circuit is done quickly and conveniently with the gadget shown in Fig. 2. You will need two transistor sockets, six tip jacks and three toggle or slide switches. One socket is used as a plug and the other holds the transistor. The latter socket along with the jacks and switches is placed on a panel. The switch of the lead whose current is being measured is left open while the other two are closed. The current meter is plugged into the jacks going to the lead under test. It is best to use a multimeter with this instrument since transistor current ranges from microamps to over an ampere for power transistors.

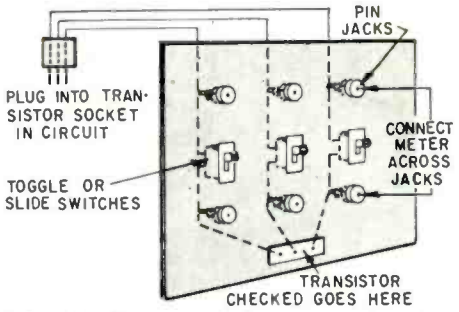


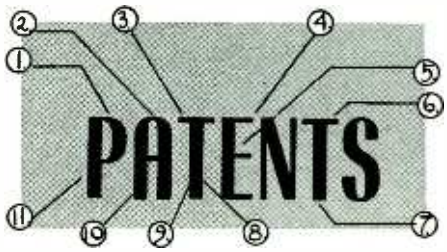
Fig. 2—Test panel for measuring in-circuit current at transistor electrodes.

Broken leads: Once in a while, despite precautions, a transistor lead will break off flush with the case. It is usually possible to remedy this. Take a piece of thin copper or brass about 1/16 inch wide and put a small dimple in it near one end. Lightly file the bottom of the transistor. Now press the dimple on the tiny dot of metal showing at the bottom of the broken lead and tie the strip tightly to the transistor. Then test it to see if it has made contact with the exposed metal. If it has, cover the whole bottom with a thick coating of glue or tool-dip plastic. If it does not make contact, keep untying and tying until it does. The new lead will not be as sturdy as the original lead, but at least it will render the transistor usable. Unfortunately this method will not always work, but it is certainly worth a try. It will not work on metal-bottom transistors. If all attempts at fastening a new lead fail, you still may be able to use the two remaining leads as a diode.

Wire for transistor circuitry: A good supply of wire for miniature transistor circuitry can be obtained by purchasing several feet of No. 22 conductor telephone cable. This will give you many short lengths of strong, thin wire. You will also have wire of many colors to allow for color-coded leads.

Saving resistor space: When building one of those tiny transistor items, it is often annoying to have resistors take up so much space. You can solve this problem by standing them on end in groups. For instance, there are usually several resistors in a circuit which have a common meeting point. With all of them standing up and attached as a group, a lot of space can be saved. This will not complicate wiring too much if the unit is centralized. The same idea can sometimes be applied to the miniature capacitors in these devices. Just remember when miniaturizing that any empty space above a part is wasted space, so don't hesitate to stack components.

Well those are my ideas for now fellas. Hope you can use them. Good luck and happy semiconducting! END



NUCLEAR BATTERY

Patent No. 2,876,368

Alexander Thomas, Weston, Mass. (Assigned to Tracerlab, Inc., Boston)

This battery is made from an electret to which a radioactive isotope has been added. An electret is made of molten wax which is allowed to solidify in an intense electric field. When it reaches the solid state, the wax molecules remain polarized and the electret behaves much like a charged capacitor. Its charge can be maintained only across an open circuit, so the electret is not a source of *power*.

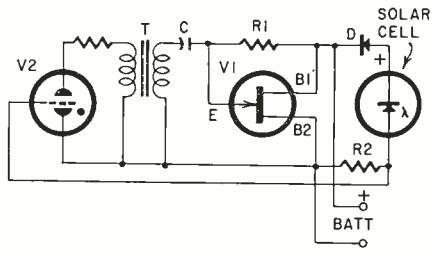
To produce steady power, this electret contains a radioactive isotope, which is mixed with the wax. Due to continual ionization, charged particles are available, and a continuous current can flow into the external circuit.

AUTOMATIC SOLAR-POWERED FLASHER

Patent No. 2,889,490

Maurice E. Paradise, Highland Park, Ill. (Assigned to Hoffman Electronics Corp.)

In this interesting application of solar power, a solar cell is combined with a storage cell (such as nickel-cadmium) to energize a flashing



light. During the day, the solar cell charges the battery and the lamp is extinguished. At night, the lamp is lighted by power from the battery.

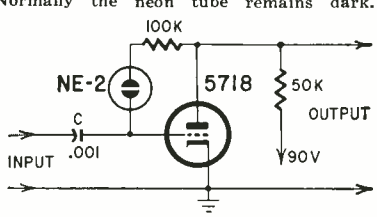
The solar cell can charge the battery, but the battery cannot discharge through the solar cell because of diode D. The battery energizes a double-base transistor (Unijunction) V1 connected as a self-oscillator. Transformer T steps up this ac and applies it across a triode gas tube V2. This tube flashes intermittently except when its grid is biased negatively. Note that this occurs only while the solar cell is charging the battery.

PULSE AMPLIFIER

Patent No. 2,890,295

Paul E. Murfin, Rochester, N.Y. (Assigned to USA, as represented by Secretary of Navy)

This low-frequency amplifier features high input resistance and minimum blocking time. Normally the neon tube remains dark. A



positive pulse at the triode grid increases plate current, and grid current begins to charge capacitor C. At the end of the pulse the grid reverses polarity because of the negative charge on C, and the tube *blocks*. *To maintain high input resistance the tube is operated without a grid leak.*

Now, there is a large potential across the neon lamp, one terminal being at negative grid voltage and the other at full positive, 90 volts (since the tube is blocked). The lamp fires, letting C discharge. The capacitor starts to charge with opposite polarity (positive on the right terminal), causing full triode saturation. Tube voltage drops quickly and extinguishes the neon lamp.

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PATENTS *(Continued)*

The blocking interval is thus kept short, and the tube is ready for the next pulse.

RADIO PAGING SYSTEM

Patent No. 2,883,523

Francis P. Meserow, Chicago, Ill.

This system is suitable for hospitals, TV studios, etc. The desired area is wired with a loop around the ceiling or wall. The carrier, about 100 kc, is modulated and impressed on the loop. A tiny pocket-size receiver will pick up this signal on an earpiece for private listening so that other persons are not annoyed or bothered.

The inventor recommends a 4-tube circuit comprising 2 rf amplifiers, a grid-leak detector and an audio output. A transistor circuit could be designed to perform well, also.

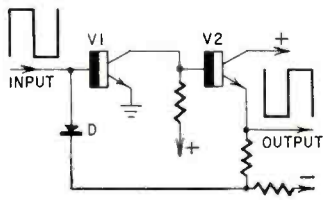
NONSATURATING SWITCH

Patent No. 2,887,542

Royer R. Blair, Berkeley Heights, and James R. Harris, Morristown, N.J. (Assigned to Bell Telephone Laboratories, Inc.)

In this switching circuit, diode D is normally blocked. V1 is cut off. V2's base is positive, so it conducts.

When a positive signal is applied to V1, it conducts and drives V2's base negative to cutoff.



In other circuits, a very large positive signal would drive the transistor to *saturation*, which is undesirable, because it leads to carrier storage effect. At saturation there are so many carriers in the semiconductor that considerable time is required to sweep them out. This delay in switching from on to off is avoided here.

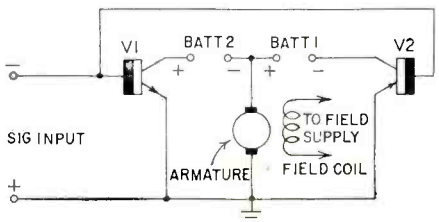
When the input goes highly positive, D conducts. This shorts out much of the input pulse and prevents saturation. Thus V1 can be blocked instantly if the input signal goes negative or is removed.

TRANSISTOR MOTOR CONTROL

Patent No. 2,875,391

Jack C. Brannan, Schenectady, N. Y. (Assigned to General Electric Co.)

This system can control a motor in either direction. V1 is n-p-n. V2 is p-n-p. The difference



in their collector currents flows through the motor armature. The motor will reverse direction when the armature flow reverses.

A negative signal produces more current in V2 than V1 and the motor will rotate in a given direction. A positive signal produces an opposite result. END

"I think I've found your trouble, Mrs. Grimly."

Technotes

WEAK SIGNALS ONLY

An unusual complaint turned up recently when a battery radio was brought in with an intermittent. It worked all right on distant stations, but the local station failed to come in. In fact the radio went dead when a local broadcaster was tuned in. Voltage readings showed an intermittently open output transformer.

The audio output transformer had an open in the primary, which was just barely making a connection. On weak signals there wasn't much output, so the open still made a contact, but when the local station, which put out a signal several times stronger, was tuned in, the extra sound output opened the circuit.—*Alfred L. Hollinden*

COLOR-BURST TIMING

Not all color bar generators have the color burst located exactly as in a TV station transmission. When you run into this problem, it must be rec-

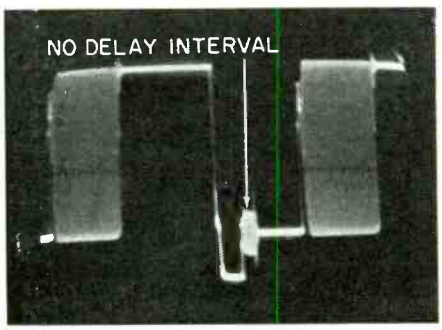


Fig. 1

ognized and allowed for to insure good color sync.

As in Fig. 1, your color bar generator may supply the burst immediately following the sync pulse, with no space between. Or, the generator may provide a definite space here, with a later burst (Fig. 2).

The burst amplifier is gated. The timing of the gate pulses changes as the horizontal hold control is carried in one direction or the other. The tim-

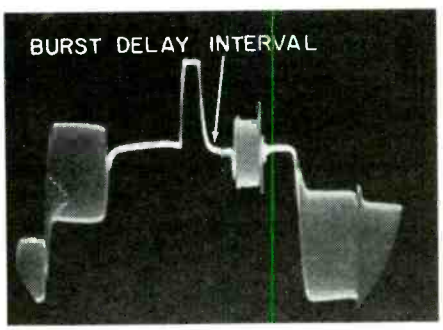


Fig. 2

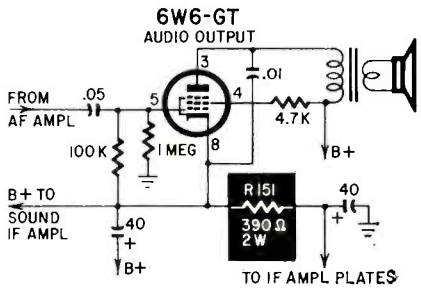
ing of the gate pulse must coincide with the burst to obtain good color sync lock.

When you set up a color receiver with an unknown color bar generator, make a preliminary test to determine whether a color TV program locks best with the horizontal hold control set at the same point as for best lock using the generator. This may or may not be so. Best lock point is determined by cutting down the antenna signal until confetti begins to appear in the picture. The color sync lock should be maintained with confetti present. Adjust the horizontal-hold control for best lock. With some color bar generators you can run into annoying callbacks unless discrepancies in burst timing are taken into account during installation.—*Robert G. Middleton*

CROSLEY 356-1

Complaint: Weak picture and sound or no picture or sound. Can be intermittent.

Reason: Low voltages in tuner, video



if stages. Caused by increase in resistance of R151 in the cathode circuit of the audio output tube. It should be 390 ohms, 2 watts.—*Harry C. Keller*

REPLACING SILICON RECTIFIERS

Most TV sets that use silicon rectifiers use a pair in a voltage-doubler arrangement. If either one of the two goes bad, replace both units as failure of one unit usually causes damage to the other. For a small additional cost, you protect yourself against a callback, and the customer against frequent repairs.—*C. S. Lawrence*

HOT-CHASSIS HAZARD

TV sets with the chassis connected to one side of the ac line can be a severe shock hazard. According to Underwriters Laboratories requirements, all metal parts that are exposed to the user must be insulated from the chassis. If you work on one of these sets, it is your responsibility to see that none of these safeguards is removed. Check tuner shafts, other front-panel control shafts, chassis mounting bolts, control escutcheons, picture-tube mounting brackets and frame and the interlock and antenna terminal board brackets. They should be insulated from the chassis, as they are exposed or in contact with the metal cabinet.

On some chassis, a high-value resistor and a parallel capacitor are connected between the insulated parts and the

chassis, to provide a leakage path for static charges while keeping them at rf potential. However, the resistance between the insulated parts and the chassis should never be less than 30,000 ohms.—*Larry Steckler*

MONTGOMERY-WARD MODEL GRX-4030A

Complaint: loss of video and audio.

If you run into one of these portables with this trouble, check the capacitor between the screen of the 6U8 (second if) and ground. It is a 1,000-$\mu\mu$f disc, but as temperature increases during set operation, its value drops to about 550 $\mu\mu$f. This is insufficient bypass for the 6U8 and the tube begins to oscillate.—*W. Shingler* 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 October, 1909, *Modern Electrics*

Combined Wireless Telephone and Telegraph Service, by Frank C. Perkins.
Construction of a Rotary Variable Condenser, by Bernadotte Anderson.
A (Wireless) Lecture Set, by Burt K. Bunch.
Thermo Battery in Wireless Work, by G. B. Sayer.
Wireless Telephone in the Navy by Frank C. Perkins.
Wireless Stations About New York: No. 3, Station at 42 Broadway.
Torpedo Run by Wireless.
The Automatic Operator, by O. A. Shann.
Improved Electrolytic Detector.
New Method for Producing High Frequency Oscillations.
New Method for Influencing Emitted Waves.
New Wireless Station in Spain.

From RSGB Bulletin, Mar. '59

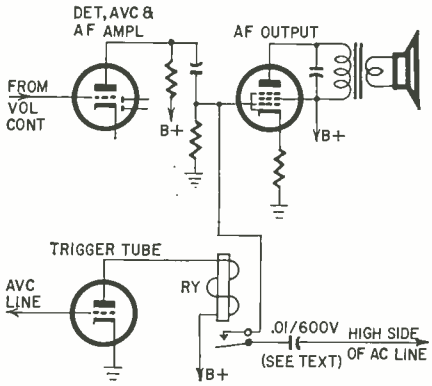
"Well, I've shielded everything here but there's still a trace of hum."

The important November issue of RADIO-ELECTRONICS on sale October 27

NOTEWORTHY CIRCUITS

CIVIL DEFENSE ALARM

Many CD members build their own CD monitors by converting low-cost table-model radios. They merely add a relay and a control tube which is keyed by the set's avc voltage. One other item is required—a bell or buzzer to give the actual warning. If the bell or buzzer could be eliminated, the cost of the conversion could be greatly reduced.



To do this, use the radio's speaker as the alarm (see schematic). An ac signal is obtained from the high side of the ac line and is fed to one of the relay contacts by a capacitor. When the relay is energized, it applies the ac signal to the grid of the audio output tube. This produces a loud 60-cycle buzz from the speaker, which serves as an excellent alarm.

The radio's volume control has no effect on the alarm signal as it is in the grid circuit of the preceding stage. The coupling capacitor I used was a .01-μf 600-volt unit, but the value chosen should be one which produces the required buzz level.—*Albert J. Krukowski*

IMPROVED METAL LOCATOR

After building Edwin Bohr's metal locator (March, 1958, issue, page 62), I ran into trouble—not enough gain. I used CK768's in both oscillators and,

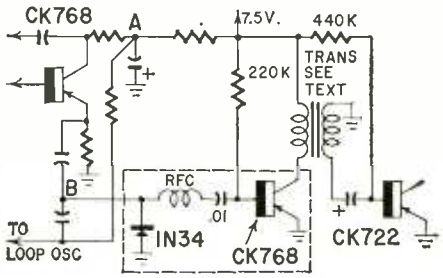


Fig. 1

having only a few CK722's and a 2N170 left, I tried a CK722 in what may be called the mixer (see Fig. 1). Very little signal was passed. I tried the rf 2N170 (an n-p-n unit) and the gain improved. As I still wanted a little more gain, I tried a 1N34 diode as a

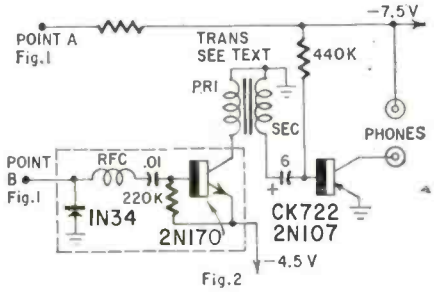


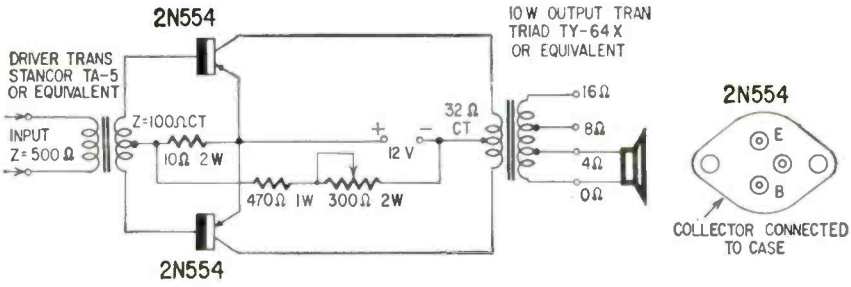
Fig. 2

mixer and found that an rf transistor was still the best bet.

By using the rf transistor, I did get enough gain so that only two audio stages were needed following the diode. In Fig. 2 you can see how I used transformer coupling to increase gain further. A vertical blocking oscillator transformer was handy, and it worked. I used the highest impedance side in the collector circuit.—*W. G. Eslick*

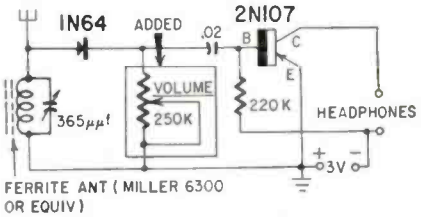
PUSH-PULL AUDIO AMPLIFIER

This amplifier delivers 5 watts with 10% or less total distortion. Power gain is approximately 20 db and the current required from the power supply varies from approximately 200 ma at no signal to about 1 ampere at full output. Input and output transformers are selected for good matching and performance at reasonable cost. (The driver transformer specified has a 1,000-ohm primary and 200-ohm secondary but is suitable here.)—*Motorola Semiconductors*



IMPROVED TRANSISTOR SET

I began fooling around with simple transistor receivers a while back and haywired a circuit that came with the transistor I was using. The set worked a little too well—it played too loud and needed some kind of volume control. I tried a couple of arrangements and ended up by connecting a 250,000-ohm volume control as in the diagram. As well as a volume control, I got an increase in volume and the output now drives a small speaker. Also, some distortion is eliminated with this arrangemen.—*G. Etherington* END



SYRACUSE HAM FEST

On Oct. 10 the Syracuse Vhf Club will hold its fifth annual *Vhf Roundup.* There will be food, prizes and entertainment along with a full schedule of events for amateurs and their wives. Any ham may participate by contacting club president R. C. Stewart, K2PKL, for preregistration, at 114 E. Newell St., Syracuse, N. Y.

How far can you go in electronics . . .

Two years ago, Field Engineer William G. Miles was asked to outline *his* thinking on how far he could go in electronics at IBM . . . without a degree. Now, he reviews the progress he's since made. His present position: Group Manager, responsible for keeping one of America's largest electronic computers in top operating condition. Here's his story.

HURDLING THE DEGREE BARRIER. "A few years ago," recalls Bill Miles, "I felt that I'd gone about as far as a technician could without a degree. I just couldn't hurdle that education barrier. Now, thanks to IBM, I have a solid electronics education. I'm a Group Manager on the SAGE project, responsible for 20 field engineers. My future looks brighter than it ever did. I don't know of another company where a technician can go farther or receive more recognition, without a degree, than at IBM."

UTILIZING HIS NAVAL TRAINING. Bill Miles spent three years as a Naval Aviation Radar Technician. After discharge from service, he worked as a TV serviceman, at the same time pursuing an engineering education at night. "I knew there were good career opportunities around somewhere, but I couldn't find them," Bill Miles says. "I investigated several big companies. They were impressed with my ability, but my lack of a degree kept me from the kind of a career I wanted. Then I answered an ad similar to this."

EXTENSIVE ELECTRONICS SCHOOLING. In May, 1955, he joined IBM and began an extended training course. "The teaching was as technically advanced as I could ask for. Each day, I gained a deeper knowledge of electronics and added to my professional stature. IBM shows real interest in you as an individual: what your goals are, what plans you've made to reach your goals, how the company can help speed you toward them or even higher goals."

ASSIGNED TO SAGE SITE. After his training, Bill Miles was assigned to a SAGE site. SAGE is an important link in America's air defense, and the heart of SAGE is a real-time computer made by IBM. The SAGE computer analyzes radar data with uncanny accuracy, checks it against available air traffic information, and presents visual displays to assist the Air Force in identifying flying objects as friend or foe.

UPGRADING TECHNICIANS. "The job of IBM field engineers is to keep SAGE computers running," he explains. "This involves maintaining, testing, and checking computer units. It means anticipating trouble before it occurs. The work turned out to be exactly what I was looking for. I had a chance to do work ordinarily done by graduate engineers . . . work usually denied to men without a degree. Of all the companies I know, IBM appears to be one of the few which upgrades technicians to levels of engineering responsibility . . . levels dictated not by your formal education but by your native talents."

MANY EDUCATIONAL OPPORTUNITIES. "SAGE field engineers have many opportunities for education beyond the 'basic' training, which lasts 20 weeks," says Bill Miles. "After a year or two in the field, they may be selected for further training to learn how the complete SAGE electronic computer system works. To

Bill Miles reviews two-year-old article about his IBM career.

without a degree?

keep up with the most advanced electronic developments, they may also attend classes during working hours."

RAPID ADVANCE TO GROUP MANAGER. In his four years with IBM, Bill Miles has received several promotions. He is now Group Manager at a SAGE site. "My advancement is an example of IBM's policy of promoting from within," he says. "The company is quick to recognize a man's contributions and quick to reward him. This means lots of opportunities for new men who show potential for advancement along clearly defined routes—both in the technical and managerial areas. There are no limits set on your future. Everything IBM has ever promised about advancement in field engineering, I've seen happen—either to me or to someone I know."

• • •

If you have a minimum of 3 years' technical schooling after high school—or equivalent experience—you may be eligible for 20 weeks' training as a Computer Units Field Engineer. While training, you receive full salary plus living allowance and overtime pay.

IBM is the leader in a field that offers you unlimited horizons. And, as you may already know, at IBM you receive company-paid benefits that set standards for industry today.

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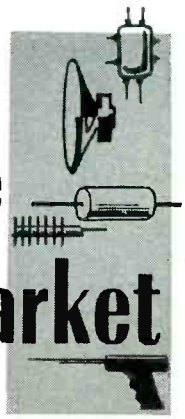
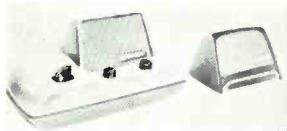
INTERNATIONAL BUSINESS MACHINES CORPORATION

On the Market



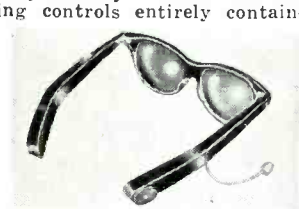
ORGAN PARTS KITS. Consoles, keyboards, and other "specials" included, along with coils, chassis and *Organ Builders' Manual* which lists all special parts.—**Electronic Organ Arts,** 4949 York Blvd., Los Angeles 42, Calif.

LOW-COST INTERCOM system uses *model CHM6* as master for up to 6 stations, *model CHM12* up to 12 stations. Each has 3 amplifier tubes plus selenium rectifier, 5¼ x 10½ x 4¾ in. *Model CHR* remote stations



match masters, have call-initiating bar across full width of case. *Challenger* line systems handle all standard intercom situations.—**Bogen-Presto Co., Div. of Siegler Corp.,** Box 500, Paramus, N. J.

SUNGLASS RADIO. *FS-201 Specta-Radio* 3-transistor set has germanium diode and mercury battery. Volume and tuning controls entirely contained

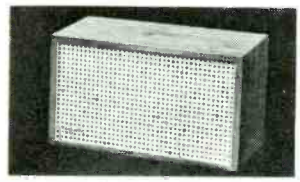


in frame of glasses.—**Lafayette Radio Corp.,** 165-08 Liberty Ave., Jamaica 333, N. Y.

ECONOMY MICROPHONE *X-206* all-purpose crystal unit may be hand-held, used with clip-on desk stand, or as lavalier.

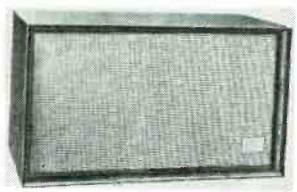
Response 65 to 10,000 cycles, output —55 db. 5 11/16 in overall.—**American Microphone Co.,** 412 S. Wyman St., Rockford, Ill.

3-WAY BOOKSHELF SPEAKER system *model XP-1* includes 12-in woofer, 5-in mid-range, 3-in tweeter, 3-stage crossover. Balance control allows adjustment of highs. Crossover frequencies 1,800 and 5,000 cycles. Response from below 30 cycles to beyond audibility. Handles up to 60 watts program material. Cabinet sealed, ¾-in wood,



filled with Acoustiglass to eliminate resonances.—**Fisher Radio Corp.,** 21-21 44th Dr., Long Island City, N. Y.

COMPACT SPEAKER SYSTEM *Esquire 200.* 3 separate drivers; 12-inch woofer, 8-inch



mid-range and diffraction horn compression tweeter. 12½ x 13½ x 24 in.—**Electro-Voice, Inc.,** Buchanan, Mich.

2-WAY 8-INCH SPEAKER *model SK-128* mounts 2-in tweeter off-center inside 8-in woofer. Level control for tweeter. Response 40 to 16,000 cycles. Cone resonance 45–65 cycles, depending on baffling. Rated 20

watts program material.—**Lafayette Radio, Corp.,** 165-08 Liberty Ave., Jamaica 33, N. Y.

TAPE PREAMP *model TRP-11* for record and playback. VU meter, cathode-follower output, microphone input, recording-speed equalization switch. Response 50–15,000 within 3 db, output 5 volts, signal-to-noise

ratio over 50 db. Matches *series 900* tape decks. Use 2 for stereo. *Model TRP-21* for stereo record/playback similar to 2 *model TRP-11's* on 1 chassis. Other models for mono or stereo record, playback, or both available.—**Telectrosonic Corp.,** 35-18 37th St., Long Island City, N. Y.

FUTURA TRIPLETS...

three models... superbly styled... covering a wide range of applications

MODEL 588

MODEL 888

MODEL 788

ASTATIC'S FUTURA SERIES DYNAMIC MICROPHONES

Most versatile performers in the microphone field are the Astatic Futura Series Dynamic Microphones—Models Metro 788, Tempo 888, and Vogue 988. Beautifully styled, encompassing the newest and most advanced principles in microphone engineering, each model is designed to outperform any other microphone in its price class.

Futura mikes are instantly convertible from hand to stand to lavalier use... offer many special features such as rugged, stable, fatigue-free Mylar diaphragm and, on the 888 and 988, the Cannon XLR-3 connector for instant detachment from cable ("Take the microphone to the cable.")

Model No.	Type	Response	Output	Impedance	Finish and Trim	Price
788	Omni-Directional	60-13,000 cps	-55 DB	Hi or 150	Black and Gold	$ 79.50
888	Omni-Directional	50-15,000 cps	-56 DB	50, 200, Hi	Black and Chrome	110.00
988	Omni-Directional	40-20,000 cps	-58 DB	50, 150, 250	Black and Gold	150.00

NOTE — Exclusive Astatic impedance selector permits instant choice of impedance without special tools.

All three microphones come complete with lavalier and belt clip, 360° swivel adaptor for ⅝ #27 thread.

Twenty-foot, two-conductor, shielded cable supplied with each microphone.

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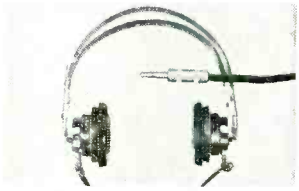
FROM WHAT YOU HEAR

ASTATIC MICROPHONES ARE A SENSATION ON ANY INSTALLATION

HI-FI PHONES *model HS-1*, extended-frequency moving-coil units. Response flat 150 to 11,000 cycles, useful 20 to over 15,000 cycles. Exceptionally sensitive with high power capability. 11

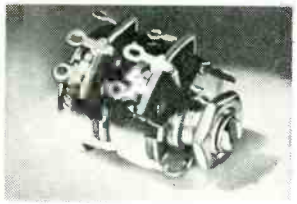


ohms. Separate conductors from each phone so 3-connector plug may be wired for stereo.—**Melody-Master Mfg. Co.**, 2842 N. Cicero Ave., Chicago 41, Ill.

ECONOMY STEREO AMPLIFIER *model AF-4*. 5 inputs, all medium level, plus 2 tape recorder outputs, stereo reverse, choice of channels for parallel

mono use, concentric clutched gain and tone controls. Output 4 watts per channel at less than 1% distortion; output impedances 4, 8, 16 and 32 ohms. Complete with metal cage. Factory-wired or kit.—**EICO** 33-00 Northern Blvd., Long Island City 1, N. Y.

STEREO BALANCE CONTROLS *type AD47* for single-



control balancing of 2 signals. Tandem-mounted pairs of 15/16-in ½-watt carbon potentiometers. As one control is increased, other decreased. Inserted at amplifier input or between preamp and amplifier. **Clarostat Mfg. Co., Inc.**, Dover, N. H.

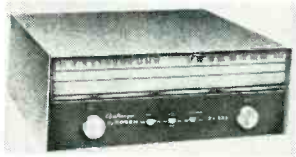
STEREO AMPLIFIER *model A230* dual 15-watt unit includ-

ing preamps. Friction-clutch type controls concentrically mounted to allow adjustment either independently or ganged. Usual stereo controls such as mode (mono, stereo, reverse, right and left). Also phono-radio selector; loudness, balance, bass and treble controls; loudness disable switch; 2 speaker switches (including switching of center speaker from left to right or off) and rumble filter switch. Optional metal cage.—**Harman-Kardon**, 320 Main St., Westbury, N. Y.

STEREO TUNER–PREAMP *model 690-A* complete control center with separate FM and AM tuning meters. Separate bass and treble controls for each preamp; gain, stereo bal-

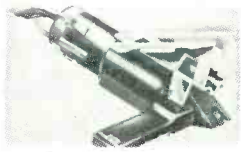
ance, mode and selector on panel as well as loudness switch, AM narrow–broad switch, FM interstation muting switch, and automatic cutoff controllable by record changer. Front panel switch for choice of 2 magnetic phono inputs (changer and turntable). —**Pilot Radio Corp.**, 37-06 36th St., Long Island City, N. Y.

ECONOMY STEREO TUNER *model Challenger TC322* has built-in FM line antenna, built-in ferrite AM antenna, auto-



matic frequency control (AFC) on FM, 8 tubes, 1 diode. FM sensitivity 5 μv, AM 7 μv per meter (external antenna). Matching stereo amplifier *AC-220* includes two 10-watt push-pull amplifiers, provisions for playing direct from any tape deck, separate bass and treble tone controls plus stereo reverse and other conventional controls. — **Bogen-Presto**, Box 500, Paramus, N. J.

CERAMIC STEREO PICKUP cartridge *model 10T* turnover type with 0.7- and 3-mil styli. Dual 0.7-mil tips and various combinations of sapphire–diamond. Entire cartridge pulled



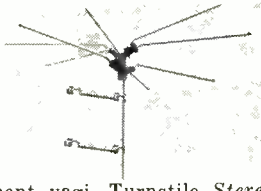
out and new one snapped in when jewel tips wear out. Total cost comparable to ordinary styli. Response 20 to 15,000 cycles. Output conforms to RIAA curve with no equalization required. Rated ½-volt output.—**Sonotone Corp.**, Elmsford, N. Y.

STEREO PICKUP STYLUS *Mk II T-Guard* in 2 models for Pickering stereo *Fluxvalves* for changers with tracking force of 3 to 7 grams or for transcription arms tracking at 2 to 5 grams. Improved compliance, higher output, better signal-to-noise ratio.—**Pickering & Co.**, Sunnyside Blvd., Plainview, N. Y.

STEREO MIXER TRANSFORMER for middle-channel speaker, *model XT-1* connects to outputs of stereo amplifier(s) to combine signals from both to

feed center-channel speaker. Designed for use with E-V *Stereon 200*, may be used with variety of speakers for program material up to 50 watts. Insertion loss from 1 to 3 db (for center channel).—**Electro-Voice, Inc.,** Buchanan, Mich.

FM ANTENNA LINE includes 8-element omnidirectional turnstile, dipole with reflector, 6-



element yagi. Turnstile *Stereocone* as attachment for mounting on present TV antennas or in full conventional mast form.—All antennas gold-anodized, factory-assembled.—**JFD Electronics Co.,** 6101 16th St., Brooklyn 4, N. Y.

UNIVERSAL MAST MOUNT for TV and FM antennas requires only hammer for erection, stands up to 100-mph

winds. Aluminum tubing secured with nail-screws with threadlike surfaces.—**Winegard Co.,** 3000 Scotten, Burlington, Iowa.

BATTERY TESTER *model WV-37B* tests radio batteries from 1.5 to 90 volts, reads replace, usable or good, as well

as exact percentage of rated voltage. Panel and switch have 8 blank positions for future voltages. Handles most transistor battery types and tube types.—**RCA Tube Div.,** 415 S. 5th St., Harrison, N. J.

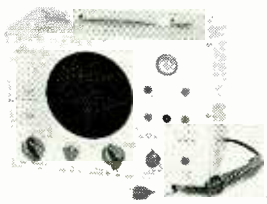
WAVEFORM ANALYZER *model 850* uses phantom detector

probe—a small loop—to locate circuit difficulties without direct connection to circuits. Used with scope, analyzer displays waveform at any point in TV set. Loop is moved from one stage to next, slipped over tubes, or placed near coils. Tunable to channels 2–13, all if, video, radio and audio frequencies.—**Winston Electronics, Inc.,** 4312 Main St., Philadelphia 27, Pa.

TUBE, BATTERY, VIBRATOR TESTER *model 13* has 5

storage drawers for tubes. Tube substitution, inventory and price guides in each drawer.—**Vis-U-All Products Co.,** 640 Eastern Ave., S.E., Grand Rapids, Mich.

TRACER-GENERATOR *model 802* high-gain audio amplifier



for signal tracing with both speaker and electron-ray indicator tube. In absence of signal, generates own 400 cycles for audio, modulated 455 kc for if checking, and 910 kc for AM rf stages. Either speaker or amplifier may be used externally for checking other components. Factory-wired or kit. **Electronic Measurements Corp.** 625 Broadway, New York 12, N. Y.

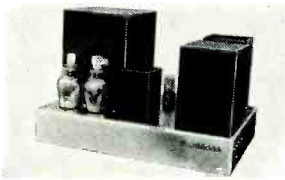
ANALYZER AND TESTER. *Model 550* low-cost dynamic mutual-conductance tube tester with common tubes listed on panel, complete reference chart in cover, supplementary charts issued regularly. Automatic line-voltage compensation built in. 7-pin and 9-pin straighteners on panel. *Model A107* Dyna-Sweep Circuit Analyzer (shown) companion unit to *model 1075* Television Analyst, provides vertical and horizontal sync and driving pulses for checking horizontal and vertical circuits, in-

cluding output transformers and yoke.—**B & K Mfg. Co.,** 3726 N. Southport Ave., Chicago 13, Ill.

KILOWATT POWER SUPPLY *model KS-1* kit supplies up to 1,500 watts dc at 1,500 or

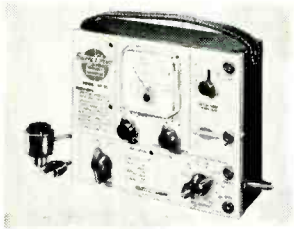
ON THE MARKET *(Continued)*

3,000 volts. Average dc 500 ma, peak 1,000 ma. Regulation better than 15% 0 to 500 ma, as high as 8% with typical linear



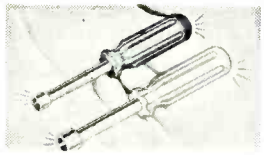
amplifiers. Ripple under 1%. Works on 115 or 230 volts dc. Fused. **Heath Co.**, Benton Harbor, Mich.

SWEEP-CIRCUIT TROUBLE-SHOOTER *model SS105* checks horizontal oscillator, horizontal output cathode current, deflec-



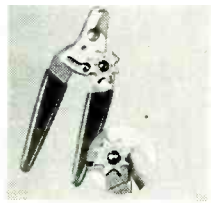
tion yoke, flyback transformer and vertical oscillator. Also serves as voltmeter, has adapter for substituting its deflection yoke without removing receiver yoke from picture tube.—**Sencore**, 112 Official Road, Addison, Ill.

HEX-NUT DRIVERS *Chrometone* (solid shaft) and *Gold-tone* (hollow shaft) lines, 31 drivers with colored plastic handles, for easy identification. Sockets tem-



pered to prevent "rounding-out."—**Vaco Products Co.**, 317 W. Ontario St., Chicago 11, Ill.

WIRE STRIPPER for any wire from 14 to 26 gauge is *Strip-Er-Clip* 7 positions adjust to varying sizes with thumb



pressure while in use. Insulated grip.—**G-C Div. of Textron, Inc.** 400 South Wyman St., Rockford, Ill.

PLASTIC-CASED CAPACITORS. *Polycaps* have outstanding humidity resistance, long life, high insulation resistance and low power factor. Solid im-

pregnant. Will be available as miniature paper-foil and metallized-paper capacitors. Also Mylar and electrolytic units.—**Aerovox Corp.**, New Bedford, Mass. END

All specifications on these pages from Manufacturers' data.

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REALISTIC STEREOLYNE-40 AMPLIFIER Only REALISTIC could bring you this sensational value! Our buyers shopped the entire market. Our engineers made comparison test after test. All agree the REALISTIC-40 delivers more watts per dollar than any other stereo amplifier on the market today! Note that it's not a kit . . . the REALISTIC-40 is completely wired, and this amazing low price includes the cabinet . . . there's nothing else to buy! Read the specs. You'll agree it's one more reason why REALISTIC is America's best buy in HI-FI!

SPECIFICATIONS and FEATURES: Two 20-watt stereo channels or 40-watts monaural; 80-watts total peak audio output. Frequency Response: 20-20,000 cps ±1 db. Feedback: 20 db Less than 1% total R.M.S. harmonic distortion at 400 cps; hum level: -59 db on phono and tape head inputs; -79 db on tuner input at 20 watts output. Controls: individual bass and treble controls for each channel; balance control and phasing switch; single volume control adjusts both channels simultaneously; separate loudness switch; AC accessory outlet. Inputs: Tuner, Stereo Phono, Stereo Tape Head. Outputs: 4 /8 /16 ohms and Tape Recorder. 117 VAC, 50 /60 cycles. Size: 12" W x 4⅛" H x 9 11/16" D. Custom-styled gold, maroon and white metal cabinet.

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For Checking Miniaturized Equipment, Pyramid's Model RC-1 New Resistance-Capacity-Ratio Bridge Tester. Budget priced . . . outstanding quality instrument . . . the RC-1 saves you both time and money. Precision-engineered, Pyramid's new model RC-1, Resistance-Capacity-Ratio Bridge Tester has a special low voltage bridge and stable vacuum tube amplifier for safe testing low voltage electrolytics such as commonly used in transistorized receivers.

Pyramid's RC-1, Resistance-Capacity-Ratio Bridge Tester is a functionally designed, sturdy, compact, lightweight unit, idéal for use by technicians, servicemen and engineers in radio, television (color as well as black and white), industrial electronics and all related fields.

PYRAMID MODEL RC-1 FEATURES:

- Special 3 volt amplifier for checking low voltage electrolytics used in miniaturized equipment such as transistor radios, etc.
- Capacity Ranges—from 10 mmfd. to 2000 mfd.
- Resistance—from .5 ohms to 200 megohms in 4 ranges.
- Ratio Test—provides quick reactance or resistance ratio between any two capacitors, inductors or resistors —range: .05 to 1 and 20 to 1. It can be used also to determine turns ratio of transformer windings within this range.
- Leakage Tests—handles all types of capacitors at rated voltages between 0 and 500V DC.
- Power Factor—0 to 60% (on capacitors from .1 mfd to 2000 mfd).
- Capacitor Test Voltages—variable between 0 and 500V DC in 17 steps.

PRICE: Dealer Net—$44.95

For further information about the RC-1 see your Pyramid distributor or write for complete technical data to: Pyramid Electric Company, Union City, N. J. EXPORT: 458 Broadway, N. Y. 13, N. Y. • CANADA: Wm. Cohen, Ltd.—7000 Park Ave., Montreal.

BURTON BROWNE/New York

PYRAMID
ELECTRIC CO.

TECHNICIANS' NEWS

TSA-MICHIGAN REJECTED

A letter signed by Frank J. Moch, executive Director of the National Alliance of TV and Electronic Service Associations was released as the reply of his national organization to the application of TSA-Michigan. It said in part, "We have processed your application and find that we cannot approve it. Under our constitution, we can recognize only one state group and only one local affiliate in each city. Since TESA-Michigan (formerly AMETA) has been duly recognized we cannot recognize TSA-Michigan. Also, since ESA of Detroit is the duly recognized local affiliate of TESA-Michigan we cannot recognize your group as an affiliate. . . . Membership for service business operators in all areas is invited by our local affiliate, regardless of what other group they may belong to. . . ."

Comment both approving and disapproving the decision of NATESA has appeared. Said *ARTSD News* (Columbus, Ohio), "This comes as a great shock to members of ARTSD, particularly those who spent many hours and dollars in the effort to bring [TSA] in. Apparently much time and effort has been uselessly spent in an attempt to unite, nationally the large, prominent and influential organizations. Regardless of what is said about unity, we find in many instances that the NATESA constitution will not permit it."

The *Guild News* (New York) agreed, ". . . It would seem that an association of such long standing and of such numerical strength would be such an asset to a national group that the leadership of that group, if they really wanted such a progressive association as a member, could find some way to work out details. Odd also is the fact that the announcement of TSA's intention to apply for membership in the spring was received . . . with open arms."

And an editorial in *The Raster* (Buffalo, Mo.): "What obstacles to complete service unity are ahead? . . . the only obstacle might be one of personalities . . . there are men now of great ability now pulling in somewhat opposite directions . . . we must have an orderly transition from our present state to that of unity. Associations cannot and must not be accepted into NATESA against the rules set up by NATESA. . . . Associations now in NATESA have certain rights which must be protected. NATESA cannot give in to the whims of its affiliating associations if they are not in harmony

with the PRESENT rules. This does not mean, however, that there should be no compromises made. . . . Hope that no one will block this unity movement because of prejudice or personal acquisitiveness."

TEXAS VIEWS

SARTA News (Texas Electronic Association of San Antonio) says, "One tremendous advantage that we service dealers have over factory service or part-timers is that we are able to service anything in the electronics field, thereby closing the door on the man who is strictly a tube changer, or the factory outfit that's tied to a single brand.

"Remember, the future holds great promise for those who prepare. You will soon find (electronic) air conditioning, heating, cooking, lighting and laundering (ultrasonic). There will be widespread use of closed-circuit TV, and videotape will enable people to record movies and TV programs and play them back. No other field of consumer products offers so wide a potential for service. . . . We must be willing to learn about these new products and train accordingly. . . . We must also cultivate the proper business procedures that will enable us to remain in business and grow. . . ."

TUBE CADDIES WILL SHRINK

A. P. Quackenschuster, noted economist, has predicted that by the late fall of 1967 there will be 7,856 receiving-tube types current, 86,516 transistor types and 189,564 kinds of fine-tuning knobs, all plastic. By early 1968, he foresees 1,870 fuse types, not counting 487 kinds of fusible resistors.

Seven new sorts of screwdrivers will be carried by top mechanics in addition to the present ones—straight split blade, six-sided Phillips, reverse Allen, obtuse Bristol, round clutch head, Kirby head and flathead.

By summer 1970, he predicts that the first plastic picture tubes will appear. Dr. Quackenschuster says these will be changed like a decal; just scrape off the old tube and press the new one into place, first wetting the paper backing and peeling it off. To convert from the popular 67-inch screen to the new 84-incher, the owner will need only to purchase the larger decal.

Asked if color TV would be perfected by 1970, Dr. Quackenschuster said, "No comment."—*TSA (Seattle) News*

LATE HOURS?

"Working hours, oddly enough, mean more than you'd think. Most people incline toward the feeling that anything that's easy to get can't be worth a lot. If you are on call 12 to 18 hours a day, your customers know that you don't set a very high value on your own time. After all, a TV set that's not working is not a major disaster. And if you have a reputation for doing top-notch work, you'd be surprised at how many people will wait until the

shop is open to get the best man in town to do their work. Sure there's an occasional call for night or Sunday service that you should make; invalids, the aged; we all try to take care of them.

"Ever try to locate someone to fix your car at night? Or get a plumber or electrician on Sunday? Sit down and figure what you get out of these night calls, remembering that if you were in the mill or factory you'd expect, and get, overtime pay."—*The Printed Circuit (Durham, N. C.) News*

ELECTRONIC TRAFFIC COURT

The "age of everything"—including "robot justice"—is in the offing. Suburban Dearborn (Mich.) is in a controversy over a proposed closed-TV circuit "drive-in courtroom" for Dearborn's new civic center. Cost for the electronically equipped courtroom with isolation booths would be around $400,000. It would permit paying tickets right from the car, meanwhile forcing the judge to leave his chambers and appear on his bench, in front of the closed-circuit TV camera.—*TSA-Michigan News*

18 COMPLAINTS IN 50,000!

Howard Wolfson, chairman of the Associated Radio & TV Servicemen (Chicago), writes about the show ARTS ran at the recent Chicago International Trade Fair: "We manned the booth with from 2 to 5 men every day for 17 days. We estimate that over 100,000 people stopped to look, out of the 850,000 who attended the fair. Many thousands engaged us in conversation. We had two Zenith sets, an RCA color set and Simpson test equipment going 12 hours a day. We answered questions all day long like 'What causes the white line in the middle of my picture?'

"We gave out more than 50,000 circulars explaining some of the expenses service shops have to carry, and 42,000 discount certificates good for $2 each at service shops. It cost ARTS members over $6,000 in time and money to run the exhibit. Most amazing to us was the fact that only 18 people stopped in to register complaints about radio–TV service technicians. This *must indicate that the public finds able servicemen, reasonable prices and few gyps!*"

DO YOU BELONG TO A SERVICE TECHNICIANS' ASSOCIATION?

For the benefit of service technicians and their organizations RADIO-ELECTRONICS is publishing a complete list of the known television service associations in this country and Canada. Due to the difficulty of contacting associations, our first lists will necessarily be incomplete and sometimes inaccurate. Service technicians can help us put out a complete up-to-date list. If you know of any association omitted from our list, or can correct any of the old listings,

please write to: Association Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

This month we publish a list of known local associations in New York and Ohio. We will list locals in other areas in subsequent months. If there is a group near you, why not contact them. It's for *your* benefit. The person whose name appears with the listing of the association is the correct one to contact.

To learn of the association nearest you *now*, drop a postcard to: Association Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

EMPIRE STATE FEDERATION OF ELECTRONIC TECHNICIANS ASSOCIATIONS
19 West Cowden Place
Jamestown, N. Y.
George Carlson, Secretary

TELEVISION SERVICE ASSN.-ALBANY
112 Central Ave.
Albany, N. Y.
Phillip Di Pace, Director

RADIO TV GUILD OF LONG ISLAND
Box 87
Bethpage, N. Y.
Robert Larsen, President

SOUTHERN TIER CHAPTER-RSA
Box 201
Binghamton, N. Y.
Michael Harris, Secretary

ASSOCIATED RADIO TV SERVICEMEN OF N. Y.
1257 Bedford Ave.
Brooklyn 16, N. Y.
Edward Eisen, President

TV & ELECTRONIC SERVICE ASSN. OF BUFFALO
703 Main St.
East Aurora, N. Y.
Irving J. Toner, President

RADIO TECHNICIANS ASSN. INC.
694 Broadway
Buffalo, N. Y.
Ted Telaak, President

MOHAWK VALLEY RADIO TV TECHNICIANS GUILD
20 Allman Place
New Hartford, N. Y.
Frank Kurowski, President

TOMPKINS COUNTY ELECTRONIC DEALER'S ASSN.
440 State St.
Ithaca, N. Y.
Ben De Young, President

ELECTRONIC TECHNICIANS ASSN.
201 East Third St.
Jamestown, N. Y.
Malcolm Nelson, President

ROCKLAND ASSN. OF TV & ELECTRONIC SERVICES
55 E. Central Ave.
Pearl River, N. Y.
Larry Critchlow, Secretary

TRI-COUNTY ELECTRONIC TECHNICIANS ASSN.
28 South Main St.
Portville, N. Y.
Jack Golden, Secretary

TV & ELECTRONIC ASSN. OF ROCHESTER
536 Jay St.
Rochester 11, N. Y.
Peter Ferrari, President

SYRACUSE TV TECHNICIANS ASSN.
410 Florida Rd.
Syracuse, N. Y.
Daniel Hurley, President

TV TECHNICIANS ASS.I. OF TONAWANDA
1032 Nash Rd.
North Tonawanda, N. Y.
Don Clark, Secretary

ULSTER ELECTRONIC TECHNICIANS ASSN.
94 Furnace St.
Kingston, N. Y.
Charles Kohl, Secretary

ELECTRONIC TECHNICIANS ASS'N WATERTOWN
1830 State St.
Watertown, N. Y.
John Thompson, Director

STEA—ELMIRA
RD #1—Pine City
Hendy Hollow Rd., Elmira, N. Y.
Ernest Scott, Director

END

BUSINESS and PEOPLE

Allan W. Greene was appointed president of Heath Co., Benton Harbor, Mich., according to an announcement by **Thomas Roy Jones**, president of the parent company, Daystrom, Inc. He comes to Heath from Motor-Mower, Inc., where he was general manager and a vice president of the parent company, Detroit Harvester Co.

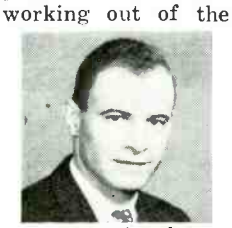
Wayne Beaverson, chief engineer, was elected vice president in charge of engineering, Electro-Voice, Inc., Buchanan, Mich. He replaces A. M. Wiggins, who resigned recently.

John Messerschmitt (left) advanced to the position of manager, power tubes and renewal sales, of Amperex Elec-

tronic Corp., Hicksville, N. Y. **Irwin Rudich** was promoted to manager, special-purpose tubes and semiconductors.

Robert W. Carr, senior engineer in microphone development for Shure Bros., Evanston, Ill., was promoted to manager of the microphone development department.

Warren E. Dalbke (left) is now district manager, equipment sales, for CBS Electronics, working out of the



Chicago office. He was previously an equipment salesman. **Carl W. Dibling**, now Midwest field engineer, held the same position in the Eastern region.

Carl Schladen was named manager of the Manufacturing Div. of Orr Industries, Opelika, Ala. He joined the company late last year as chief industrial engineer and manager, technical section.

Bill Crawford was promoted to assistant sales manager of Oxford Components, Inc., Chicago. He has been with Oxford for a year and has a wide background in engineering and business administration.

Robert J. Cohen (left) joined Allied Radio, Chicago, as promotion assistant to **Leonard S. Preskill**, sales development manager. He had been with Travler Radio. **Samuel S. Crandell** (right) joined Allied as customer services manager, from Ryerson Steel where he was office manager.

Edward C. Hughes, Jr. (left), administrator, commercial engineering programs for RCA Electron Tube Div., Harrison, N. J., advanced to the position of manager, commercial engineering. He succeeds **Robert S. Burnap** who retired recently, but continues with the company as a consultant.

RCA celebrates its 40th anniversary this year. The summer 1959 edition of the company house organ *Electronic Age* marked the celebration with special features and a chronology of the historic highlights in electronics during the past 40 years.

William G. Tuscany is now senior sales representative of the Erie Resistor Corp., Electronics Div., in the Midwestern regional sales district, Chicago.

Frederick R. Lack was elected to the board of directors of Dukane Corp., St. Charles, Ill. He recently retired as vice president of Western Electric Co. after 45 years with the Bell System.

BUSINESS AND PEOPLE *(Continued)*

Edward O. Johnson was appointed manager, advanced development, RCA Semiconductor & Materials Div., Somerville, N. J. He had been manager, high-temperature product development. He succeeds **Dr. W. M. Webster** who is now administrative engineer on the staff of the vice president of RCA Laboratories.

I. Barbitta (left) was appointed production line manager, industrial communications, for the Gonset Div., Young Spring & Wire Corp., Burbank, Calif. He comes to the company from Link Radio, where he was vice president.

John Hunt joined Gonset as manager, amateur sales, from Collins Radio where he was assistant manager, amateur sales.

Harry R. Ashley, president of Electronic Instrument Co., Long Island City, N. Y., was among those presented with "American Success Story Awards" by the Free Enterprise Awards Association, Inc., for their "up from the ranks" achievements.

T. Edward Rogers, formerly with the Philco TechRep Div. in Washington, D. C., is now general sales manager of the Parts and Accessory Div. in Philadelphia.

EIA PRODUCTION AND SALES—first half

	1959	*1958*
TV set production	2,782,715	2,167,930
Total radio production	7,107,586	4,619,163
FM radio production	223,423	not available
TV retail sales	2,263,957	2,177,652
Radio retail sales	3,158,881*	2,712,134*
Receiving-tube factory sales	201,979,000	190,406,000
TV picture-tube factory sales	4,370,535	3,689,587

*Excluding auto radios.

Jensen Industries, Forest Park, Ill., designed a "cheese-tray" needle stock control case for distributors and dealers of its diamond or sapphire needles. The company also launched a Big 8 fall phono cartridge program, offering dealers a free stock cabinet with the purchase of a combination of eight of its most popular crystal cartridges.

Raytheon Co., Industrial Tube Div., achieved a record 4,000,000 accident-free man-hours, the longest run in its history, for which it was awarded a plaque by Liberty Mutual Insurance Co.

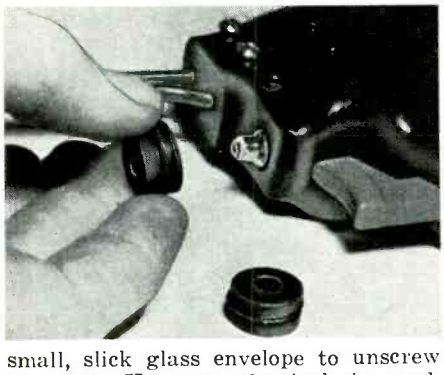
END

FAST AUTO RADIO SERVICE

As all service technicians know, the top and bottom of many auto radios are attached with ¼-inch hex-head self-tapping screws. Some auto radios have between 15 and 20 such screws and it's a slow, tedious job to remove them with a nut driver. I solved this problem by hacksawing the handle off a nut driver, and then inserting the nut driver shaft into a hand drill. Simply place the nut-driver shaft on a screw head, turn the crank and the screws pop out quicker than a wink. They can be replaced in the same manner if they are started by hand. This handy tool can also be used on TV high-voltage cages where many of these self-tapping screws are also used. —*Albert J. Krukowski*

GROMMET AIDS GUN LAMP REMOVAL

If the "spot light" of your soldering gun has ever blown, you know just how hard it is to remove it for replacement. It is difficult to get a good hold on the



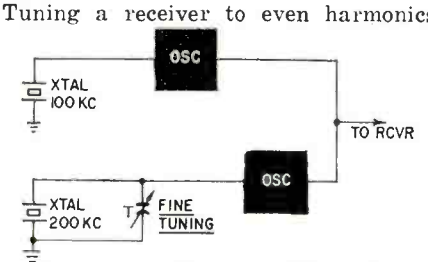
small, slick glass envelope to unscrew the bulb. However, the task is much easier if you take a small rubber wire feed-through grommet and press it tightly against the bulb's smooth envelope.—*Charles A. Cunningham*

RECEIVER CALIBRATION

A good receiver must be properly calibrated whether it is calibrated directly in frequency or a dial number. Dial calibration requires stable secondary standards plus some way of determining whether you are tuned to an even or odd harmonic. By itself, a 100-kc oscillator is not adequate for this purpose. The least expensive way to identify harmonics is to add a 200-kc crystal oscillator with a trimmer capacitor across the crystal. Once a zero-beat setting is established, turning

TRY THIS ONE *(Continued)*

the trimmer slightly higher or lower lets the operator distinguish between odd and even harmonics of 100 kc. Tuning a receiver to even harmonics



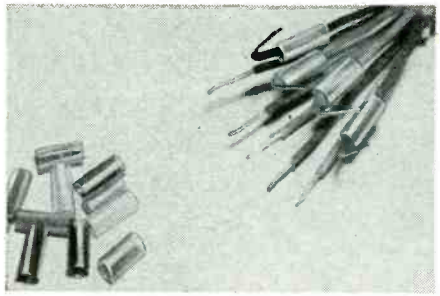
produces an audio tone while odd harmonics give off only an rf signal. Be careful not to overload the receiver, for too high an output fed into a nonlinear amplifier will produce unwanted beat frequencies.—*Albert J. Citrullo*

MAST MEASURES LEAD-IN

Ever wish for an easy way to measure the length of TV lead-in used for an antenna installation? It's pretty difficult to use a tape measure. Next time don't use a tape measure or estimate the amount of lead-in used—be sure, do it the easy way with a 5- or 10-foot section of mast. This way you won't overcharge or undercharge for the amount of wire used.—*Charles A. Cunningham*

WIRE-TERMINAL IDENTIFIERS

When I have to unsolder and remove a wire lead or a number of leads from a terminal in an electrical circuit, I mark the terminal and the wire with a short length of colored plastic soda



straw. By slipping these "identifiers" over each wire and terminal, using corresponding colors, I am always able to resolder the wires to their correct lugs. I keep a container full of the colored identifiers on my bench for instant use whenever they're needed.—*James C. Alexander* END

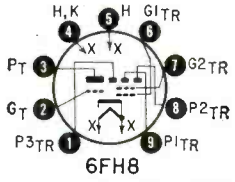
"Our serviceman is reactivating your tube right now."

NEW TUBES and SEMI-CONDUCTORS

HARMONIC generators, Citizens band transceivers, and TV damping are only some of the jobs to which this month's releases can be applied.

6FH8

A multi-unit 9-pin miniature tube containing a medium-mu triode and a sharp-cutoff tetrode with a pair of additional plates. The tube is intended



6FH8

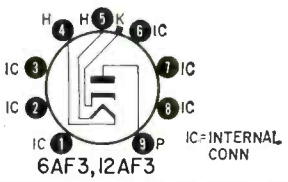
for use in harmonic generator applications.

Design maximum ratings for the RCA 6FH8 in harmonic generator service are:

		triode	tetrode
V_P		275	——
V_{P1}		——	275
V_{P2}		——	200
V_{P3}		——	200
V_{G2}	supply	——	275
V_{G1}	(neg bias)	40	40
	(pos bias)	0	0
P_P	(watts)	1.7	——
P_{P1}	(watts)	——	2.3
P_{P2}	(watts)	——	0.3
P_{P3}	(watts)	——	0.3

6AF3, 12AF3

Indirectly heated half-wave rectifiers designed for use as the damping diode in TV receiver direct-drive sweep circuits. They can withstand extremely high voltage pulses between cathode and both heater and plate. The cathode is connected to the top cap. The 6AF3



6AF3,12AF3

has a 6.3-volt 1.2-amp heater while the 12AF3 has a 600-ma 12.6-volt controlled warmup heater for use in series-string circuits. All other ratings of these Sylvania tubes are identical.

Design maximum ratings of the 6AF3 and 12AF3 are:

V_P	(peak inverse)	4,500
I_P	(dc) (ma)	185

NOVEMBER ISSUE ON SALE OCTOBER 27th

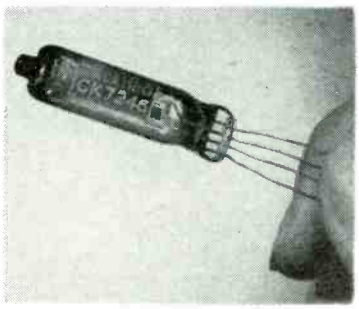
AT ALL BETTER PARTS DISTRIBUTORS AND NEWSSTANDS

NEW TUBES & SEMICONDUCTORS *(Cont'd)*

I_P	(steady-state peak) (ma)	750
P_P	(watts)	6

CK7246

A filamentary subminiature triode operating up to 500 mc that is designed for use in portable communications equipment as a superregenerative detector, high-frequency oscillator, class-C amplifier, frequency multiplier or



mixer. The frequency range of the Raytheon CK7246 makes it particularly useful for transceiver use in the 465-mc citizen's radio band.

Typical operating characteristics are:

Class-A Amplifier

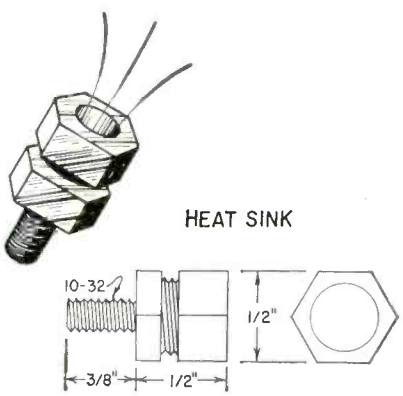
V_{fil}		1.25
I_{fil}	(ma)	150
V_P		105
I_P	(ma)	4.5
V_G		−2.5
Gm	(μmhos)	2,700
μ		22

Class-C Oscillator (465 mc)

V_P		105
I_P	(ma)	6
I_G	(ma)	0.9
P_{output}	(mw)	60

Transistor heat sink

A stud-mounted heat-sink mounting designed for transistors in the TO-5, TO-9 and TO-11 outline packages is being manufactured by Jadaro Machine Products. Its design provides a simple method of heat-sinking transistors that

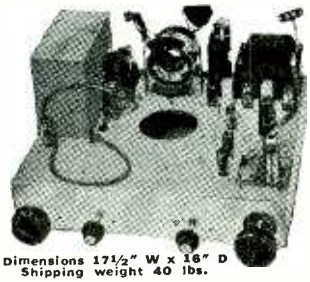


have a round weld package. Firmly tightening the gland nut provides a good thermal contact between the transistor and the heat sink. Heat generated in the transistor is conducted to the chassis through the threaded stud.

An insulated version provides complete electrical insulation between the transistor and the chassis. This is done by using a special type of hard-coat anodize finish on the heat sink. It pro-

DX-16 Super Deluxe TV KIT

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



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

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

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Most Up-To-Date and Practical Course in Television

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with SET of WESTINGHOUSE TUBES $79.97

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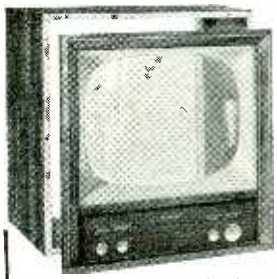
Also sold on **EASY-PAYMENT-PLAN** Buy LIFE-SIZE Instructions—$2.49—and buy Parts as you build.



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RONETTE or SONOTONE STEREO CART. . . .	4.62	**UNIVERSAL 90° FLYBACK TRANSFORMER**	5.24
RECORD CHANGER BASE. any type, any finish	3.41	**UNIVERSAL 110° FLYBACK TRANSFORMER**	5.74
RECORD CHANGER BOARD any type, unfinished	1.49	**17" TV MASK** gray 13¾" x 17¼"	1.49
$99 NORELCO 12" HI-FI SPEAKER #9762M	35.97	**21" TV MASK** gray 18" x 22½"	2.38
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6" x 9" OVAL TWIN-CONE SPKR. 1.47 magnet	2.19	**24" or 27" TV SAFETY GLASS** 21" x 26" . . .	5.87
PHONO MOTOR 4-speed complete with T.T. etc.	4.61	**AC-DC PHONO AMPLIFIER** incl 12AT6, 50B5, 35W4	5.98
PHONO ARM . . complete with 4-speed Cartridge	3.38	**$25 AC AMPLIFIER** . . . . incl 3 Tubes, 5 watts	12.95
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.035-1000v, .047-1000v, .1-1000v, .007-1600v, .03-1600v, .05-1600v, .005-3000v, .001-6000v, 14¢ ea.

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½ WATT 10% 2700, 3300, 3900, 4700, 5600, 6800, 8200, 10k, 15k, 18k, 22k, 27k, 33kΩ. . . . 2¢ ea.
½ WATT 10% 39k, 47k, 50k, 56k, 68k, 82k, 100k, 120k, 150k, 180k, 220k, 270k, 330kΩ. . . . 2¢ ea.
½ WATT 10% 390k, 470k, 560k, 680k, 820k,Ω 1, 1.2, 1.5, 2.2, 6.8, 10, 15 MEGΩ. . . . . 2¢ ea.
1 WATT 10% 3.3, 10, 39, 100, 120, 150, 330, 470, 560, 680, 820, 1k, 1800, 2700, 4700Ω. . 3¢ ea.
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2 WATT 10% 18, 22, 82, 100, 180, 2200, 3900, 4700, 6800, 8200, 18k, 22k, 100k, 470kΩ. . . . 4¢ ea.

WIREWOUND RESISTORS 5-5w, 16-10w, 20-10w, 47-5w, 100-5w, 140-5w, 220-5w. 16¢ ea.

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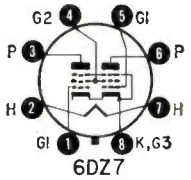
TELEPHONE COrtland 7-2359

vides a 400-volt breakdown. The heat sinks typically increase transistor dissipation 3 to 4 times the free air rating or 85% of infinite heat-sink rating.

6DZ7

A twin power pentode designed for use in the output stage of hi-fi audio amplifiers. Its two pentode sections in one envelope make the 6DZ7 especially suitable for compact stereo systems.



6DZ7

Design maximum ratings of the General Electric 6DZ7—per section—are:

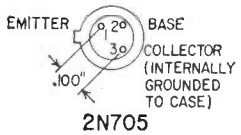
V_P	440
V_{G2}	300
P_P (watts)	13.2
P_{G2} (watts)	4

Characteristics in a push-pull Class-AB1 amplifier are:

	Fixed Bias	Cathode Bias
V_P	400	300
V_{G2}	250	250
V_{G1}	−11	———
$R_{cathode\ bias}$ (ohms)	———	120
$V_{peak\ af\ grid\ to\ grid}$	22	22
I_P (zero signal) (ma)	40	66
(max signal) (ma)	100	80
I_{G2} (zero signal) (ma)	4	7
(max signal) (ma)	13	15
R_L (plate to plate) (ohms)	9,000	9,000
Harmonic distortion (total %)	2.5	3.5
Max signal power out (watts)	18	12

2N705

A p-n-p germanium diffused-base mesa high-speed switching transistor.



2N705

It is made by the diffusion process for high-speed logic applications.

Maximum tentative ratings of the Texas Instruments 2N705 are:

Design characteristics at 25°C are:

V_{CB}	15
V_{EB}	3.5
I_E (ma)	50
I_C (ma)	50
P_{total} (mw)	300

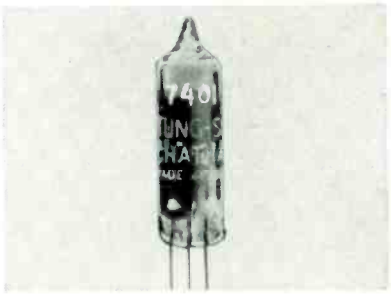
Design characteristics at 25° C are:

h_{FE} (V_{CE} = 0.3, I_C = 10 ma) (typ)	40
h_{fe} (V_{CE} = 10, I_C = 10 ma, f = 100 mc) (db) (typical)	6
f_{ocb} (V_{CB} = 5, I_C = 10 ma) (mc) (typical)	300

Self-indicating thyratrons

Two cold-cathode units (7400 and subminiature 7401) and one hot-filament type (7323) make up a complete family of self-indicating thyratrons.

The cold-cathode units require no heater power and provide a bright

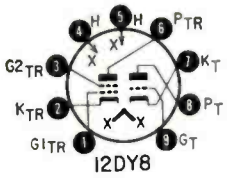


surface-glow indication for end-on viewing. A small pulse voltage, which can be generated by transistor equipment, is superimposed on a dc bias to trigger these tubes.

The 7323 needs 1/3 watt filament power and —4.5 volts dc grid bias. Trigger signals can be applied directly at ground reference level. The gas discharge glow is not as bright as that of the cold cathode versions but can be viewed end-on or from any side. All three units are made by the Chatham Division of Tung-Sol.

12DY8

A double-section tube featuring a tetrode designed for relay service in signal-seeker applications and a general-purpose sharp-cutoff triode. The tube is intended for operation where the heater, plate and screen voltages



are obtained directly from a 12-volt automobile battery.

Made by Sylvania, characteristics and typical operating specifications of the 12DY8 are:

		triode	tetrode
V_P		12.6	12.6
V_{G1}		0	contact potential bias developed across specified grid resistor
R_{G1}	(megohms)	———	2.2
V_{G2}		———	12.6
Gm	(μmhos)	2,000	6,000
μ		20	———
R_P	(ohms)	10,000	5,000

END

CORRECTION

Two typographical errors appeared in the captions for the Baldwin organ photographs in the article "Servicing Electronic Organs" in the August issue. The Baldwin 5A is referred to as an A5 (page 30) and the word "lower" used instead of "upper" on page 31. That caption should read "Master oscillators and power amplifiers are on the upper chassis."

A large number of correspondents called these errors to our attention.

(See also correspondence column).

LITERATURE

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

ELECTRONICS PARTS AND EQUIPMENT fill this 218-page *1959 Catalog* of industrial and amateur equipment, radio and TV supplies and electronic components. Amateur receivers and transmitters, antennas, tools and PA equipment are included.—**Modern Electronics Co.,** 2000 Broadway, San Antonio 6, Tex.

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RADIO–TV INDUCTOR REPLACEMENTS may be made using the 36-page *Parts Selector Catalog.* Exact replacements are featured with helpful service hints. —**Ram Electronics,** 600 Industrial Ave., Paramus, N. J.

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PICTURE-TUBE COMPARISON CHART shows characteristics and base diagrams for about 300 cathode-ray picture tubes from 7DP4 to 30BP4. Suitable for wall hanging, it is printed on only one side.—**Sylvania Electric Products, Inc.,** 1740 Broadway, New York 19, N. Y.

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AUTO RADIO COIL GUIDE *Catalog 260* is a 20-page booklet listing every auto radio coil in use by radio make. It includes a cross-reference of 1,000 part numbers from 45 manufacturers.—**J. W. Miller Co.**, 5917 S. Main St., Los Angeles 3, Calif.

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TV–FM HOME OUTLET installation and use is described in an issue of the *Technical Reporter* with detailed photographs and diagrams. Subscription to the entire series of *Technical Reporter* is also available on request.—**Jerrold Electronics Corp.**, 15th and Lehigh Ave., Philadelphia 32, Pa.

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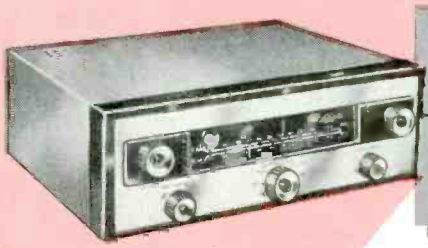

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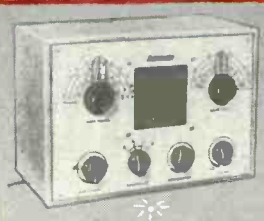

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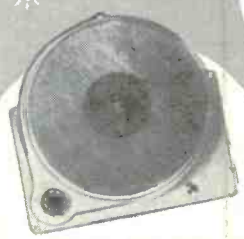

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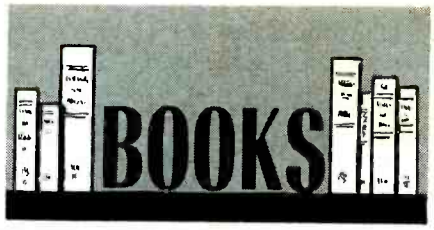

LOGICAL DESIGN OF ELECTRICAL CIRCUITS, by Rene A. Higonnet and Rene A. Grea. McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y. 6 x 9 in. 220 pp. $10.

This book is for engineers who work with computers, automation or switching networks. The first few chapters introduce the reader to Boolean algebra. This equips him to understand switching networks and shows him how to simplify complex circuits. Many tables, examples and illustrations are included.

After a study of various circuits, the last chapters analyze relays, rectifiers and tubes as switches.

LOW-FREQUENCY AMPLIFIERS, edited by A. Shure, PhD, EdD. John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 79 pp. $1.80.

This book is an introduction to the field of audio and hi-fi. It gives the basic facts of tubes and transistors, and shows how to use them in circuits.

Although the introductory chapter speaks of the importance of frequencies under 20 cycles, the text is concerned only with the range of human hearing, and the lowest frequency mentioned in a problem is 50 cycles.

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ANALYTICAL TRANSIENTS, by T. C. Gordon Wagner. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. 5¾ x 9 in. 202 pp. $8.75.

This is an excellent book for advanced study of networks and transients. The author presumes an elementary knowledge of these topics and of mathematics. He introduces the reader to Fourier analysis and Laplace transforms, as well as complex variables. These are powerful tools in the study of advanced theory.

Numerical examples are worked out to illustrate theory and formulas.

FUNDAMENTALS OF ELECTRICAL ENGINEERING (2nd Edition), by Fred H. Pumphrey. Prentice-Hall, Inc., Englewood Cliffs, N. J. 6 x 9 in., 534 pp. $8.50

Starting with fundamentals, the author covers dc and ac (including polyphase) circuits, principles of magnetism and electrical measurements. Then the book proceeds to transformers, motors and generators, amplifiers, tube circuits, etc.

Because of its wide coverage and clear analyses, the book is recommended for students and specialists in other engineering fields who work with electrical devices and circuits. It is especially strong on electrical machines, measurements, amplifiers and controls. Among other topics are illumination, hf heating, industrial wiring, etc.—*IQ*

RADIO CIRCUITS, by W. E. Miller, Fourth Edition, revised by E. A. W. Spreadbury. Iliffe & Sons, Ltd., London, England. 5½ x 8½ in. 172 pp. 15 shillings net.

Very little previous training in radio is needed to understand this book. Written in simple language, it explains the principles of FM and AM radio, stage by stage. Each brief chapter covers a single topic (detection, negative feedback, transistors, etc.).

Typical schematics for each portion of a receiver are explained in detail and show suggested component values.

MAGNETIC TAPE RECORDING, by H. G. M. Spratt. MacMillan Co., 60 Fifth Ave., New York 11, N. Y. 5¼ x 8½ in. 319 pp. $8.50

Sound recording is but one of many important magnetic-tape applications. Tape is also used for data processing and storage, automatic control, waveform analysis, video recording, etc. This book can help engineers who work in such fields.

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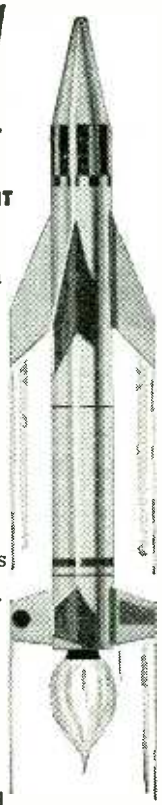

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SCHOOL DIRECTORY PAGE 155

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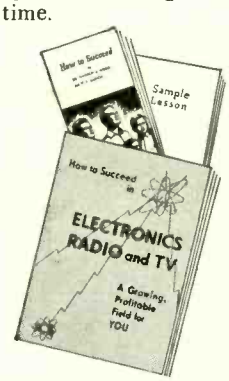

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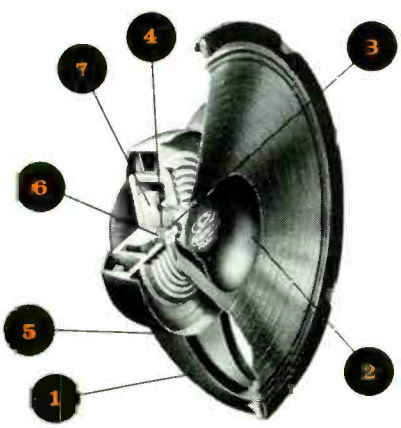

		WOLVERINE	SPEAKER A	SPEAKER B	SPEAKER C	SPEAKER D
1	Die Cast Frame	Yes	No	No	No	Yes
2	Radax Cone	Yes	No	No	Yes	No
3	Edgewise-Wound Voice Coil	Yes	No	No	No	Yes
4	Glass Coil Form	Yes	No	No	No	No
5	Low-Silhouette Frame	Yes	No	No	No	Yes
6	Long-Throw Voice Coil	Yes	Yes	Yes	Yes	No
7	Slug-Type Magnet	Yes	Yes	Yes	No	Yes
	NET PRICE	LS 12 $19.50 LS 8 $18.00	$23.75	$19.50	$33.00	$59.40

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Heavy-Duty Diecast Frames—The hallmark of fine loudspeakers. Frames are heavy and rigid, holding the speaker cone and the delicate voice-coil in exact center position without danger when the speaker is bolted to the cabinet.

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Edgewise-Wound Voice Coil—Voice coils are edge-wound from precision, flattened-ribbon conductor; efficiency is increased 18% over conventional round-wire coils, gaining the equivalent of five extra watts from a typical amplifier.

Glass Coil Form—The voice coil is wound on a fiberglas form into a rigid, concentric assembly. This exclusive assembly maintains shape for the life of the speaker system, permanently preventing shorts and distortion-causing rubs.

Long-Throw Voice Coil—Wolverine speakers contain deep, medium-diameter voice coils. Conductor remains in the air gap even on longest excursions, preventing nonlinear operation characteristic of wide-diameter, short-throw coils.

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in blonde, mahogany, or walnut-grained finishes

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THE LORAINE

A corner-horn enclosure, the Loraine employs a corner of the room to reinforce and extend the bass range. For 12" speakers. Has pre-cut ports for adding HF1 and MF1 Step-Up-Kits . . .
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Direct radiator enclosure for 8" speakers. Excellent for use in stereo pairs. Has pre-cut port for addition of HF1 Step-Up-Kit.
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EXPAND YOUR HIGH-FIDELITY SYSTEM WITH WOLVERINE SET-UP KITS

STEP 1 . . . Add the Model HF-1 High-Frequency Step-Up Kit. Can be added to all Wolverine full-range loudspeakers. Extends high-frequency performance beyond the limits of audibility, for silky, precise definition of string and woodwind instruments. Consists of VHF driver and crossover network with built-in level control. Complete with all wiring, mounting hardware and instructions for simple, 5-minute installation.
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STEP 2 . . . Add the Model MF-1 Mid-Range Step-Up Kit. Can be added to Wolverine speakers after the HF-1 Step-Up Kit is installed. Spreads mid-range sound evenly throughout the room, increases output in the vital "presence" range, consists of treble driver and cross-over network with built-in level control. Complete with all wiring, mounting hardware and instructions for simple, 5-minute installation.
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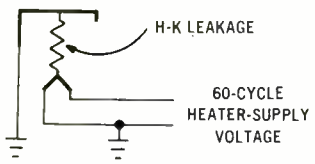
STOP PROFIT LEAKS!

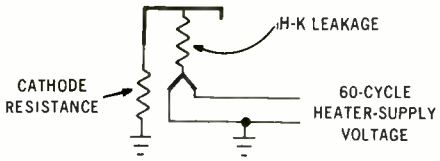
Review these important facts about heater-cathode leakage

Did that TV set come back? Same symptoms —60-cycle hum bars? You diagnosed the trouble correctly—a leaky tube.

Here's why a leaky tube can cause you a lot of trouble.



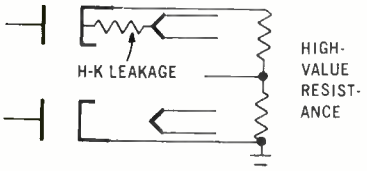
H-K leakage provides a path for 60-cycle current to flow from the heater to the cathode. If there is no resistance or impedance in the cathode circuit, this leakage current usually causes no difficulty.



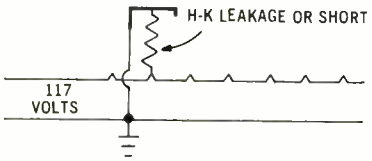
When there is resistance in the cathode circuit, the H-K leakage current develops a 60-cycle voltage across the cathode resistor. This voltage may produce visible and/or audible 60-cycle "hum".

H-K leakage in the RF, IF, or video stages of a TV receiver can produce 60-cycle horizontal pulling and "hum" bars.

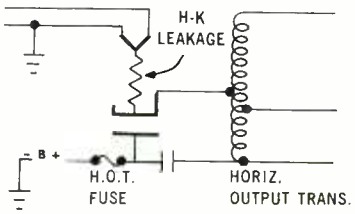
H-K leakage in the sync-separator tube or in the horizontal AFC, oscillator, or output tubes can produce 60-cycle horizontal pulling without "hum" bars.



In detector, discriminator, and AFC stages, which usually have relatively high values of resistance in the cathode circuit, even a slight amount of H-K leakage current can easily cause visible and/or audible 60-cycle "hum" symptoms.



An H-K short circuit, or low-resistance leakage, in a series-string tube, short-circuits part of the heater circuit. The resulting higher voltage across the remaining heaters may cause heater burnout.



H-K leakage in a damper tube which has its heater grounded may cause the H.O.T. fuse to blow.

RCA tubes help you beat these problems—drastically reduce heater-cathode leakage and shorts through such improvements as precise control of heater coatings to eliminate "thin spots"...better heater stem lead arrangements...new cathode materials and structures. Avoid callbacks caused by tubes that develop H-K leakage problems and keep your profits from "leaking" too. Remember to always ask your distributor for *RCA TUBES!*

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Electron Tube Division — *Harrison, N. J.*