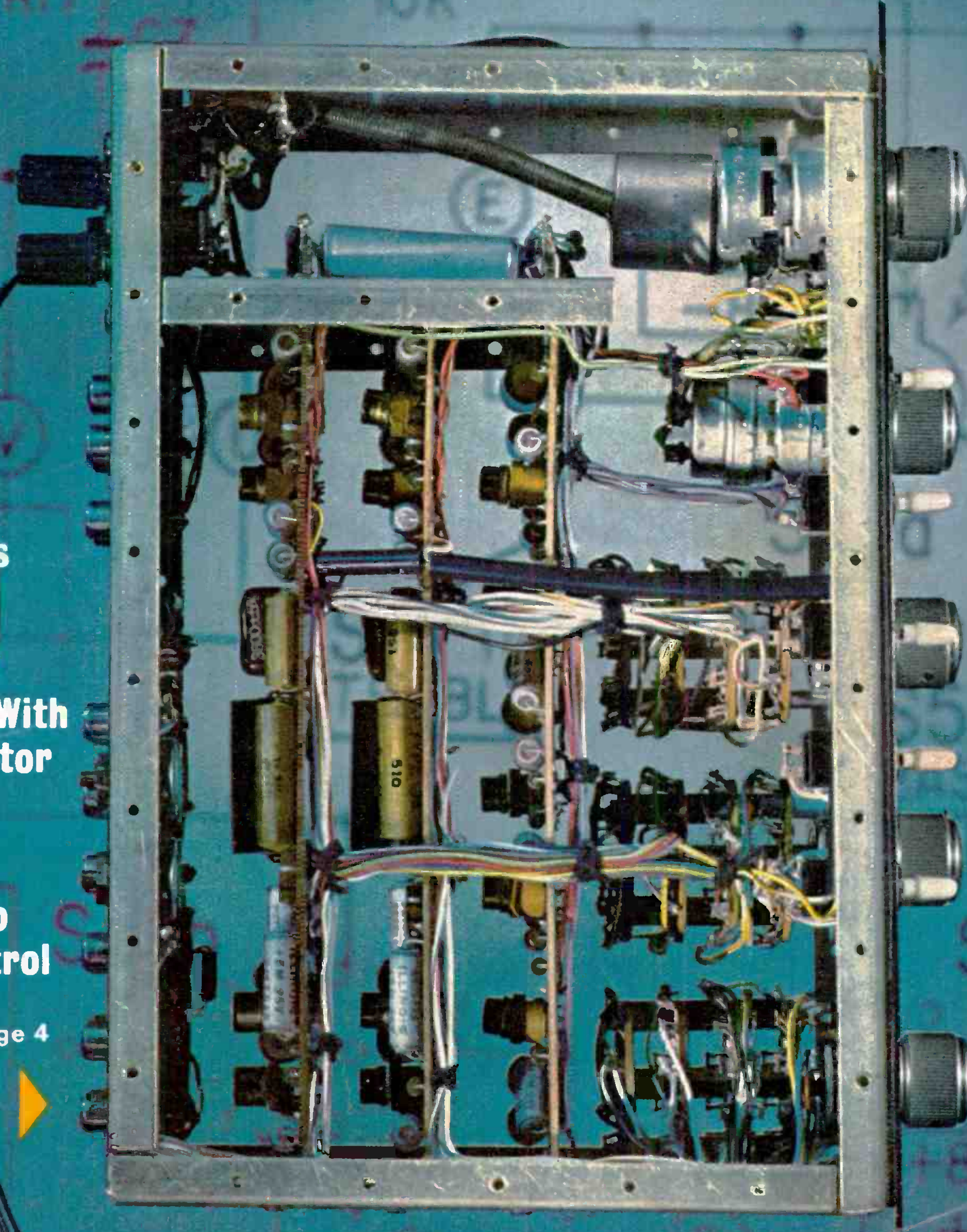
OCTOBER

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor-in-chief



Safety Valve for Sensitive Meters

Adapters for Tube Testers

New Solid-State I.F. Transformers

Troubleshooting With Color Bar Generator

Transistor Stereo Preamp and Control Center

See page 4

50c

Here's why Audio Magazine says Scott® Kits are

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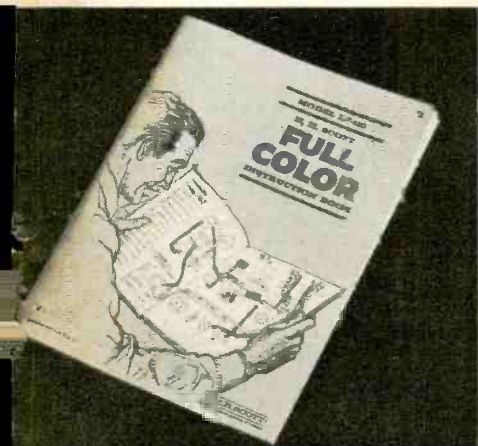
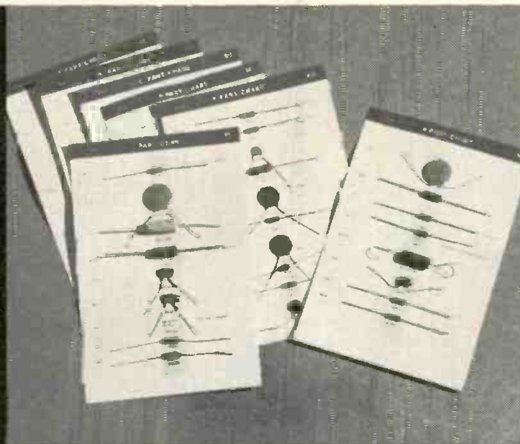
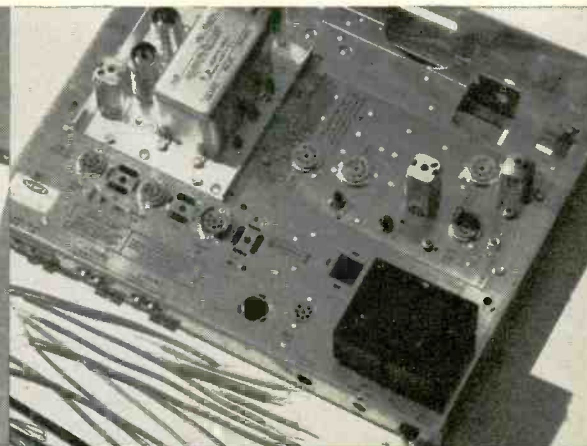


The exclusive Scott full color instruction book shows every part and every wire in natural color and in proper position. To make the instruction book even clearer, each of the full color illustrations shows only a few assembly steps. There are no oversized sheets to confuse you.

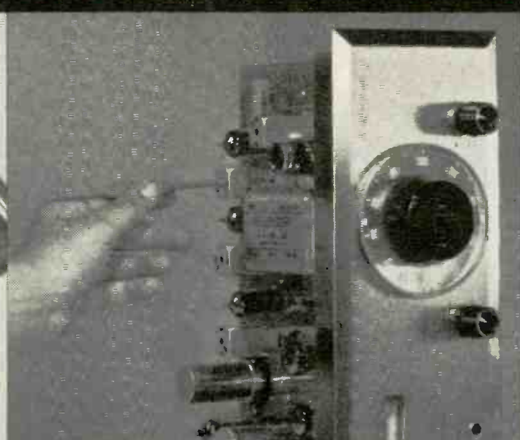


Each full color illustration is accompanied by its own Part Chart . . another Scott exclusive. The actual parts described in the illustration are placed in the exact sequence in which they are used. You can't possibly make a mistake.



Much of the uninteresting mechanical assembly is completed when you open your Scott Kit-Pak. All the terminal strips and tube sockets are already permanently riveted to the chassis. To insure accuracy all wires are pre-cut and pre-stripped to proper length.

There are certain areas in every professional high fidelity component where wiring is critical and difficult. FM front ends and multiplex sections are an example. In Scott Kits these sections are wired at the factory, and thoroughly tested by Scott experts, assuring you a completed kit meeting stringent factory standards.



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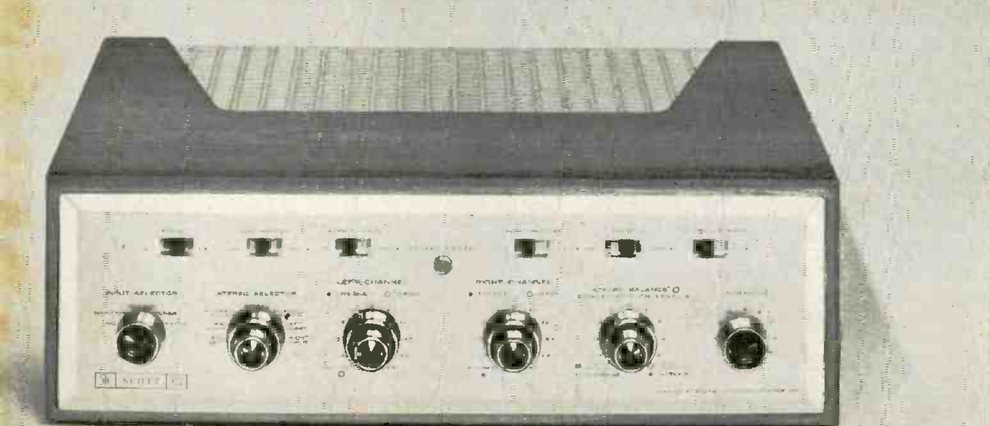

When you finish your kit you'll be delighted by its handsome good looks. And when you turn your Scott Kit system on you'll know for yourself why the expert editors of leading high fidelity magazines like Audio say . . . "only the most sophisticated engineering thinking could design a kit as simple and foolproof as this . . ." *

*Audio — February 1961, Pages 54-56

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Radio-Electronics

OCTOBER 1962
VOL. XXXIII No. 10

Formerly RADIO CRAFT—Incorporating SHORT WAVE CRAFT—TELEVISION NEWS—RADIO & TELEVISION*

editorial

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—on the cover—

(Story on page 44)

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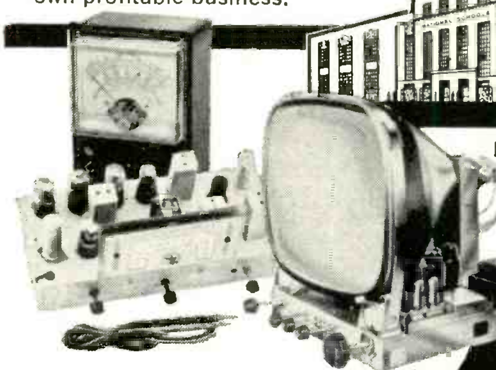

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News Briefs

New Gas Maser Emits Visible Light

Five new gas masers, including one that emits light at 6,328 Angstroms, in the visible light spectrum, have been demonstrated by Bell Telephone Laboratories.

The gas maser, originally demonstrated by Ali Javan of the Laboratories (RADIO-ELECTRONICS, April 1961, page 6) operates by exciting atoms in gases to a higher than normal state of energy. Collisions between the atoms knock them down to the normal energy state again, causing them to emit light in the process. Light traveling through the gas stimulates other atoms into producing light. Mirrors at the ends of the tubes reflect the light back and forth through the tube, producing powerful standing waves of light.

Gases used in the demonstrations of the new masers were helium-neon, neon-oxygen, argon-oxygen, helium, neon, argon, krypton and xenon. It is possible to obtain radiation at fourteen frequencies ranging from visible light to the far infrared.

Another feature of the new masers is that they can be excited by direct current as well as with the radio frequency used on earlier gas masers. A cathode is built into a branching tube at right angles to the main tube at one end, and an anode into a similar branching tube at the other end. About 5,000 volts is then impressed across the tube. It has been discovered that there is no serious contamination of the maser gas by particles emitted from the electrodes.

Other improvements on earlier masers include external concave mirrors instead of flat mirrors built into the earlier tubes, and windows at the ends of the tubes set at an angle (the Brewster angle) which permits light polarized in the direction of travel to leave the tube with a minimum of reflection. The mirrors are also covered with a number of coatings of exactly the correct thickness to cause them to be highly reflecting at the desired wavelengths.

Kumar Patel and William Bennett, Jr., of Bell Laboratories, with their five new optical masers, containing helium, neon, argon, krypton and xenon. These masers, though fitted for dc excitation, are being excited by rf (transmitted through the clip type capacitors) in this experiment.

Allocation Rules Set For FM Broadcasters

The FCC has established rules covering FM allocations and power limits. Three zones are established: Zone I, Northeast; I-A, California, south of 40°; II, the rest of the country. Three classes of stations are recognized: class A, used in all zones, with 3-kw maximum power and 300-foot maximum antenna height, 100-watt minimum; class B, in zones I and I-A, 50 kw, 500-foot maximum antenna, 5-kw minimum; class C, in zone II, 100 kw, 2,000-foot maximum antenna, 10-kw minimum. Class A stations must be at least 65 miles apart; class B, 150 miles, and Class C, 180 miles. Existing stations will not be disturbed, even if they don't comply with the new standards.

Biggest Radio Telescope Abandoned by Pentagon

The huge radio telescope in Sugar Grove, W. Va., mentioned several times in these columns, has been abandoned, due largely to costs far greater than had been expected when construction was started in 1958. At that time, the cost was estimated at $79,000,000. More than $130,000,000 has already been invested in the project, and it is expected that, if brought to completion, the telescope would cost more than $200,000,000. It was also rumored that the primary purpose of the telescope was not entirely research in physics, space communications, navigations and radio astronomy, as originally announced, but primarily to eavesdrop on radio messages within the Soviet Union, by using the moon as a reflector. Advances in electronic and satellite technology, it was said, have rendered this approach obsolete.

New Tape Recorder Runs 60 Miles Per Hour

A tape recorder that runs a mile a minute has been developed by the RCA's Surface Communications Div., Camden, N. J. The tape holds 15 channels of information, and is used for recording operational analog data from a missile-tracking radar. It is guided through the recorder

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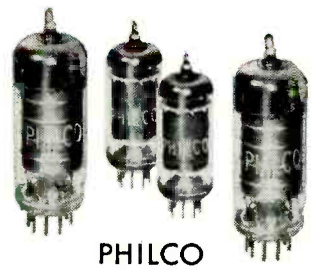

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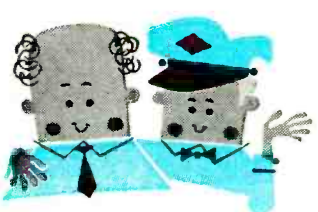

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by compressed air, to allow the 7-mile length stored in the machine's 30-inch reels to travel at such a fast rate without mechanical difficulties. Special devices prevent tape breakage in case of accidental stops, power failures, etc. One mile of tape is used to get up to speed, and another to brake down to stop.

Color TV to Get Rectangular Tube

Corning Glass Works has sent all tube makers blueprints of proposed 19- and 25-inch rectangular color tubes of the shadow-mask type. They are informing manufacturers that sample envelopes can be delivered early in the summer of 1963, with some production by the fall of that year. Tube makers suggest that there may be several slips between the glass bulb and the final rectangular, 90° shadow-mask color tube, but work already done seems to indicate that such a tube can be constructed.

Electronic Safeguard Controls Nuclear Weapon Firing

The Government has announced the successful development of an electronic lock to safeguard nuclear weapons from accidental or unauthorized firing. The lock would be controlled from a command headquarters remote from the missile base. A radio signal from that point will be necessary to arm a warhead. If by accident, or under special conditions of stress, a nuclear weapon should be released without this arming, it could not cause a nuclear explosion.

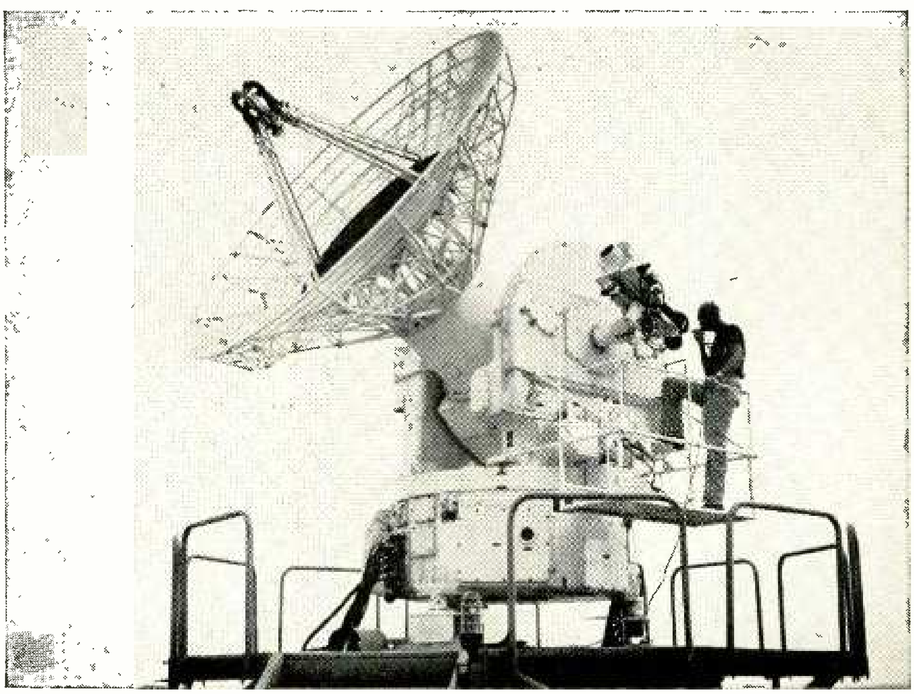
New Radar Technique Assures Moon Landings

A new approach to measuring the velocity of missiles and space vehicles was demonstrated to the press by the RCA Missile and Surface Radar Div. at Moorestown, N. J. The demonstration showed that velocity measurements accurate to 0.1 foot per second are possible. Accuracy of this order is extremely important in such projects as landing a vehicle on the moon. Under certain given conditions, the velocity a craft must attain to make a perfect bull's-eye on the moon is 34,830 feet per second. If the velocity is 34,790 feet per second or less, the craft cannot reach the moon. If it is 34,880 feet per second or more, it will overshoot.

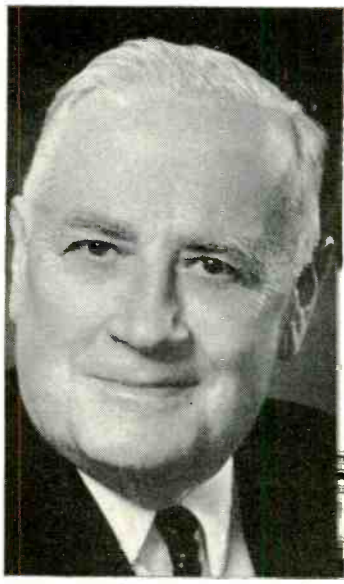
The new technique improves measurement accuracy by using what is called the "coherent pulse technique". The radar signal triggers a beacon in the missile or spacecraft. This beacon actually amplifies and retransmits the radar pulse without materially affecting the rf phase and frequency content. When the pulse is returned, the radar measures the doppler frequency shift, giving the vehicle's velocity. An ordinary radar-triggered beacon returns the pulse with no exact relationship to the pulse that triggered it, and therefore would be useless in making precise measurements.

The system is applied to an FPS/16 radar, and the receiver local oscillator signal is also synchronized to the transmitter signal, to keep the phase exact.

(*Continued on page 12*)



The FPS/16 radar, used to demonstrate the new method of precise velocity measurement.



THE HONORABLE ALEXANDER WILEY OF Wisconsin was elected to the United States Senate in 1938 and has served continuously since then. Widely recognized for his knowledge of our nation's needs for skilled manpower, Senator Wiley strongly supports technical education as an aid to our welfare and security.

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URGES MEN 17-55 TO TRAIN NOW FOR THEIR COUNTRY AND THEMSELVES — Senator Wiley knows the real need for Electronics Technicians. Our national defense plans, he said, call for thousands more of the "men who back the men in space capsules." The Senator is enthusiastic about DeVry's Space and Missile Electronics training, hailing it as a "forward step," and a program "that offers so much to the individual and means so much to his country."

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TELLS FELLOW SENATORS ABOUT DeVRY TECH'S UNUSUAL PROGRAM

In an overtime speech before the United States Senate, the Honorable Alexander Wiley of Wisconsin strongly urged his fellow Senators to advise young men about the advantages of training in Electronics. He praised DeVry Tech as one of the nation's largest and finest Electronics training centers, and for the thousands of thoroughly trained technicians it has helped to develop for industry since 1931.

Typical of the many opportunities for trained Electronics technicians are interesting, good-paying jobs in Space and Missile Electronics, 2-Way Radio, Television, Radar, Automation, Broadcasting, Industrial Controls, Computer work, etc. Previous technical experience or advanced education is not needed to enroll in DeVry's highly effective spare time, practical training, Senator Wiley also noted.

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(*Continued from page 8*)

FM Stereo Progress Report

Now roughly one year after stereo got under way with the coming onto the market of FM stereo receivers and adapters—some four months after the FCC approved FM stereo—there are more than 200 stations on the air in the US. By the end of this year you can increase this figure to 300. Advances in equipment have been remarkable—though it has been noted in some quarters that receiving apparatus is often better than the transmitting gear. Inadequate stereo separation and improper phasing have been reported in some areas.

Besides the US stations, there are two Canadian FM stereo broadcasters.

CALENDAR OF EVENTS

11th Annual Industrial Electronics Symposium, Sept. 19—20; Hotel Sheraton, Chicago, Ill.

New England Stereo/High Fidelity Show, Sept. 21—23; Mid-Town Motor Inn, Boston, Mass.

12th Annual Broadcast Symposium, Sept. 28—29; Willard Hotel, Washington, D. C.

8th National Communications Symposium, Oct. 1—3; Hotel Utica and Municipal Auditorium, Utica, N. Y.

Trade Exhibition of Electronic Equipment, Oct. 1—6; Apollo Hall, Amsterdam, Holland

National Symposium on Space Electronics and Telemetry, Oct. 2—4; Fontainbleu Hotel, Miami Beach, Fla.

1962 N. Y. High Fidelity Music Show, Oct. 2—6, N. Y. Trade Show Bldg., New York, N. Y. RADIO-ELECTRONICS exhibit in Room 624.

18th Annual National Electronics Conference, Oct. 8—10; McCormick Place, Chicago, Ill.

7th Annual Electronics Symposium, Oct. 12—13; Greensboro Coliseum, Greensboro, N. C.

ISA Instrument-Automation Conference and Exhibit, Oct. 15—18; New York Coliseum, New York, N. Y.

Symposium on Space Phenomena and Measurement, Oct. 15-18; Statler-Hilton, Detroit, Mich.

Society of Motion Picture & TV Engineers Convention, Oct. 21—26; The Drake, Chicago, Ill.

1962 Computer Applications Symposium, Oct. 24-25; Morrison Hotel, Chicago, Ill.

1962 Electronic Devices Meeting, Oct. 25-27; Sheraton Park Hotel, Washington, D. C.

17th Midwest Quality Control Conference, Oct. 26—27; Denver Hilton Hotel, Denver, Colo.

Conference on Spaceborne Computer Engineering, Oct. 30—31; Disneyland Hotel, Anaheim, Calif.

Shortwave Broadcasting Again in News

An application for a 250-kw international short-wave broadcast station has been filed by the Mormon church. The transmitter is to be operated in Deer Park, Fla. Trans World Radio has also applied for a 250-kw station, to be operated in Puerto Rico and beamed to Europe, North Africa and South America. Trans World also expects to use this station for religious broadcasts.

"Gibson Girl" System For Jersey Motorists

Ten emergency SOS signal stations have been set up along a stretch of New Jersey's Garden State Parkway for the use of motorists in trouble. Bright red boxes are installed about a mile apart. The motorist in difficulty simply turns a se-

lector switch to the right if he desires auto repair service, or to the left to bring the police, and turns a crank to generate the signal, after the fashion of the wartime "Gibson Girl" lifeboat radios. The message is then transmitted directly to police headquarters. The equipment was developed and installed by the ITT Kellogg Co. of Chicago.

Measles Good for Westinghouse Engineers

Measles on schematics indicate sources of error in a new Westinghouse reliability technique. A schematic diagram called a "measles chart" is marked with a dot wherever a part fails. The dots are in three colors indicating true failures, handling failures and test errors. A glance at where dots are concentrated on the schematic shows the engineer the parts that need attention in further design or modification.

Brief Briefs

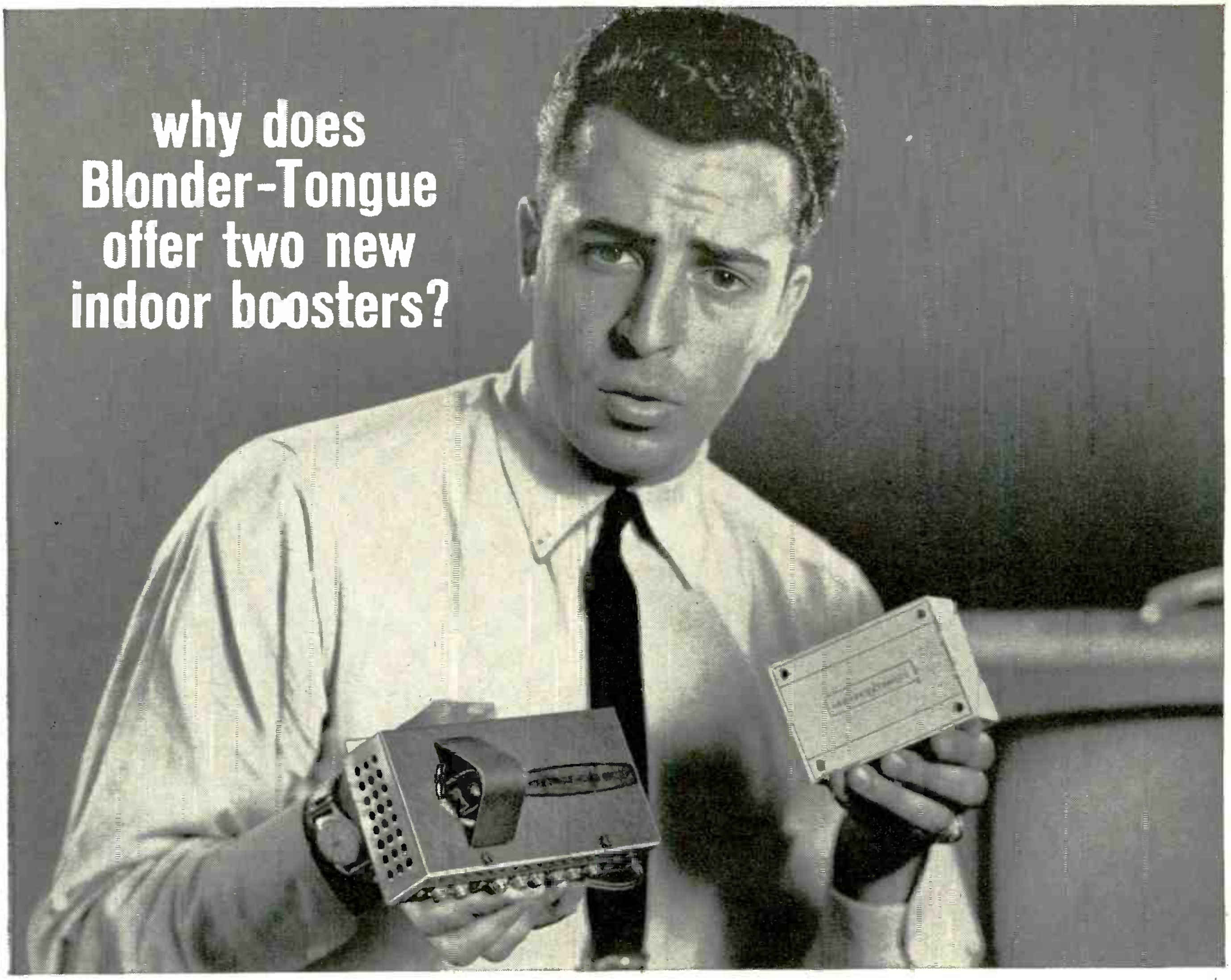
Radar, used to detect migrating birds, (RADIO-ELECTRONICS, December 1961, page 8) is now used to check bird speed, long a matter of dispute among ornithologists and hunters. A special Doppler radar, used at the American Museum of Natural History's research station on Long Island, has checked the speed of many flying birds, ranging from the ring-necked duck at 66 miles per hour to the chickadee at 17.

Owen D. Young, for many years the head of General Electric, died July 11 at the age of 87. He organized the Radio Corporation of America and was chairman of the board of RCA from 1919 until 1929.

Dr. Adolph H. Rosenthal ("Television Projection Methods," RADIO-ELECTRONICS, March 1949, page 36) died July 21 at the age of 56. Dr. Rosenthal was the developer of the Skiatron dark-trace tube, and did important work in large-screen television, as director of research and development of Scophony, Ltd.

RCA has announced the establishment of an applied research laboratory to perfect techniques in mass production of superconductive niobium-tin high-field magnets. The new research facility will be located at the David Sarnoff Research Center at Princeton, N. J.

Microseal transistor developed by Hughes eliminates the fragile thermo-bonded leads that cause many transistor failures. Tiny metal balls in a ceramic sandwich are used instead of the fragile leads. END



Let's talk straight-from-the-shoulder about indoor boosters. Transistor boosters provide higher gain and are more rugged, but they have one problem—overload (windshield wiper effect, loss of sync, etc.). If you use a transistor booster in an area with one or more strong TV or FM signals — *you may be buying too much booster!* On the other hand, tubed boosters perform very well in these areas—and what's more, they cost less. That's why Blonder-Tongue has two new home indoor boosters — the transistor IT-4 Quadrabooster and the frame-grid tubed B-33 Amplicoupler.

The B-33 costs less than the transistor IT-4, $19.95 as against $29.95. In most cases, the extra cost of the IT-4 is more than justified by its remarkable performance and long life. However, if the B-33 can do the job, we don't want you to spend more than is necessary for the finest TV reception.

Which one is best for you? Try one, or both. They can be hooked up in seconds at the set terminals. Try them on all channels. With either an IT-4 or a B-33, you'll end up with the best TV reception possible.

BLONDER-TONGUE IT-4 TRANSISTOR QUADRABOOSTER • 4 to 8X increase of signal voltage for 1 set • improves reception on up to 4 TV or FM sets • long-life transistor • stripless terminals • exclusive neutralizing circuit minimizes overload. List $29.95

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The Grantham Communications Electronics Course prepares you for a *FIRST CLASS* F. C. C. license, and it does this by TEACHING you electronics. Each point is covered simply and in detail, with emphasis on making the subject easy to understand. The organization of the subject matter is such that you progress, step-by-step, to your specific objective—a first class F. C. C. license.

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Gary DeLeo, 9219 N.E. 76th St., Vancouver, Wash.	1st	12
Dennis P. Miller, 416 W. Oak St., Alexandria, Va.	1st	12
Cecil C. Hironimus, 113 Berwick Rd., Johnstown, Pa.	1st	12
Max D. Reece, 4222 Fremont Ave. N., Seattle 3, Wash.	1st	20
Robert Benns, 3802 Military Rd. N.W., Washington, D.C.	1st	12
Jon M. Martin, 7913 Sausalito Ave., Canoga Park, Calif.	1st	24
Kline H. Mengle, 401 Granville Dr., Silver Spring, Md.	1st	24
Gary D. Burnard, Johnson Rd., Kirkwood, RD #1, N. Y.	1st	12
Newton E. Hastings, 318 Poplar Hill Ave., Salisbury, Md.	1st	12
Larry L. Tracewell, 1509 43rd St., Parkesburg, W. Va.	1st	12

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Correspondence

30 Speakers in Series!!! Horrors!!!

Dear Editor:

I was shocked to see in the April issue an article suggesting the use of 30 speakers connected in series ("PA Under Adverse Conditions"). Notwithstanding the serious possibility of complete breakdown should just one unit open, series connection is never advised for PA work because of reproduction deterioration due to the lack of electrical damping of the individual units via the relatively high series impedance of the others in the chain. Operation from the 70-volt output of the amplifier with line transformers at each speaker is the correct system.

HAYDON G. WARREN
Association of Public Address Engineers
Luton, Beds, England

[As a general rule Mr. Warren's comments are valid. But the case in point was unusual. It was a temporary installation for just a couple of hours. Cost was a factor. Thirty line transformers would have made the installation costly.—*Editor*]

Get Rid of TV Camera Shadows

Dear Editor:

This little tip may help readers who have built the TV camera that appeared in the May and June issues and are still looking at shadows. Remove all tubes but the 12AT7 modulator. Take a video signal from the video detector of an operating TV receiver (through a piece of RG-59/U coax, center conductor to video detector, shield grounded). Turn the camera on and connect the free end of the coax center conductor through an 0.5-μf capacitor to the modulator grid and ground shield. Now tune in a TV station. A good reproduction of the TV set signal should appear on the camera monitor. If not, troubleshoot the camera modulator.

When you are satisfied that the modulator is reproducing the signal properly, put the 6BR8's in and place the coax at the grids of each tube, starting from the fourth video amplifier and working back to the vidicon input circuit.

This method will show if the video amplifier is passing high and low frequencies or just low frequencies. You can save considerable time, since poor

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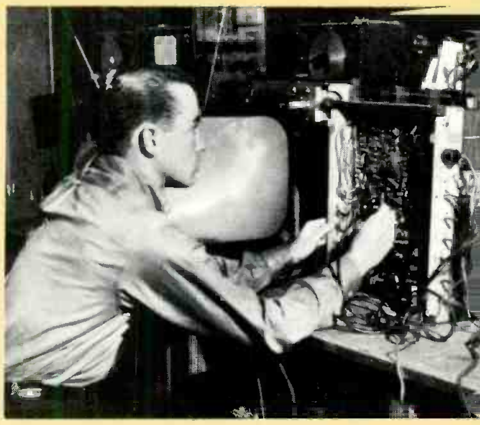

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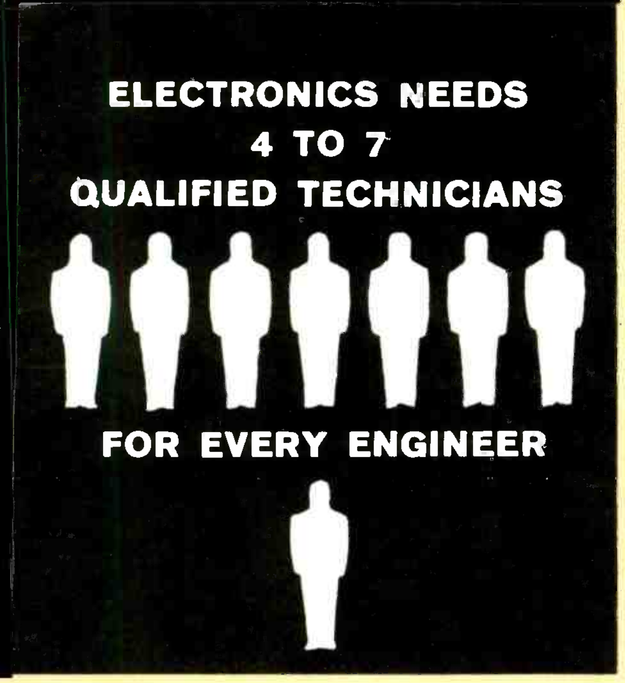

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SEE OTHER SIDE

"THE FINEST JOB I EVER HAD" is what Thomas Bilak, Jr., Cayuga, N. Y., says of his position with the G. E. Advanced Electronic Center at Cornell University. He writes, "Thanks to NRI, I have a job which I enjoy and which also pays well."

BUILDING ELECTRONIC CIRCUITS on specially-designed plug-in type chassis, is the work of Robert H. Laurens, Hammonton, N. J. He is an Electronic-Technician working on the "Univac" computer. Laurens says, "My NRI training helped me to pass the test to obtain this position."

"I OWE MY SUCCESS TO NRI" says Cecil E. Wallace, Dallas, Texas. He holds a First Class FCC Radio-telephone License and works as a Recording Engineer with KRLD-TV.

MARINE RADIO OPERATOR is the job of E. P. Searcy, Jr. of New Orleans, La. He works for Alcoa Steamship Company, has also worked as a TV transmitter engineer. He says, "I can recommend NRI training very highly."

FROM FACTORY LABORER TO HIS OWN BUSINESS that rang up sales of $158,000 in one year. That's the success William F. Kline of Cincinnati, Ohio, has had since taking NRI training. "The course got me started on the road," he says.

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video response here can throw the monitor out of sync.

Video will appear as black areas on the monitor screen, broken up, and horizontal sync will run wild when there are no highs in the video response.

Be sure the video amplifier is working properly and the modulator is reproducing the signal faithfully.

SAL LAURA, WA2RBB
FRANK MELLI, W2GJ1
Brooklyn, N. Y.

[Don't forget to check page 41 of the August issue. It gives additional dope on the TV camera.—*Editor*]

Watch Out for This One

Dear Editor:

I am afraid that Mr. Guthrie's ignition experiment (May 1962, Correspondence) is not likely to be very long-lived. The 2N1539 transistor has a voltage rating of only 40 and the possible "kickback" voltage with the circuit shown would appear to be about 200 volts minimum. As a designer and manufacturer of transistor ignition systems, I would like to reassure anyone who may have tried that circuit that with proper design a transistor electronic system can be extremely reliable.

FRANK ANDERSON
Wrentham, Mass.

About Light Dimmers

Dear Editor:

After reading "Semiconductor Light Dimmers for the Home" by Robert F. Scott in the March issue, I felt it should be stressed that the use of these controls (which are in essence dc controls) with fluorescent lights might result in damage to the ballasts.

The fact that the power to the load is half-wave over half the dimming range and, at best, nonsymmetrical over the remainder should also be brought out more fully. The statement regarding heaters, motors, etc. is correct but it should be stated that these devices may actually be damaged by the dc component of the power applied to them by these controls.

Also, since many living rooms, etc. have a wall switch which controls wall outlets intended for floor lamps, these outlets should be clearly marked "for use with floor lamps only," whether a light dimmer is used or not. Even the ordinary wall switch is not designed to handle the overloads that some devices require. If these outlets are marked properly, a dimmer can be used for very pleasing effects.

If indirect lighting by means of fluorescent lights is desired, there are available at this time at least two semiconductor light dimmers which control the phase of each half of the cycle in a symmetrical way and can, therefore, be used to control fluorescent lights very

(Continued on page 22)

(Continued from page 21)

effectively. These are the P-8764 300-watt and the P-8765 600-watt dimmers manufactured by Progress Webster Corp.

EDWARD M. LONG
Engineering Dept.
Progress Webster Corp.

Preventive Maintenance

Dear Editor:

I remember distinctly when Mr. Hugo Gernsback wrote an editorial in *Radio-Craft* somewhere around 1937 or 1938 explaining that doctors in China were paid to keep patients free from sickness; they are not paid when patients are sick. He suggested that the same method be applied by electronic technicians. The idea is very good. I personally have been servicing motion-picture sound and projection equipment on the same basis at a modest fee per month. It does not cost the owners anything extra when trouble develops.

JOHN H. FUNG
National Union Radio Service
9 Cornelio St.
Port of Spain, Trinidad, B.W.I.

Old Mags for Sale

Dear Editor:

My husband, Joe Simpson, known to many of your readers as an old-time radio man and collector of antique radio equipment and magazines died April 20, 1962, of a heart attack. I find it difficult to sell his collection, but it must be done, and maybe someone else can have the enjoyment he had.

Among the many items are Bunnell and Mesco parts; some 250 radio textbooks and service manuals; *Modern Electrics* (set incomplete), 1908's, etc.; *Wireless Age*, 1913 to 1925 (2 numbers missing); *Radio-Craft*, 1929 through 1948; *Radio-Electronics*, 1948 through 1960; *Electrical Experimenter*, 1913 through 1931 (9 copies missing); *Popular Radio*, 1922 through 1930; *Short Wave & Television*, 1930 through 1941, and many others and odd issues.

Anyone interested in more detailed information can write to me at the address shown below.

DOROTHY SIMPSON
85-39 152nd St.
Jamaica 32, N. Y.

Watch Those Antennas

Dear Editor:

From the attached clipping (Pasadena, Calif., *Star News*) you will see that "they are still at it." This pair is lucky to be alive.

"A La Puente couple are recuperating at home today after they suffered minor burns when a 30-foot ham radio antenna they were removing fell across a 12,000-volt power line. The antenna was being removed from the ground in front of their home when it fell."

RUFUS P. TURNER
Altadena, Calif.

END

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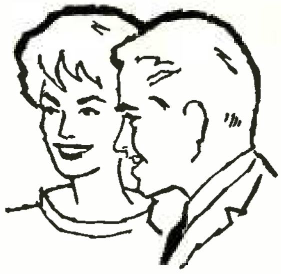

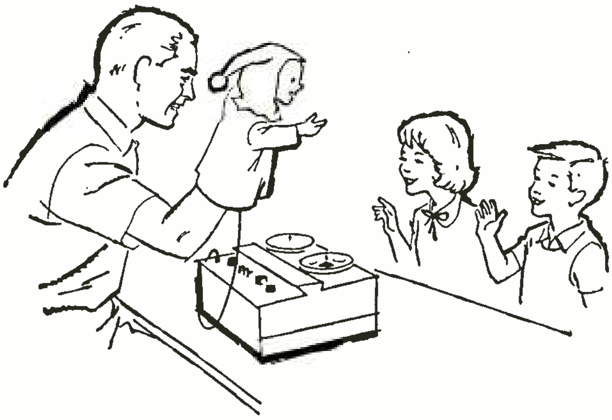

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How do you get microphone-shy youngsters to talk freely? Try slipping the microphone inside a hand puppet. While the child talks to the puppet, you will be recording every word on long-lasting Tarzian Tape.

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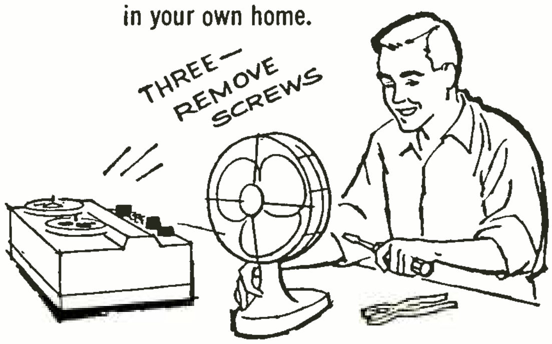
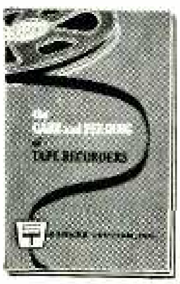


This Free Tarzian Booklet,

"The Care and Feeding of Tape Recorders," is available from your tape dealer—or write to the address below. It contains 32 pages of additional ideas for the use and maintenance of your tape equipment. And for hours of entertaining and practical recording, ask for Tarzian Tape—either acetate or Mylar* base, on 3, 5, or 7-inch reels. Compare its sound reproduction to that of any other tape on the market. Discover for yourself that, while Tarzian Tape's price is competitive, its quality is unchallenged.



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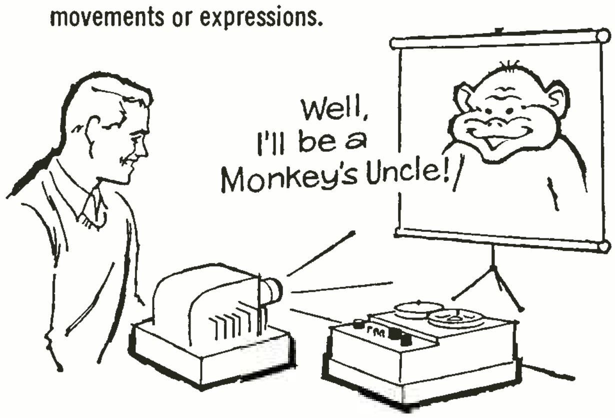
Tape recorders and Tarzian Tape pep up your movie and slide shows just as Rodgers worked with Hammerstein—good separately, outstanding together. In addition to straight commentary and music, other voices and sounds can be taped from radio and TV for use as needed—traffic, machinery, applause, and so on. For something different, try filming house pets or zoo animals—then synchronize, on tape, the voices of family and friends to match the animal's movements or expressions.



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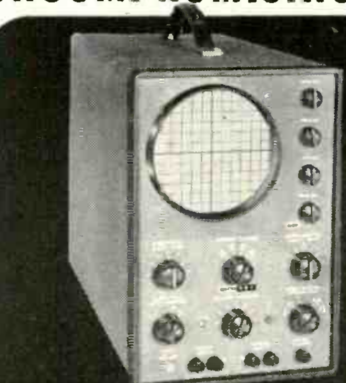

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Vertical amplifier with 3 push-pull stages, direct coupled throughout; 4-position, frequency-compensated V input attenuator; internal calibrating voltage. Recurrent sweeps from 10cps-100kc in 4 overlapping ranges; choice of int. +, —, 60cps, or ext. sync fully automatic sync. operation; full retrace blanking. Intensity, focus and astigmatism controls on panel. Sharp, clean, non-blooming trace. Instantaneous, drift-free positioning. Convenient direct plate connections. V amp: 10mv p-p/cm sens.; flat dc-500kc, —6db at 1mc; 1 meg input Z. H amp: 0.5V p-p/cm sens.; 2cps-450kc flat response; 10 meg input Z.

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Highly sensitive, reliable AC VTVM & wideband amplifier. Measures 100 microvolts to 300V in 12 ranges; 10c-600kc ±0db response, 10 megohms input impedance, ±3% accuracy. Wideband amplifier switch-controlled for external use: 8c-800kc response, 5VRMS output, 5K ohms output impedance, gain control, noise —40db. Frame-grid triode cathode follower input circuit, freq.-compensated input attenuator, cathode circuit attenuator. Regulated power supply.

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All the precise VTVM facilities of the #250 less external use of the wide-band amplifier.

*Formerly designated as #260.

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AC voltmeter & load-compensated audio wattmeter of unique quality. Measures AC voltages from 1mv to 1000V in 11 ranges, power from .015mw to 150W in 7 ranges, across standard loads from 4 to 600 ohms. Tapped power resistor load (4, 8, 16 and 600 ohms) handles up to 80W on 8 ohms and 40W on other taps. Switch to external load up to 150W. Meter automatically compensated for any load selected, internal or external, to provide single watt scale.

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Complete with exclusive dual-purpose Uni-Probe® (U. S. Pat.)

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Tests capacitors in the circuit without unsoldering. Checks for shorts, (even in the presence of as little as 1 ohm shunt resistance). Checks open units (as little as 5MMF in the circuit). Measures capacitance with ±10% accuracy between 0.1mf and 50mf. Measures RC product, convertible into dissipation or power factor. Utilizes electron-ray tube EM84/6FG6 with sharp bar pattern. Line adjust control permits maximum sensitivity regardless of line voltage variations.

TRANSISTOR & CIRCUIT TESTER #680

Kit $25.95 Wired $39.95

Measures ICEO, ICBO & DCβ directly, ACβ indirectly, without charts or special settings—plus all dc volts, currents & resistances needed to service transistor equipment. Battery powered. 50μA, 3½" face meter movement provides sensitivity & scale length necessary for accuracy. Built-in 20,000ΩV VOM facilities free your other test equipment.

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ELECTRONICS IN 2012 AD

... The Flower of Electronic Engineers Forecast the Future ...

WHEN the Institute of Radio Engineers (IRE) celebrated its 50th anniversary last spring, the editor of the *Proceedings of the IRE* asked IRE Fellows to let their imaginations roam 50 years hence, to the year 2012. There was a wide response, which was recorded in the 50th anniversary issue. The following are excerpts from the prognostications of a number of internationally famous electronic engineers: —*H.G.*

Dr. Lloyd V. Berkner, president, Graduate Research Center of the Southwest, Dallas, Tex.: . . . The basic communication and navigation system utilizes coherent radiation in the wavelength ranges of 1,800 to 30,000 angstroms which lend themselves to formation of highly focused beams with very lightweight and miniature radiating systems. . . . Our main transmitter with an antenna of 2 decimeters diameter can focus the entire radiation of 1-watt peak power on an area 500 meters in diameter on earth. . . . You will take part in construction of the new Jovian system designed to provide communication, navigation and control, for the expedition to land on the minor satellite of Jupiter next year. . . . Travel arrangements between earth and moon . . . are entirely controlled by automatic data systems using the high-speed real-time computer of the type that I hold here in my hand. . . . Your travel time to the moon was 36 hours . . .

Dr. J. H. Dellinger, retired physicist and radio engineer, former president of the IRE: . . . Probably intelligent beings on the planets of many stars are sending out signals with the idea of contacting life on other worlds. . . . If we probe the entire spectrum, we might learn something on the moon that we could not do on earth . . .

Dr. Frederick E. Terman, vice president and provost of Stanford University, Stanford, Calif.: . . . The basic training for the electronic scientist of 2012 will be a 4-year course, as it is today. The amount of knowledge will, however, be increased by a factor of at least 50% through programmed learning systems growing out of today's teaching machines. . . . The overall result will be that in 2012 the typical recipient of a Bachelor's degree will have covered material that would today require at least 3 postgraduate years of solid course work . . .

Dr. Harold A. Zahl, director of research, US Army Signal Research and Development Laboratory, Fort Monmouth, N. J.: . . . even children disliked education in the 1960's. A person of that era would be amazed to see our 2- and 3-year-olds sitting in front of their televideo screens learning the International Language and other basic studies.

Dorman D. Israel, executive vice president, Emerson Radio & Phonograph Corp., Jersey City, N. J.: . . . in 2012 . . . newborn infants can be operated upon and the latest submicroelectronic equipment installed in the brain and at certain critical points in the spinal column so that they are almost certainly assured not only of the benefits of full nonradio communicative powers but also there is reason to believe that their scientific creative ability will be enhanced. . . .

Dr. W. D. Lewis, executive director of Research Communications System Div., Bell Telephone Laboratories, Inc., Murray Hill, N. J.: . . . it seems likely that most written communication will be transmitted electrically. . . . The private citizen will have electrical access to machines of all kinds, for example, access to reference libraries and centralized data-processing units for banking. . . . It is possible that a combination of visual recording, teaching machine techniques and human intervention will make available the best education in any subject, to anyone who wants it . . .

Dr. Henri Busignies, vice president and general technical director, International Telephone & Telegraph Corp., New York, N. Y.: . . . On the very dense transmission links for relatively short distances (up to a few thousand miles) on land, waveguide transmission will replace microwave space transmission and will give a bandwidth capacity that will make available thousands of television channels; this will permit transmission of masses of data, of newspapers and printed material and will make available phone vision to a large section of the subscribers at a reasonable cost. The carrier used in the waveguide will be a coherent beam of light. . . . Newspapers (or rather their equivalents) will be made locally automatically from a liquid . . .

Dr. Peter C. Goldmark, president of CBS Laboratories, Stamford, Conn.: . . . Anyone in 1962 with some imagination should have been able to predict our moon-to-earth citizens radio service, operating so effectively in the millimeter citizens band, but it would not have been easy to foresee our tremendously efficient high-power solid-state wristwatch transceivers and plasma antennas. . . . TV cameras of today (2012 AD), our 1-inch-diameter, 2-inch-long solid-state camera units, combining the multicolor-sensitive, scanning and amplifying elements in a number of evaporated layers, are far ahead of what (was) predicted . . .

Dr. Yasujiro Niwa, president, Tokyo Electrical Engineering College, Chiyodaku, Tokyo, Japan: . . . Again, the advancement of electronics decisively solved this problem: today principal languages of the world can be translated instantly by the aid of electronics. Our telegrams are simultaneously translated into, and typewritten by, the language of the receiver, and on our overseas telephone the speech is also converted to the language understood by the receiver and vice versa. Moreover, by hyper-miniaturization of electronic parts and appliances, the size of the translating machine is also reduced to such an extent that it can be easily used at home and carried by hand . . .

Benjamin B. Bauer, vice president, acoustics and magnetics, CBS Laboratories, Stamford, Conn.: . . . Devices for converting sounds to nerve impulses for direct connection to the brain will have been developed; however, they will require a delicate implanting operation and will not be in general use. These "artificial cochleae" will largely replace deaf-aid devices as we know them today in cases of inner

(*Continued on page 81*)

Electronic Applications AKG K-50 phones.

stereo headphones for high fidelity

Listen, and enjoy listening without disturbing others

By JOSEPH MARSHALL

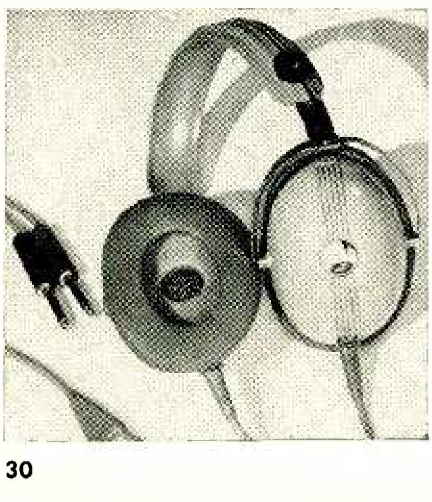
There are several very good reasons for using headphones for listening to high-fidelity stereo programs. The most obvious: it is the easiest way to resolve peacefully the all-too-common conflict between your own desire to listen to the hi-fi and the rest of the family's preference for "Untouchables" on TV —or vice versa. True, a good set of headphones will set you back from $15 to $50, but family peace and harmony should be cheap at several times the price.

With headphones, you can listen at "concert-hall" volume level without inviting the wrath of neighbors, the cancellation of a lease in an apartment building or a summons in quiet suburbia—though I have never been able to understand why people can tolerate the noise of six power lawnmowers per block on a Sunday morning but complain about one musically loud hi-fi at other times. Moreover, the high listening level is obtained with minute amounts of driving power and thus at a point in the amplifier's operating range where distortion of all kinds is at a minimum.

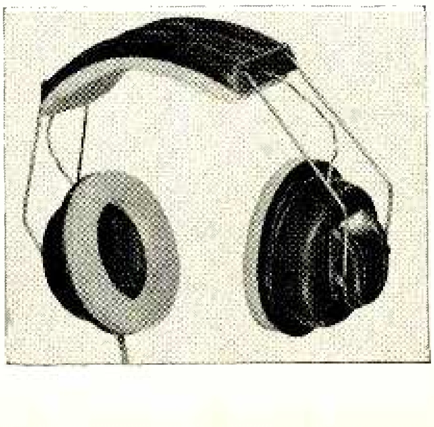
In several very important respects headphone quality can be superior to speaker quality. Since headphone elements are small and have very little mass, they can have less inertia, acquire less momentum and are more easily damped. Thus well designed headphones can provide superior transient response. The high-frequency response does not suffer from directional effects or absorption by the environment because all highs are piped directly into the ears. Because the tight coupling eliminates practically all room noise, there is far less masking of subtle components. This and the fact that amplifiers operate at their minimum distortion point, and that we can listen at a higher subjective level—and therefore the low-level components are louder to begin with—can result in superior definition.

Headphone design has progressed tremendously in the past few years. Most headphones used to be weak in the bass end—partly because of their small size and partly because of the very small air chamber in which the sound must be generated. To improve the bass response some afficionados went so far as to apply heavy grease to the rims of headphones to seal the air chamber completely. This is no longer necessary. Good stereo headphones will amaze you with their bass response, and unless you have a speaker system with a genuine response well below 40 cycles, you are not likely to miss any bass at all. The bass response is aided in most cases by the fact that the high sensitivity of headphones permits you to operate with the volume control just barely cracked open. At this point most preamplifiers deliver maximum "loudness" bass compensation, thus providing tremendous bass boost. Since, even with this boost, the amplifiers are loafing, the boost is minus the distortion you would get from most amplifiers if you tried to get a similar

Sharpe HA-10.



Koss SP-5VW.



Lafayette F-770.

Monarch ES-300.

amount of boost at a similar subjective loudness with loudspeakers.

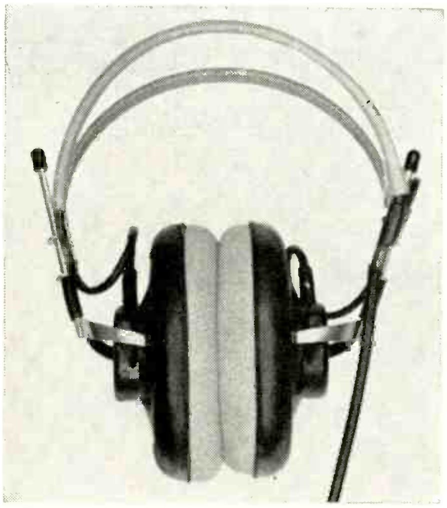
Finally, headphone listening to stereo recordings provides an entirely different aural perspective and, therefore, an entirely different kind of experience than that provided by loudspeakers. This results partly from the greater intimacy of the aural experience with headphones and partly from the fact that headphone listening provides a *binaural* rather than the stereophonic perspective offered by speakers. Since this is a very big and important difference, let's clear it up right now.

Binaural vs stereophonic

Stereophonic reproduction attemps to produce the perspective of the *observer* at an event, sitting at some distance from it—for instance, in the 20th row, middle aisle, of Carnegie Hall. With this perspective the listener is always clearly detached from the source of the sound. It is spread out as if on a stage, at one side or end of a room, but always at some distance from the hearer. It has width and depth and directionality but it is always *out in front*. But, however you manipulate it, stereophonic reproduction always produces the perspective of the observer or bystander hearing the event but not participating in it.

Binaural reproduction *can* be manipulated to produce the very same effect. But it can go further than that

Jensen HS-1.

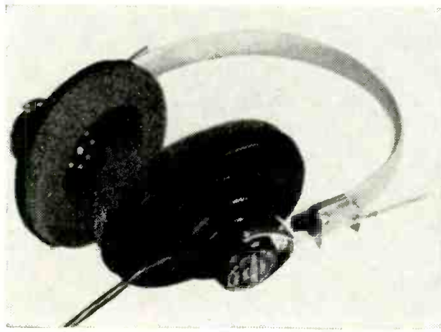


Permaflux B-DHS and DHS series phones.

—it can provide the perspective of an actual *participant* right in the middle of the event that produces the sound. It can, for example, take one right into the middle of a symphony orchestra, or a factory or a street crowd, or even place one in the middle of a bowling alley, halfway between the foul line and the pins, with the ball coming right through one's legs before hitting the pins. This is exactly what listening to a stereo recording with headphones does —it converts the perspective from that of a mere spectator to that of a participant. In the case of a symphony orchestra recording, headphones pluck you right out of that seat in the 20th row and plunk you right into the chair of that legendary percussionist with the rare Siamese instrument who will strike one note in the entire evening's program, merely sitting in the orchestra the rest of the time. This is a most spectacular effect, particularly when experienced for the first time.

Not everybody will like this perspective. It will obviously seem most natural to musicians and conductors. I find it frustrating to seem to be a participant without actually participating. I keep wanting to find a flute, a horn or even a stick to beat time with, so I can contribute to the total noise. Fortunately, it is possible to manipulate this perspective so that you can have either the stereophonic perspective of the observer or the binaural perspective of the participant.

R-Columbia type A.



Superex ST-M.

Phones change the perspective

To understand how we can do this, let us find out why headphones change the perspective. You will recall that the big problem with early stereo reproduction was that of obtaining a uniform spread of the sound source with only two channels. Early records, and some recent "spectaculars," tended to have half the band out in left field, half out in right field and nobody in center field. The problem was resolved by filling the "hole in the middle" with an infinite number of phantom speakers spaced between the two actual speakers. This was done by exploiting an interesting acoustic phenomenon. If the same sound reaches both ears with the same intensity and exactly in phase from two speakers separated by a considerable distance, the ear imagines that the sound emanates from an imaginary speaker at a point halfway

Knight KN-845.

STEREO HEADPHONE ROUNDUP

Manufacturer	Model	Price	Type and Impedance	Frequency Response (cycles)	Accessories
Allied Electronics Corp. 100 N. Western Ave. Chicago 80, Ill.	Knight KN-845	$19.95	Dynamic, 4–16 ohms	25-16,000	Hookup Box $7.95
California Radio Hollywood, Calif.	Calrad HP-1	$11.95	8 ohms	—	—
	Calrad HP-2	$14.95			
Electronic Applications, Inc. 80 Danbury Road, Route 7 Wilton, Conn.	AKG K-50	$22.50	Dynamic, 200 ohms	30–20,000	Matching Transformer for High Impedance
Gotham Audio Corp 2 West 46 St. New York 36, N. Y.	Beyer DT-48	$79.50	Dynamic, 5–25 ohms	20-18,000	Matching Transformer for 600-ohm line $79.50 each
Jensen Mfg. Co. 6601 S. Laramie Ave. Chicago 38, Ill.	HS-1	$24.95	Dynamic, 8 ohms	20-15,000	Includes Jack Panel, Bauer Cross-Feed Network $19.50, and Stereo Headphone Control Center $39.75
Koss Electronics, Inc. 2227 North 31 St. Milwaukee 8, Wis.	SP-5VW	$24.95	Dynamic, 4 ohms	10-15,000	Various Adapter Boxes for Different Connections
Lafayette Electronics Corp. 111 Jericho Turnpike Syosset, L. I., N. Y.	F-767	$13.95	Dynamic, 8 ohms	30–15,000	Resistor Box $4.95 Y Connector $2.45 Extension Cord $2.95
	F-770	$19.95		25–15,000	
Marcor Inc. 200 South Tioga St Ithaca, N. Y.	700	$37.50	Dynamic, 20 ohms	30–16,000	
Monarch Electronics Intl. Corp. 7035 Laurel Canyon Blvd. North Hollywood, Calif.	ES-300	$19.95	Dynamic, 8–16 ohms	25-15,000	3-Way Switchbox included
Permoflux Corp. 4101 San Fernando Rd. Glendale 4, Calif.	HDB-16-16	$40.00	Dynamic, 16 ohms	30–18,000	Various Adapters
	B-DHS	$45.00–$52.00	Dynamic, 12–15,000 ohms*	20–20,000	
Radio Shack Corp. 730 Commonwealth Ave. Boston 17, Mass.	Realistic	$14.95	Dynamic 8–500 ohms	20-20,000	Includes Jack Plate and Load Resistors
R-Columbia Products Co. 2008 St. Johns Ave. Highland Park, Ill.	Type A	$15.95	Dynamic, 8 ohms	20-17,000	
Sharpe Instruments Inc 965 Maryvale Dr. Buffalo 25, N. Y.	HA-10	$43.50	Dynamic, 8–3,000 ohms*	20-20,000	Adapter Control Unit Available
Superex Electronics Corp. 4-6 Radford Place Yonkers, N. Y.	ST-M	$29.95	Dynamic Woofer 8–16 ohms Ceramic Tweeter 15,000 ohms	20-20,000	Chairside Stereo Control Box. Miscellaneous Adapters
	ST-MH	$34.95			

*All data from manufacturer's specifications. * A series of phones of various impedances*

between the two actual speakers. If phase is maintained but the loudness of the sound from the two speakers differs, the imaginary speaker assumes positions at various points between the two actual speakers.

It is quite simple to manage this. If we feed a portion of the sound from each channel to the other channel in exact phase, the in-phase components add when they reach the first common load and appear to emanate from the phantom speaker. This is now commonly done in the recording process. One way is to overlap the patterns of the two stereo microphones in the middle. The portion of the orchestra covered by both microphones is fed to both channels in phase and in the reproducing process appears to emanate from the middle as soon as both channels meet a common load in which mixing can occur. Another way is to use three mikes, the two end mikes with no overlap, and a third mike covering the middle. The recording is made on three tracks. Then, in the master, the output of the middle mike is fed into both channels in varying proportions. Since it is in phase in both channels, it combines in a common load and to the ear appears to issue from the middle, as it did in the original performance.

The common load

Note that I have monotonously kept repeating the phrase "common load". This was deliberate, because it is here that the difference between loudspeaker and headphone reproduction of a stereo record arises. To reproduce the middle channel there must be a common load in which the in-phase components cross-fed into the two channels can mix and combine. But in a stereo system great pains are taken to isolate the two channels, starting right at the grooves of the recording and going all the way to the speakers. In short, there is no common load from pickup to speakers. It is the air in the listening room, shared by both speakers, which provides the common load. In other words, the phantom speaker is generated by *acoustic* mixing.

But with headphones, intimately coupled to each ear, the air chambers in which the sound is generated are also isolated from each other. Hence there is no common load whatever, there is no mixing and the middle channels are never generated at all. Therefore, the listener is transported to a point exactly halfway between the center of the pickup patterns of the two end microphones or right in the middle of the sound itself.

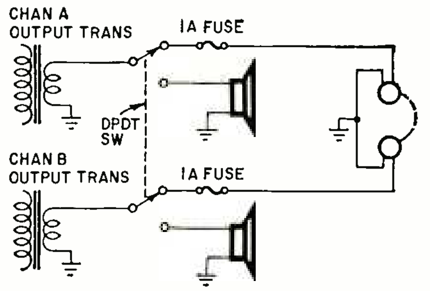


Fig. 1—A dpdt switch is the simplest device for coupling headphones to a hi-fi system.

If you like this, and you may love it, there is no problem. But if you would like to duplicate with headphones the perspective obtained with loudspeakers—and intended in the making of a stereo recording—something must be done to restore the original perspective in spite of the refusal of headphones to behave like loudspeakers. Fortunately there are several ways of doing this with varying degrees of complexity and success.

Headphone hookups

Let's consider ways of connecting headphones into a stereo system. To begin with, if you do not mind, or prefer, the changed perspective, the job is simply to connect the phones conveniently, safely and with reasonably good matching. Such matching or control units are available from practically every manufacturer of headphones. Some come as standard equipment. And the purchase of one of these is the simplest way of meeting this problem.

On the other hand, these devices are quite simple and those who prefer to roll their own, or who want more elaborate control, can easily construct one. The simplest possible coupling unit is shown in Fig. 1. It consists of a dpdt switch and a pair of 1-amp fuses. Throwing the switch provides either headphone or speaker listening. Do not leave out the fuses. Headphones are easy to burn out.

This simple method has one disadvantage. Phones are far more sensitive than speakers. Consequently, if you throw the switch without turning the

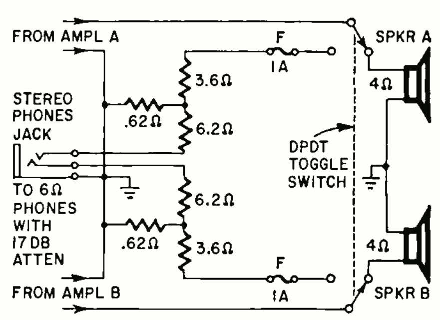


Fig. 2—This arrangement will keep you from blowing the protective fuses every time you switch from speakers to phones.

volume control down first, you are likely to blow the fuses or burn out the phones if you have no fuses. The network in Fig. 2, used by our editor, will avoid this and provide about the same relative loudness level with phones as with loudspeakers at any setting of the volume control. The resistors can be small ½-watt units. A more elegant way of adjusting level would be to use a pair of ganged stereo L- or T-pads as in Fig. 3, so the headphone level can be set and adjusted to any desired level. With this arrangement, the switch and fuses could be located near the amplifier or control unit, and the pad fitted into a small box fed by three-wire cable long enough to reach the desired listening position, thus providing a convenient way of controlling volume from a remote location. Although these methods of maintaining the same relative loudness are a convenience and provide a safety factor, their use eliminates one of the biggest advantages of head-

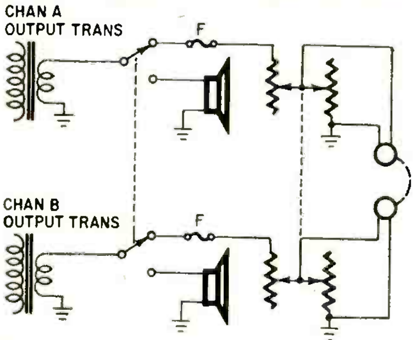


Fig. 3—Add pads so you can vary the level to suit your ears.

phones—the ability to obtain a high subjective level with far lower driving power and therefore with mimnium distortion.

Correcting the inversion of perspective can complicate matters. B. B. Bauer, chief engineer of CBS Labs, proposes the two networks in Fig. 4, which were developed with the aid of an analog computer and provide automatic correction of the inversion effect. Unfortunately, neither network meets the most common need—matching a pair of low-impedance headphones to the low-impedance output of a stereo amplifier. The network in Fig. 4-a will feed a pair of high-impedance phones from the low-impedance source. The one in Fig. 4-b will feed a pair of low-impedance headphones from a high-impedance source, such as a preamp. Not owning an analog computer and being incapable of the manual mathematics necessary to adapt these networks to the more common need, we can offer no version for matching low-impedance phones to a low-impedance source.

Fortunately, the system is now available in commercial form, Jensen having received a license under the Bauer patent (see table). There are other ways

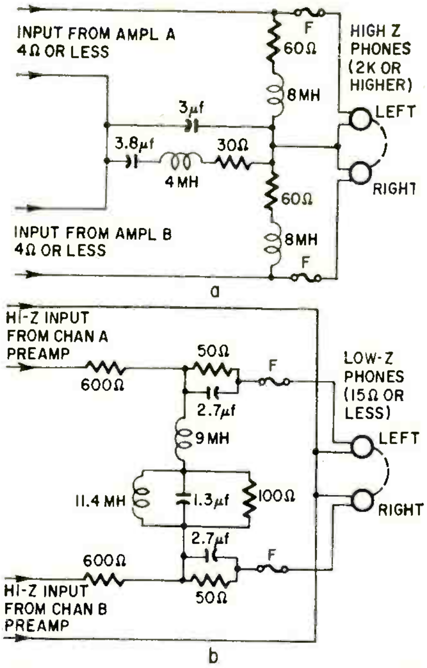


Fig. 4—Two networks for correcting inversion of perspective caused by headphones: a—for high impedance headphones fed from low-impedance source; b—for low-impedance headphone fed from high-impedance source.

of getting a similar job done. If your preamp has a "blend" control, no additional adapter is necessary. The blend control will provide an electrical common load and cross-feed and blend the in-phase elements so that they are mixed when they reach the headphones. In the stereo position you will get the binaural perspective; with blending you can restore the original stereophonic perspective or, as with loudspeakers, produce a strictly monophonic perspective.

If your preamp does not have a blend control, the same effect can be achieved with the arrangement diagrammed in Fig. 5. Here, pot R serves as the blend control. With the switch off, the control is out of the circuit and

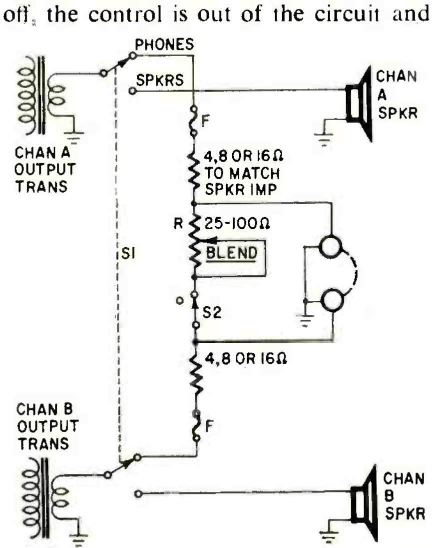


Fig. 5—A blend control lets you mix the sound from the two channels.

you get binaural reproduction; with the switch in, the pot will provide an electrical common load, the amount of cross-feeding being determined by the resistance brought into the circuit. With the pot short-circuited, you get a strictly monophonic perspective. The pot can be any convenient value between 25 and 100 ohms.

The most elegant and flexible solution of all is presented by the gadget diagrammed in Fig. 6. It is inserted between the stereo preamp and the power amplifiers. This consists of two cathodyne inverters inserted in shunt with the two stereo channels. As we know the output of such an inverter is in phase with the input if taken off the cathode load, and out of phase with the input if taken off the plate load. The pots bridge the two outputs of each inverter, and feed them to the opposite channel. In the middle position, the output slider is grounded and there is no cross-feeding at all. As the sliders move toward the cathode side, the output is

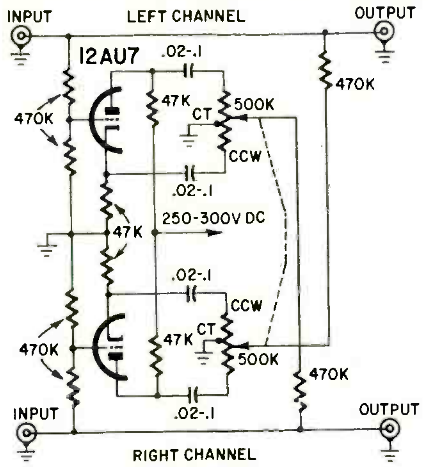
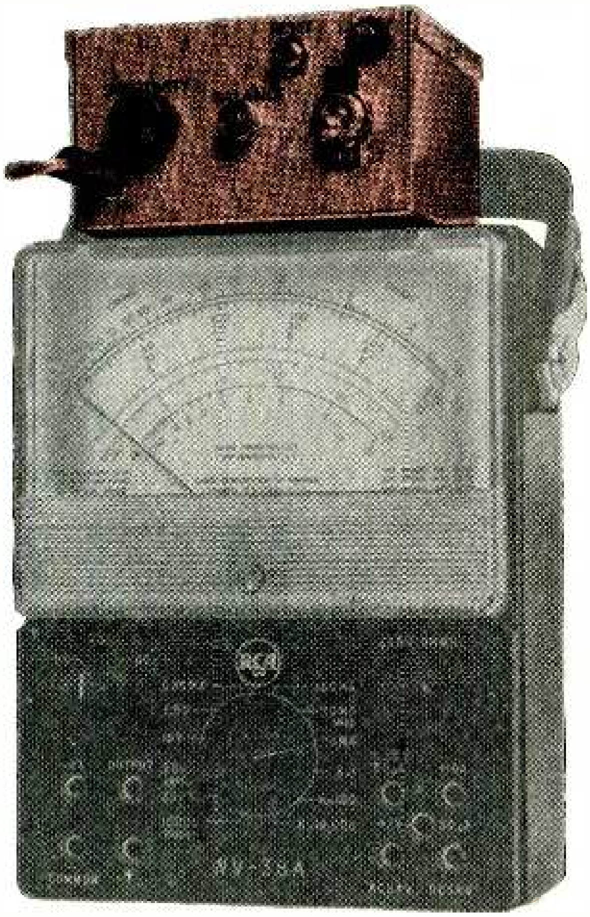


Fig. 6—The ultimate device for coupling headphones to an amplifier.

in phase; as they move toward the plate side, the output is out-of-phase. With this arrangement we can cross-feed varying amounts of either in-phase or out-of-phase components from each channel to the other. If the cross-feed is in-phase, the in-phase elements of the two channels add to produce blending and decrease the separation between channels. This is what we want to do when using headphones to restore the stereo perspective. On the other hand, if the cross-feed is out of phase the common or in-phase elements are cancelled out. This does not affect headphone reproduction markedly; but with loudspeakers it will increase the separation and remove the phantom middle, and thus make the recording more directional than it was intended to be. Of course, it can also be used to increase the middle component and reduce the separation. This then is an extremely versatile gadget capable of providing a wide variety of effects with both speakers and headphones. END



transistor meter saver ends burnouts

This little circuit protects even low-range microammeters against excessive currents

By TONY KARP

Many pieces of modern test equipment use sensitive meters. In most cases, these meters are unprotected and can be damaged easily. It's not hard to burn out a meter or bend the needle so it gives inaccurate readings. All it takes is the slip of a test prod or trying to measure the resistance of a live circuit.

What can be done to protect a sensitive meter? The smallest fuse made is rated at 2 ma. But besides being expensive ($1 apiece), they don't offer much protection for a delicate microammeter.

The circuit breaker described here can be used to protect even the most sensitive meters. When used with a vom or vtvm, it protects on all ranges and has no effect on the readings.

The meter saver is connected directly across the meter terminals. When the current exceeds a preset value, the thyristor triggers, short-circuiting the meter and lighting the neon indicator lamp. The thyristor locks on once it is triggered, so the meter remains short-ed until the RESET button is depressed. This opens the thyristor circuit, turns off the thyristor and de-energizes the relay. The meter saver is powered by two penlight cells and draws a standby current of less than 100 μa. (Fig. 1 shows the circuit.)

R1—pot, 500,000 ohms, linear taper
R2—pot, 10,000 ohms, linear taper
R3—47 ohms, 1/2 watt
BATT—3 volts (2 penlight cells. Alkaline or mercury types are preferred.)
D1, D2, D3, D4—1N198, 1N34, 1N60 or equivalent
J—phone jack with matching plug
RY—spdt relay, 50-ohm coil (Sigma 41F-50S-SIL or equivalent)
S1—spst toggle
S2—spst push button, normally closed
T—input transformer: primary, 3,000 ohms, ct; secondary, 100,000 ohms (Argonne AR-101, available from Lafayette Radio, or equivalent)
V1—2N217 (see text)
V2—2N1213 mesa thyristor (RCA)
V3—2N241, 2N107 (see text)
Chassis and case to suit
Battery holders,
Transistor sockets (3)
Neon lamp, NE-2
Miscellaneous hardware

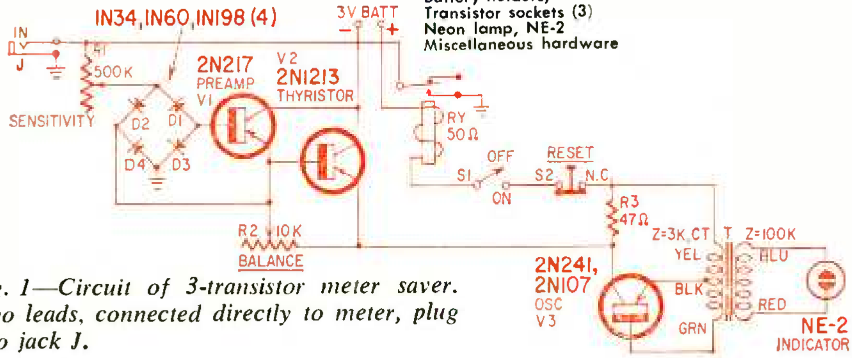


Fig. 1—Circuit of 3-transistor meter saver. Two leads, connected directly to meter, plug into jack J.

Since the circuit breaker must short its own input, some sort of latching device is needed so the meter will remain shorted. As a low-voltage latching relay was not available, I decided to let the circuit itself "lock in". An RCA 2N1213 thyristor was chosen for this purpose.

Named after the thyratron, the thyristor is a p-n-p transistor with two stable states. It stays "off", passing only a small amount of collector current, until the input current at the base exceeds a certain value. Then it "turns on". There is no halfway state as with a regular transistor—the thyristor is either off or on. This is a great advantage as it draws current only when in its on state. Unless the collector current is limited to less than 10 ma, the thyristor will remain on even after the input signal has been removed. It is this feature that allows an inexpensive relay to be substituted for a latching relay. Pressing RESET button S2 disconnects the power supply, and the thyristor returns to its off state.

V1 is an emitter-follower preamplifier that raises the input current to a level high enough to trigger the thyristor. Although a 2N217 is specified, almost any high-gain transistor will work.

The network of diodes (D1 to D4) is actually a full-wave bridge that makes the circuit breaker nondirectional and protects the meter from overload currents of either polarity. If this is not needed, the diodes can be omitted and V1's base becomes the negative input terminal.

The neon indicator lamp is powered by oscillator V3. Transformer T steps up the voltage to light the lamp. If you don't need an indicator, V3, T and the neon lamp can be omitted.

The circuit breaker can be built into a small chassis box as shown or right into the piece of test equipment it protects if there is enough room.

Construction hints

Mount the sockets for V1 and V2 on a terminal strip. This eliminates the need for a circuit board. Don't plug in the transistors until construction is completed, batteries in their holders, and S1 in the off position. Transistors and thyristors can be damaged by transient currents, especially if there are large inductances such as the relay and transformer in the circuit.

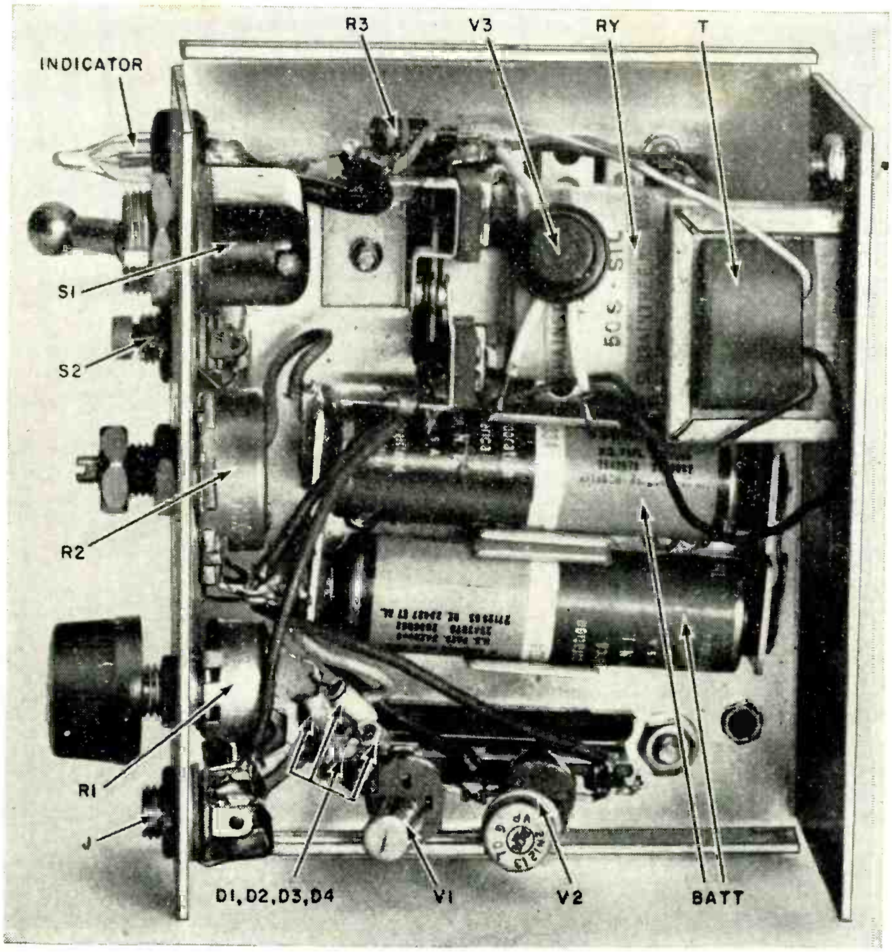
It will be wise to insulate the input jack from the case. My jack was grounded and the leads shown connected to it were also simply grounded. But I use it bolted to a bakelite meter case. If your vtvm is in a metal case, and some of its circuit connections are grounded, you will be safer with the meter-saver case isolated from any circuit.

Test V1 with a leakage-gain type transistor checker. The circuit breaker will not function properly if V1 has excessive leakage. If it has low gain, sensitivity is decreased.

If penlight cells are used for power, they should be of the alkaline or mercury type for longer life. Some of these cells have metal cases with thin paper protective coverings. When inserting them in the holder, be careful that a sharp edge does not pierce the paper and ground the cell.

After the circuit breaker is assembled and the wiring has been carefully checked, test it before you use it to protect a meter. Set R2 to its highest resistance and turn the unit on. If the relay closes and the neon lamp lights, leakage current from V1 is triggering the thyristor. This leakage is balanced out by adjusting R2. Press the reset button to open the relay and extinguish the neon lamp. Set R2 for a slightly lower resistance and, if the circuit still fires when the reset button is released, keep lowering R2 until you find a setting where the lamp remains off. Leave R2 at this setting and readjust it only if the circuit will not reset. If the circuit will not reset at any setting of R2, there is a wiring error or V1 has excessive leakage and should be replaced.

Set R1 about halfway and connect a flashlight cell across the input leads.



Parts layout inside the case.

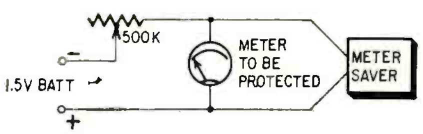


Fig. 2—Setup for calibrating the unit.

If the unit does not trigger, check the wiring, batteries, diode polarity, etc. If the unit does not trigger with the flashlight cell connected both ways, there is a mistake in the diode network.

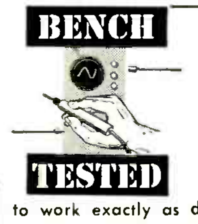
If the relay closes but the neon lamp does not light, check for a wiring error between V3 and the transformer. If it still does not light, replace V3.

After the circuit breaker has been checked out on the above tests, connect the input leads to the meter that is to be protected. If the circuit breaker is used with a vom or vtvm, connect it *direct* to the meter movement.

Fig. 2 shows a setup for calibrating the circuit with the meter. Adjust the potentiometer so the meter reads slightly over full scale. Adjust SENSITIVITY control R1 so the circuit breaker triggers at this value. If the unit fires but the meter does not return to zero, check the wiring of the relay contacts. The circuit breaker is more sensitive to pulses and may be triggered by a pulse of less than the full-scale reading. If this happens, set R1 to a slightly higher value. The sensitivity control has a range of from about 20 μa to several milliamperes.

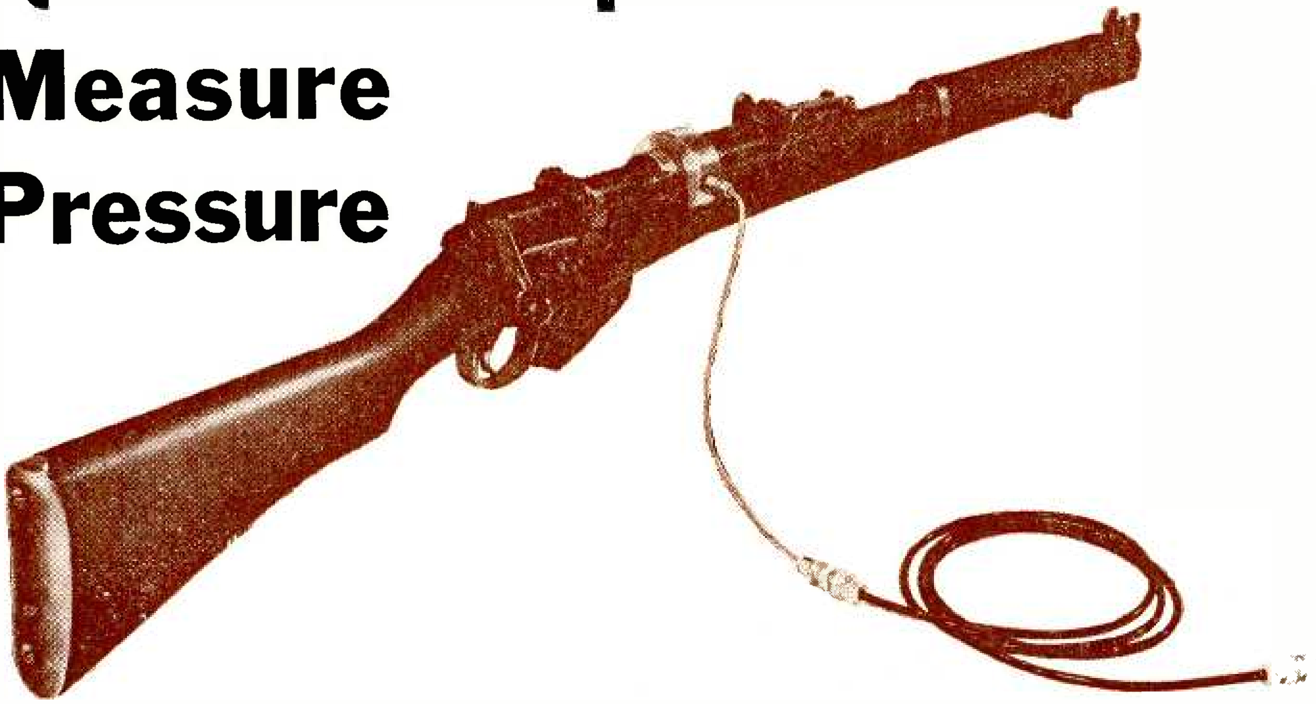
There are many other uses for the circuit breaker. It can protect sensitive elements such as tunnel diodes and high-frequency transistors. If the relay contacts are not connected across the input, it can be used as an extremely sensitive (microwatt) latching relay.

By far the best use is the one for which it was designed. I can use my vom on its 50-μa range and a 1-ampere transient doesn't bother me a bit. END



This circuit breaker was tested by the staff of RADIO-ELECTRONICS and found to work exactly as described. It was set on the 50-μa range and the test prods put across the 120-volt line. The meter moved over about one-third of its range, then dropped back to zero. A dry cell produced the same result, somewhat less dramatically.

Quartz Pickups Measure Pressure



Big brother of the crystal cartridge plays an important role in industry

Quartz pressure pickup adapted to a test rifle for measuring chamber gas pressures.

By WILLIAM F. KERNIN

Remember the piezoelectric crystal? In our general science class we learned that when such a crystal is mechanically stressed in a certain axis it produces an electrical output in another axis. In simplest terms, that's the way the crystal phono cartridge works. Now let us see how industry has put this principle to work.

The Kistler Instrument Corp. (North Tonawanda, N.Y.) along with the Swiss Locomotive Works takes natural quartz crystals and grinds them into the form of two semicylindrical elements. They are mounted in a protective housing with a specially designed flexible diaphragm affixed to one end of the crystals. This diaphragm transmits any pressures exerted on it to the proper axis of the crystal pair. The electrical connection from the other axis of the crystals terminates in a connector on the opposite end of the housing. And, thus, the quartz-crystal pressure pickup is born.

The photographs show a few of the more common models. The end that looks like two concentric circles is the corrugated diaphragm. The pressure to be measured is applied to this end through proper adapters and fittings. The electrical connector on the opposite end carries the output signal from the crystals.

This transducer is essentially a pressure-sensitive device. The signal it generates is transmitted by special cable to an impedance-matching amplifier–calibrator. Here it is transformed to a signal suitable for recording or viewing on an oscilloscope.

Engine analysis

An interesting use for this type of transducer is in the automotive industry. Research is continually going on to develop better and more efficient engines. Many electronic technicians are familiar with electronic scope analysis of ignition performance (see "Ignition Analyzer," RADIO-ELECTRONICS, September 1957, page 46). In its own right, it is a valuable aid in determining or improving the performance of the electrical system of an engine.

Now, with the help of the quartz pressure pickup, the engineer can easily add a pressure picture of each cylinder to correlate the compression of the engine with the ignition system.

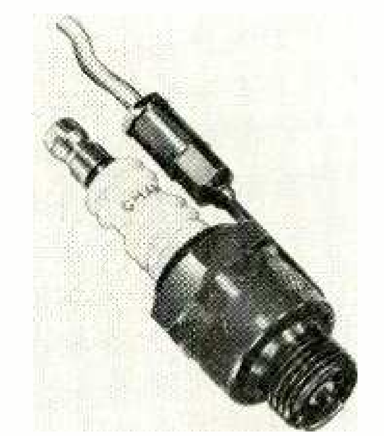


Fig. 1—The 601 quartz pressure pickup mounted in its spark-plug adapter.

Fig. 1 shows a pickup (Kistler model 601) adapted to the standard automotive sparkplug. This modified sparkplug is inserted in place of the one in the engine. It functions as a normal sparkplug, but can monitor cylinder pressures. This pickup measures static and dynamic pressures from 0.5 to 5,000 psi (pounds per square inch). Intermittent temperatures of 3,000°F can be handled. For continuous use, 500°F is the limit.

Fig. 2 shows some typical pressure patterns seen on a scope when monitoring cylinder pressure with the sparkplug pickup. Such information is becoming increasingly important in these days of high-compression engines. Most automobile owners are familiar with the knock, ping and thud aspects of their car's engine, learning through experience what causes them and how to get rid of them. Now comes a new one—rumble and roughness due to what is known as surface ignition. This ignition fault is caused by combustion deposits, mostly carbon. Combined with the high rate of pressure rise in cylinders of high-compression engines, they can cause trouble. Under conditions that may be encountered in everyday driving, these deposits on the tops of pistons begin to glow and act as ignitors. The result is early burning in the compression cycle, and the engine has to fight itself. The result—rumble, roughness and overheating.

These dynamic pictures are useful

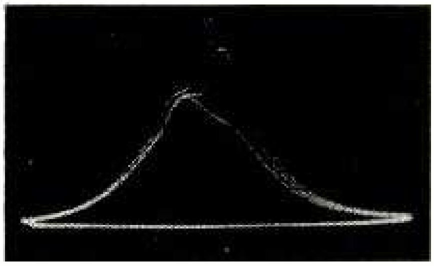


Fig. 2—Typical pressure patterns obtained from an operating engine.

in troubleshooting and taking the bugs out of the engine. A multiple-cylinder sparkplug pressure indicating system for handling engines with up to eight cylinders is available.

There are other types of quartz pressure pickups, each with a line of adapters to make them suitable for a wide range of jobs. The model 601 mentioned covers a pressure range from 0.5 to 5,000 psi. It has a response time—rise time—of 3 μsec to an abrupt step in pressure. The unit measures ¼ x ½ inch. Its adapters include a water-cooling jacket for high-temperature work. Basically, it is a good pickup for gas-pressure work—either static or dynamic.

For general engine applications, there is a larger unit (model 401) with standard sparkplug thread. It has a much greater output—approximately eight times that of the 601 for a given pressure. The 401 has its own line of adapters for various jobs. It is a good pickup for fluid-pressure work—static or dynamic. Its range is 0.1 to 3,000 psi. More about its uses later.

The type 701 combines the good features of the 601 and the 401 into one general-purpose, fast-response pickup. It has four times the sensitivity of the 601, similar pressure range and rise time of 7 μsec. With its adapters for flush mounting, it is a good universal pickup. The high-temperature, fast-response characteristics of these pickups make them ideal for many difficult applications.

Testing rifle bullets

One fascinating use is the monitoring of peak pressures in an explosion chamber, recording this information on an oscillograph or properly triggered scope. Explosion testing is done primarily in environmental test laboratories.

Akin to such testing is the ballistics field, concerned with rifle design and evaluation of ammunition types and loads. One of the important points in such studies is measuring chamber pressures developed in the rifle.

Normally, a radial system is used to measure these pressures. Fig. 3 is a cross-section of the setup. It consists of a steel housing constructed around the chamber of the rifle. This structure supports an adjustable anvil positioned over a steel piston. The piston moves in a carefully bored hole in the barrel that extends down into the powder chamber.

For proof-testing a round of ammunition for pressure buildup, the cartridge is inserted in the chamber. A grease-filled cup and the piston are set firmly in their hole. A copper cylinder called a "crusher" is placed on top of the piston. The anvil is positioned over the "crusher" and a predetermined amount of pressure is applied to it by the heavy setscrew.

When the rifle is fired, the piston is forced upward by the gas produced by the charge. This action compresses the copper cylinder. Its length is measured and compared to its original length. The difference can be related to chamber pressure using prepared tables

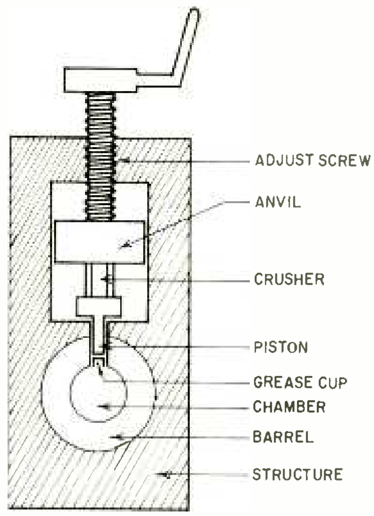


Fig. 3—The quartz pickup replaces this radial chamber pressure measuring device.

that relate compressive force to decrease in "crusher" length.

This method is simple, economical and suitable for most purposes. However, due to a number of intangible variables, the results of one laboratory may disagree with those of another, even though both laboratories use the same type of cartridge and testing system.

Thus, a more accurate system is needed. The head photo shows a setup using a 601 quartz pressure pickup with a special ballistics adapter. Combined with its electronic circuitry, it can furnish accurate peak pressure indications. After the cartridge is fired, the peak pressure reading is held electronically and displayed on a digital voltmeter until reset.

With this type of ballistics pickup, the whole sequence of pressure vs time for firing a cartridge can be obtained. Let's see why this is important.

When the cartridge is fired, there is a lag between the time the powder is ignited, burns and produces gas, and the time the bullet begins to move down the barrel. A properly loaded cartridge reaches maximum pressure just after the bullet begins to move and rapidly falls off as the bullet travels down the barrel.

Curve A in Fig. 4 represents this sequence of events. An improperly loaded cartridge—fast burning powder, too much powder, too small granular size—might create a maximum pressure much before the bullet can start to move. With the fast rise in pressure with no relief from bullet movement, the pressure safety margin of the rifle can be exceeded, as shown by curve B in Fig. 4. This can result in the rifle action letting go, or the chamber bursting.

With this transducer, a manufacturer developing a powder or test-loading new types of cartridges can start low and work his way up, guided by the quartz pickup curves of pressure vs time.

The basic measuring system consists of the pickup, a special low-noise oil-filled extension cable with a very high leakage resistance, an amplifier–calibrator and an indicating device of some sort—usually a recording galvanometer or dc oscilloscope.

Equipment setup

Let's set up a typical installation to see more clearly what is involved. Suppose we consider a gas turbine compressor. It is desired to measure the high-frequency, low-pressure fluctuations between impeller blades rotating within a chamber. Operating temperatures run close to 400°F, and there is considerable vibration.

First select a pickup. The 601 seems like a good one for high-temperature gas pressure measurement. Use a water-cooled adapter with the pickup to maintain as near a static response as possible. It will keep the pickup's operating temperature down low and leakage to a minimum.

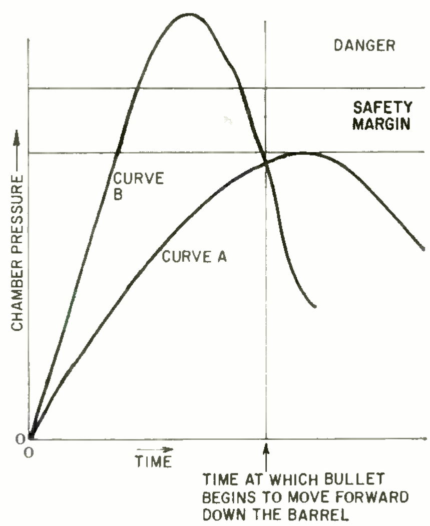


Fig. 4—Graph of chamber pressure vs cartridge firing.

Next, add an extension cable to transfer the signal from the pickup to the input of the amplifier–calibrator. To prevent noise pickup due to cable movement, tape down the cable or support it in as many places as possible. Feed the amplifier–calibrator output to a good dc scope. So much for the physical lashup—now to calibrate the system.

Expected dynamic pressures run around 50 to 100 psi. So, we'll calibrate at 100 psi.

First, balance the amplifier according to the operating manual. This is done quickly and easily with a 20,000-ohms-per-volt vom and a screwdriver. Then set the amplifier range switch for the appropriate pressure range, push the ground button once and position the scope trace on a line near the bottom of the screen.

Now, apply 100 psi of air pressure to the pickup. The scope trace should rise and stay put. Adjust scope gain for a suitable deflection—say 4 inches for 0 to 100 psi. Now the air presssure can be dropped to zero, then raised to 100 psi again as often as necessary until the scope is set up as desired.

To set the reference calibration dial on the amplifier, remove the pressure, push the ground button and check the scope-trace zero position. Reapply 100 psi of pressure—you should have 4 inches of deflection. Then, rotate the calibrate dial until the trace returns to zero. For this dial setting, 100-psi deflection is obtained whenever the calibrate button is pushed. Once this is finished, install the pickup in its location and you are ready to run.

For a clearer insight into the system see Fig. 5, a basic sketch of the pickup, its extension cable and the input circuitry of the amplifier.

When a known static pressure, P, is applied to the pickup, it generates an electrostatic charge, Q. This is distributed between the internal capacitance of the pickup, its cable and the input attenuator capacitor C_a. Thus, the voltage that appears at the electrometer tube's grid depends on the charge generated (Q) and the distributed capacitance in the input system (C_t). The relationship is E_{in} equals Q/C_t.

The low end of C_a is returned to ground through calibrate potentiometer R1—the large calibrated dial on the front of the amplifier. Across R1 is a dc potential of opposite polarity to the voltage developed by a pressure on the pickup. To set a reference, R1 is adjusted until the voltage on the low end of C_a is equal and opposite to the signal voltage on the high end of C_a. This setting is then the calibrate equivalent to the given input pressure.

The input impedance of the amplifier is 10^{14}, ohms—achieved by using an electrometer tube. The quartz pickup plus high-impedance amplifier input has such a long time constant—something like 24 hours—that the system is considered a static device. That is, it has dc response to pressure. This greatly simplifies calibrating a pressure pickup of this type. It is relatively easy to apply a known air pressure to the pickup and to set up the system correspondingly. One known pressure point is all that is normally required because of the excellent linearity of the quartz pickup.

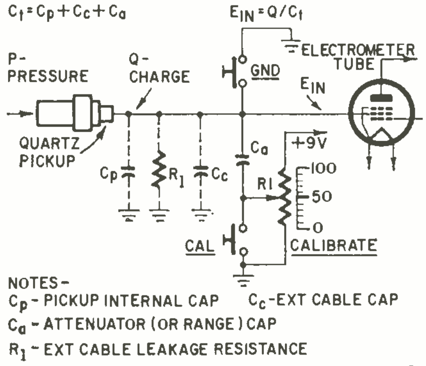


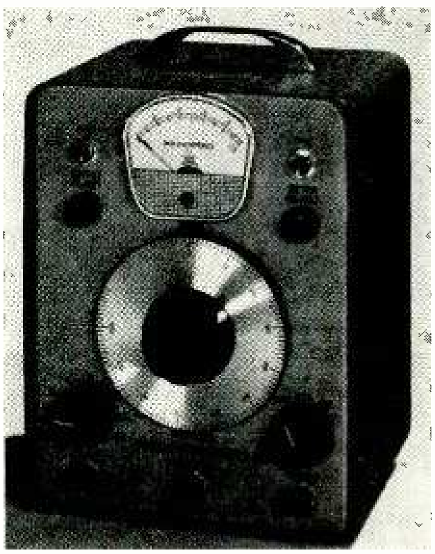
Fig. 5—Basic input circuit of the amplifier–calibrator.

Thus, the basic system is quite simple. Maintenance is low, mostly checking and occasionally replacing the mercury batteries that power the amplifier–calibrator. The input cables and pickups require intelligent handling. To maintain the high leakage resistance in the input system, all connectors must be kept clean and dry. Any moisture or grease would he detrimental. In practice, all connections exposed to operating environments—acid fumes, vapors, dust, etc.—are taped to provide a fairly decent seal. When the cables are not in use, small plastic bags are slipped over the connectors and taped to the cable. For storing pickups, a warm, dry location is desirable. A dry oven or heat box around 125°F. is ideal.

Maintenance and repairs

Prerun checks will enable the technician to determine the condition of his setup. With the complete system hooked up and working, gently tap the pickup diaphragm, if physically possible. Output on the scope means the pickup is OK. Install the pickup.

Next push and hold down the



The amplifier–calibrator used with the quartz pickups.

calibrate button. The scope trace should rise the amount determined by the previous calibration, and stay there. If it does, all is well. Push the ground button once and run the test.

Trouble in the input system is indicated by either no calibrate deflection or a suitable deflection that drifts back down to zero. The first symptom points to a short, the second to a low-resistance leakage path. Both can be found by elimination. For shorts, use an ohmmeter. For leakage, use the

The smaller 601 pressure pickup.

amplifier–calibrator with the dc scope on the output. Disconnect the pickup and hold the calibrate button down. No drift means a bad pickup. Drift usually means extension-cable leakage. A defective amplifier could cause drift too. However, unless the input connector is dirty, the amplifier is rarely the cause.

Usually, cleaning the connectors on the extension cable, amplifier and pickup with clean, dry industrial tissue solves the problem. Solvents must never be used because they leave a film of grease. If cleaning doesn't help, try baking the pickup in a warm, dry oven. As for the extension cable, cut a foot off each end and solder on new connectors. Outside of a new pickup and extension cable, this should clear up the most stubborn cases.

These prerun checks are most reassuring — especially in rocket-engine development and testing programs where each run is considered a one-shot deal and the system has to work. Quartz pressure pickups are naturals for measuring dynamic and static pressures—both liquid and gas—at most any level on a rocket engine. With their special fluid-cooled adapters they can be used in practically any location or environment. Flush-mounting these pickups allows the capture of illusive high-frequency pressure variations. With a basic pressure pickup and its adapters, many pieces of operating information can be gathered.

In its present form, the quartz pressure pickup is relatively new. It

The 701 quartz pressure pickup.

should find jobs of ever increasing importance as industry becomes more familiar with its versatility. The industrial electronics technician is quite likely to become acquainted with it in the near future, especially in the fields of research and development. END

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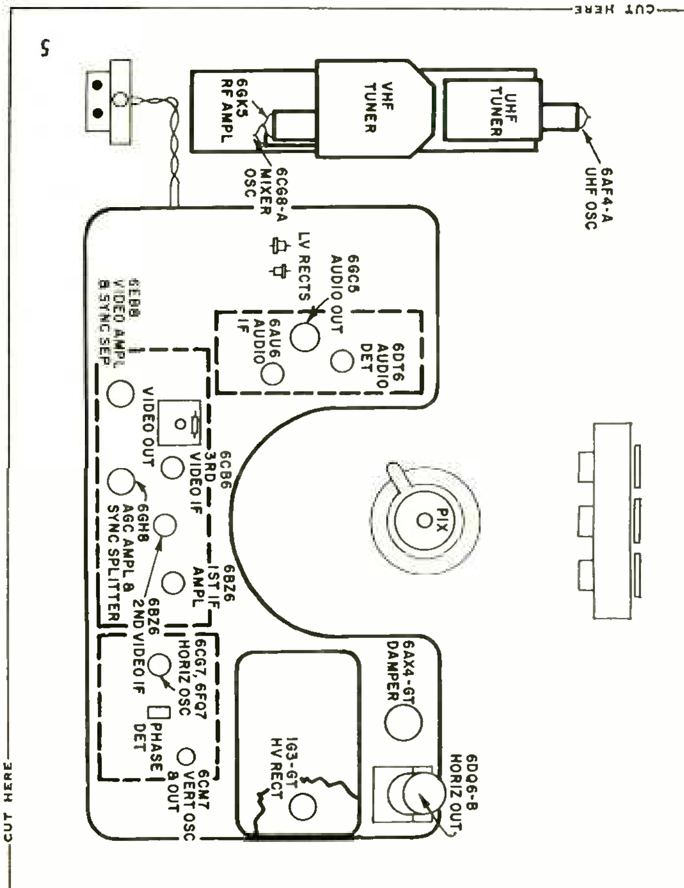

CHASSIS SERIES 35

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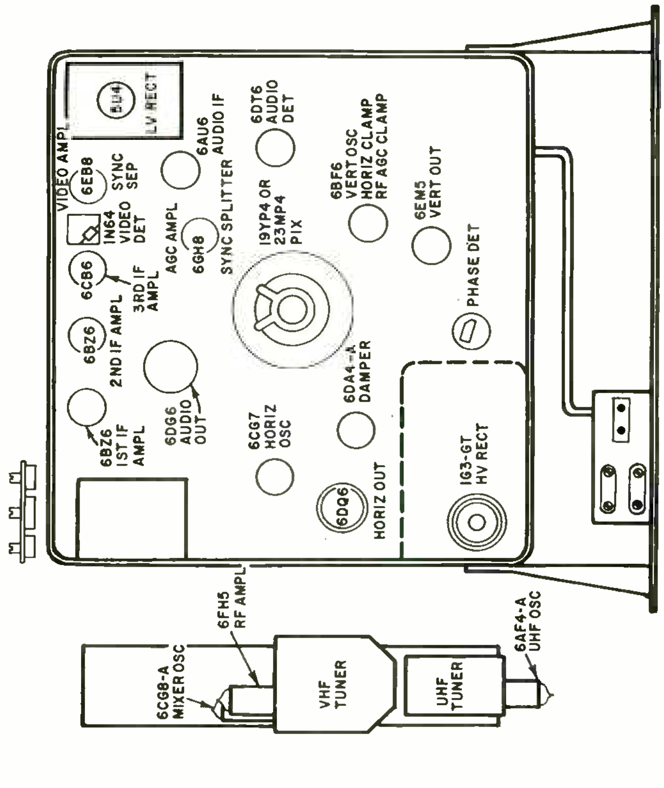

CHASSIS SERIES 34

CUT HERE

CUT HERE

TRIM HERE AFTER FOLDING

Radio-Electronics

TUBE LAYOUTS IN TV SETS

Compiled by Larry Steckler, Associate Editor

MAGNAVOX
1960—1962

HOW TO FOLD

Fold the top down and back, keeping the cover facing you. Then trim the right and left edges. Now staple the booklet along the vertical center fold, about ¾ inch from the top and bottom. Now fold from left to right, keeping the cover facing you. Trim a fraction of an inch off the top and trim the bottom to size and you're finished. You now have another useful piece of service data, exclusive with RADIO-ELECTRONICS.

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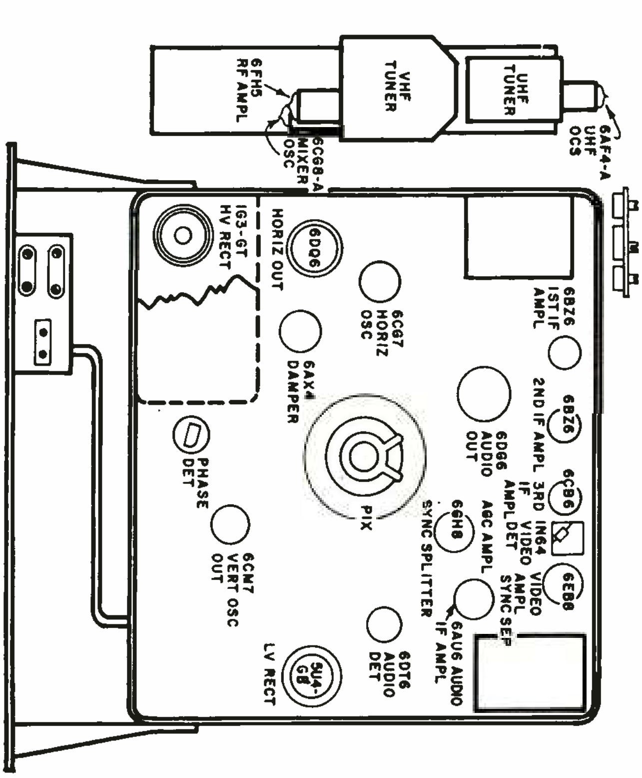

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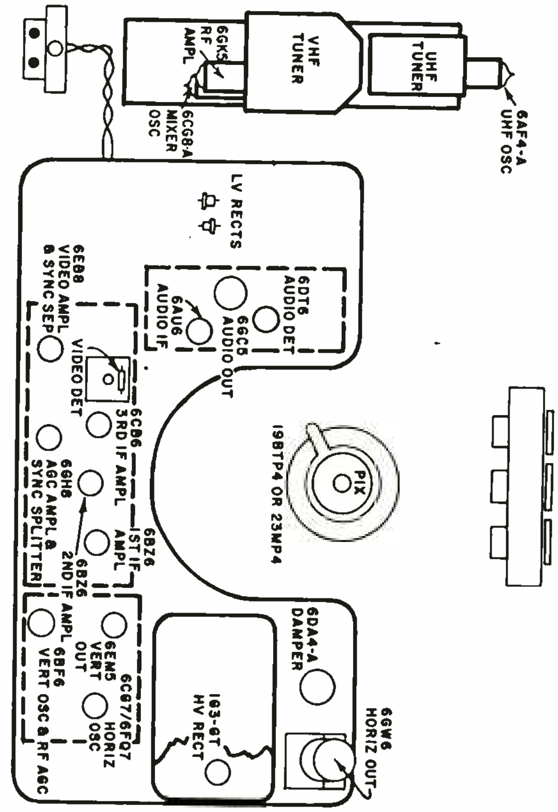

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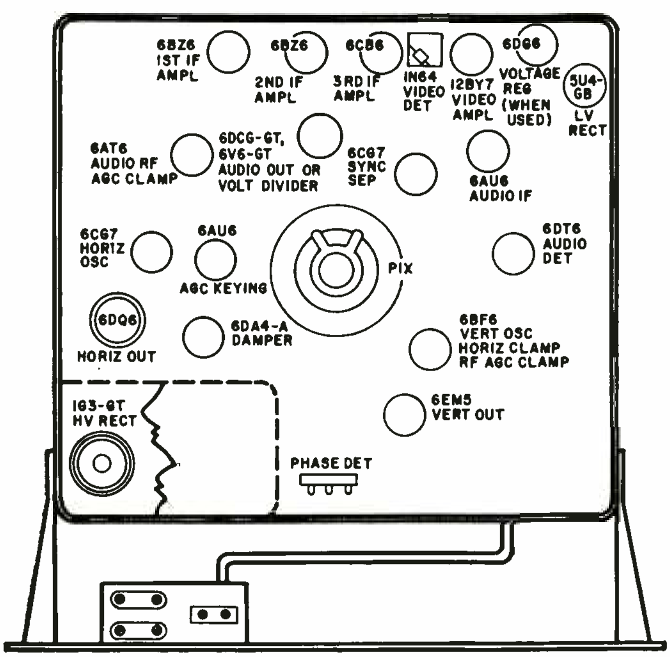
CHASSIS SERIES 30



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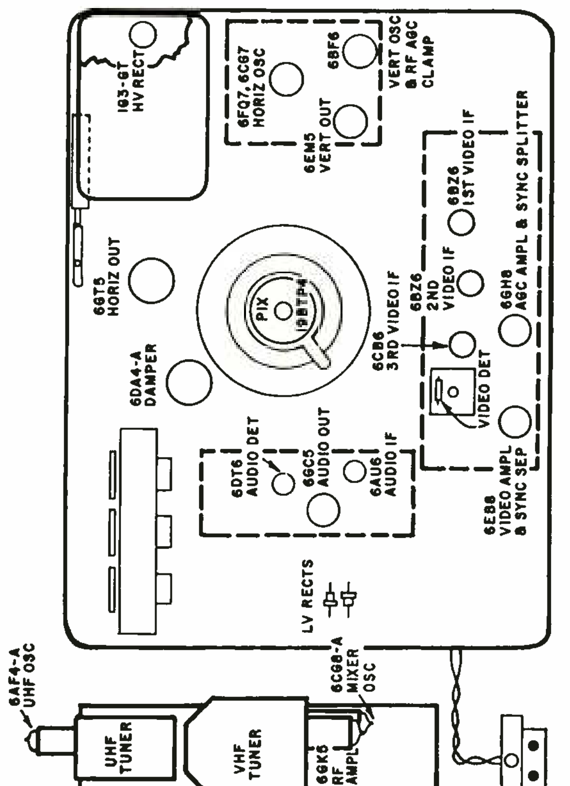

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7

end of i.f. transformers? ...Transfilters!

New solid-state device may replace the i.f. transformer in transistor receivers

By JOHN POTTER SHIELDS*

EVER SINCE THE SUPERHET RECEIVER became popular, the familiar double-tuned i.f. transformer has been standard equipment in all but the most selective receivers. Although these transformers offer reasonable selectivity and are inexpensive, they have a number of limitations:

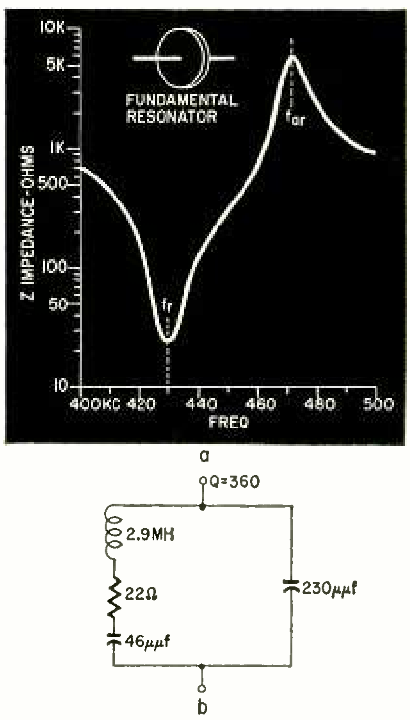
1. Alignment is needed on installation.
2. Alignment tends to drift over a period of time.
3. Shielding is necessary to prevent fields radiated from transformer inductances from interfering with nearby circuitry.
4. Physical size limits miniaturization.

*Clevite Electronic Components

A new line of solid-state ceramic filters, produced by the Electronics Components Div. of Clevite Corp., neatly overcomes these problems, while offering additional benefits possible only with devices of this new type. Named *Transfilters*, these ceramic filters are designed as replacements for conventional i.f. transformer assemblies in transistorized receivers. These new units are small, do not require alignment, have excellent long-term stability, require no shielding, are extremely rugged and inexpensive. They are already being used by some manufacturers and appear in the circuitry of new communications receivers.

These ceramic filters depend upon the piezoelectric properties of a lead—zirconate—titanate ceramic material for their operation. Their operating frequency and bandpass characteristics depend upon both the physical dimensions of the ceramic element and electrode configuration and placement. In this respect, they are similar to quartz crystal filters.

The active ceramic elements of Transfilters are small discs pressed from a powder at high pressure, much as are aspirin tablets. Silver electrodes are attached to the ceramic discs, after which they are "polarized" by applying a high voltage to obtain the desired piezoelectric properties. This manufacturing technique assures excellent uniformity of electrical characteristics from batch to batch.



SPECIFICATIONS TF-01A

Frequency: Resonant, 455 kc ± 2 kc
Bandwidth: 4 to 7% at 6 db
Capacitance: 600 ± 15%
Impedance: At resonance, < 15 Ω
Electromechanical Coupling: $k_p > 35\%$
Maximum Voltage: At resonance, 2 volts
Frequency Stability:
 Time: Within 0.2% for 5 years
 Temperature: ±0.1% from —20°C to +60°C
Symbol:

Fig. 1-a—Fundamental radial resonator. b—Equivalent electronic circuit.

Radial resonator

One basic Transfilter type, known as a "fundamental radial resonator," has the characteristics of a high-Q series-tuned circuit. As with a conventional series-tuned circuit, it offers a very low impedance to applied signals at its resonant frequency. Fig. 1-a depicts a fundamental radial resonator, showing the placement of electrodes. Fig. 1-b represents the equivalent electrical circuit. The essential electrical characteristics of a typical unit are given.

Since a fundamental radial resonator filter offers low impedance at resonance, it is extremely useful as an emitter-resistor bypass in transistor i.f. amplifiers. Fig. 2-a is the circuit of a conventional common-emitter stage with a fundamental radial resonator connected in parallel with the emitter resistor. Fig. 2-b is a plot of the relative attenuation vs applied frequency of this stage. Assume for a moment that the input signal frequency is 410 kc. Stage gain will be reduced, due to degeneration caused by the essentially unbypassed emitter resistor, since this frequency is below the resonant frequency of the filter. Raising the applied signal frequency to 455 kc, the filter appears practically as a short circuit across the emitter resistor, due to its low impedance at this, its resonant frequency. This greatly reduces stage degeneration and gain increases.

As the applied frequency is raised further, past the filter's resonant frequency, degeneration will again occur due to the filter's rise in impedance away from resonance. This effect is used to advantage in complementing overtone

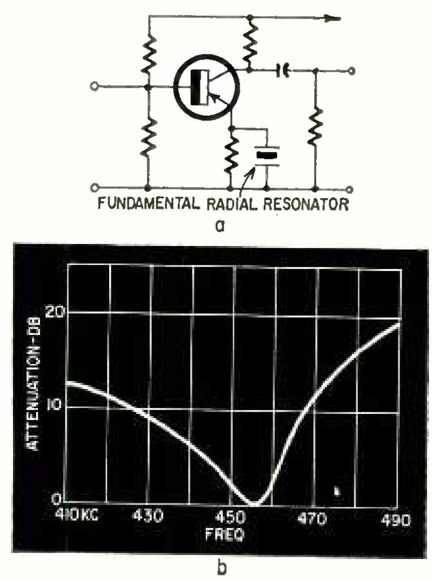
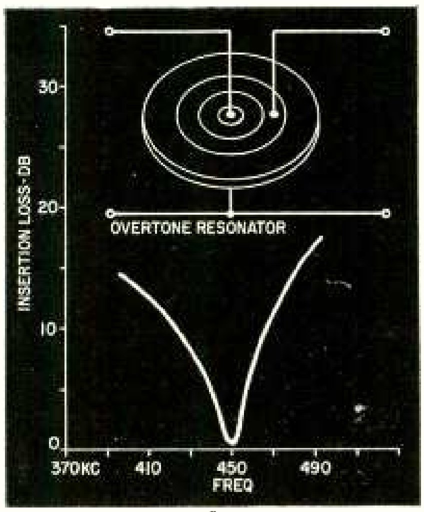


Fig. 2-a—Fundamental radial resonator as an emitter bypass. b—Attenuation curve for the circuit.



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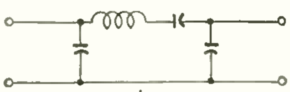


b

SPECIFICATIONS TO-01A

Frequency: At resonance 455 kc ± 2 kc (measured at output with input open-circuited)
Bandwidth: 4 to 7% at 6 db
Input Capacitance: ≧ 180 μμf.
Output Capacitance: ≧ 800 μμf.
Input Impedance: 1,800 ohms nominal
Output Impedance: 300 ohms nominal
Insertion Loss (Power): At 455 kc 2 db maximum
Frequency Stability:
Time: Within 0.2% for 5 years
Temperature: ±0.1% —20°C to +60°C
Model TO-01B: Same except 465-kc center frequency
Model TO-01C: Same except 500-kc center frequency

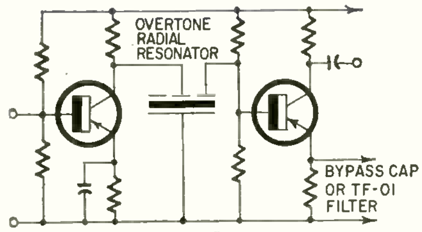
SPECIFICATIONS TO-02A

Frequency: At antiresonance 457 kc ± 1 kc (measured at output with input open-circuited)
Bandwidth: 1 to 4% at db (function of loading)
Input Capacitance: 480 μμf +20 —10%
Output Capacitance: 2,650 μμf +20 —10%
Input Impedance: Minimum 3,900 ohms; maximum 15,000 ohms
Output Impedance: Minimum 680 ohms, maximum 3,000 ohms
Insertion Loss (Power): At antiresonance 3 db maximum
Frequency Stability:
Time: Within 0.2% for 5 years
Temperature: ±0.1% —20°C to +60°C
Model TO-02B: Same except 465-kc center frequency
Model TO-02C: Same except 500-kc center frequency

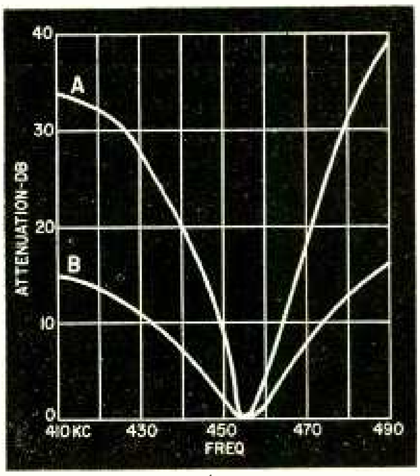
Fig. 3-a—Physical configuration of overtone radial resonator. b—Equivalent circuit of device.

radial resonator filters used as interstage couplers, as will be shown a bit later. Besides this use, fundamental radial resonators are excellent in applications that warrant the use of an effective series-tuned circuit in either series (coupling) or shunt (bypass) applications.

Fig. 3-a shows the physical configuration and the frequency response characteristics of an overtone radial resonator type Transfilter. As indicated by the equivalent circuit, Fig. 3-b, its behavior is similar to the familiar pi-section coupler. As we know, the output impedance of a pi coupler may be lower than its input impedance. This is also true for the overtone radial resonator, and allows efficient operation between the relatively high collector output impedance and low base input impedance of transistor amplifiers. Fig. 3 lists the essential electrical characteristics of TO-01A and TO-02A overtone radial resonators. The latter is especially useful in circuits using higher-impedance drift transistors.



a



b

Fig. 4-a—Circuit of 2-stage common-emitter amplifier with overtone radial resonator as coupling element. b—Response of circuit with fundamental radial resonator shunting emitter resistor of second stage (curve A) and response of same circuit with bypass capacitor across emitter resistor (curve B)

Fig. 4-a is a circuit of two common-emitter amplifier stages with a type TO-01A overtone radial resonator filter inserted between stages. In Fig. 4-b curve A indicates the response with a fundamental radial resonator filter connected across the second-stage emitter resistor, while curve B is the response with this same resistor shunted with a capacitor. The results are obvious.

Practical circuits

To investigate the possibilities of Transfilters, I assembled the circuits illustrated in the photos. The first is a three stage common-emitter amplifier with TO-02A overtone radial resonator filters inserted between stages as shown in Fig. 5.

Considerably more gain could have been obtained with rf chokes (2.5 mh) substituted for collector load resistors R1, R2 and R3. Almost the full collector supply voltage would then have appeared at the collectors. Better performance could also have been obtained with rf transistors; however, I was mainly interested in the performance of the Transfilters, not in squeezing the last bit of gain from the circuit.

With these modifications, this circuit makes an excellent substitute for the regular i.f. strip for that proposed receiver or converter project. A convenient method of assembly is shown in the photos. Brass eyelets act as terminals for both Transfilters and transistors —the Transfilter terminals being soldered directly to the eyelets.

A rather novel circuit is shown in Fig. 6. Here, a TO-01A is used as the frequency-determining element in a simple, yet very stable, 455-kc alignment generator. In operation, V1 and V2 form a

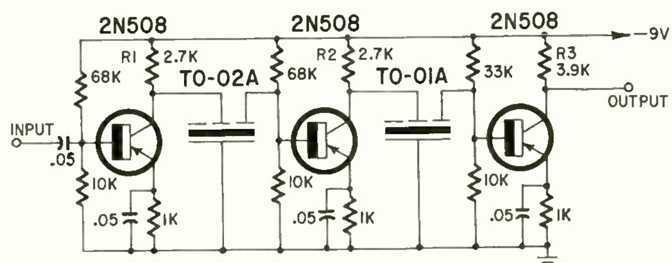


Fig. 5—A 3-stage common-emitter amplifier with 2 overtone radial resonator filters used as coupling elements.

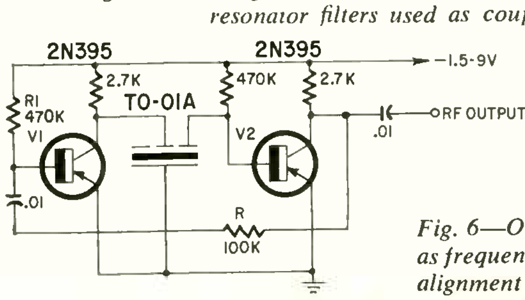
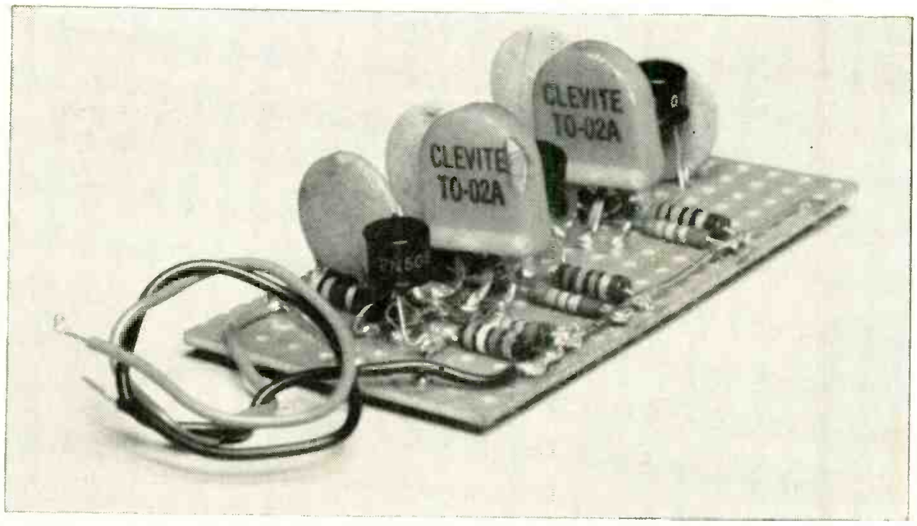


Fig. 6—Overtone radial resonator filter used as frequency-determining element in a 455-kc alignment generator.

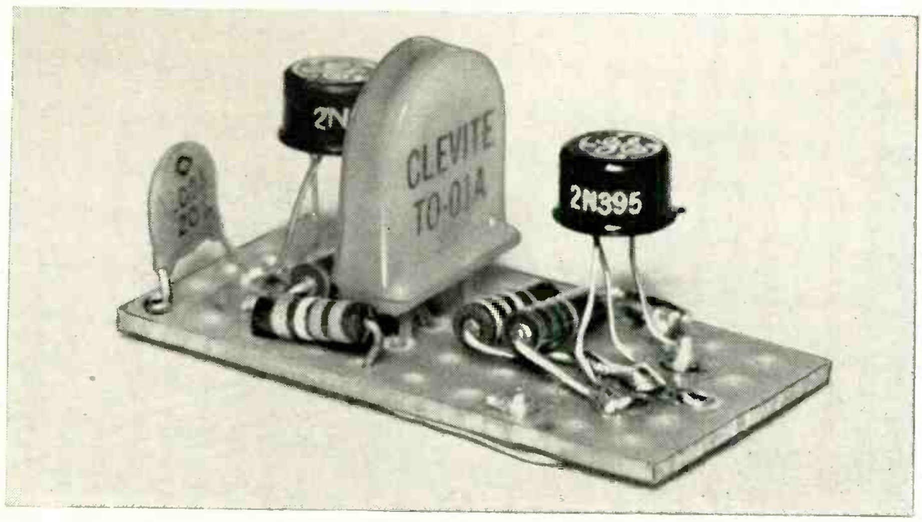


Breadboard arrangement of unit shown in Fig. 5.

two-stage cascaded amplifier with the TO-01 filter inserted between stages. Due to the 180° phase reversal in each of the two common-emitter stages, a signal appearing at V2's collector produces regeneration (oscillation) when applied to V1's base. The impedance presented by the filter is lowest at its resonant frequency so that maximum amplification, and hence oscillation, occurs at this frequency—for the TO-01A, 455 kc. Feedback resistor R is adjusted to the point where oscillation is just sustained. This avoids excessive feedback which might produce spurious signal generation.

This little generator offers many attractive advantages over conventional L-C tuned units. It is much more stable, as supply voltages and temperature variations have negligible effect on its operating frequency. It is inexpensive—only a few components are used. Current consumption is but a few ma, and its small physical size adapts it to miniaturization.

So, there you have the Transfilter. I hope this brief introduction will be of interest and I am sure you will find the circuits both interesting and useful. Experimental units can be obtained from Ace Radio Control Inc., 203 W. 19 St., Higginsville, Mo. The TF-01 is $1.15 (each); TO-01 and TO-02 are $1.25 each. END



Prototype of the generator shown in Fig. 6.

measuring meter resistance

By PHILIP KASZERMAN

IT IS OFTEN HANDY TO KNOW THE RESISTance of a meter movement. The resistance of milliammeters ranges from fractions of an ohm to around 100 ohms and the resistance of many microammeters is in the thousands of ohms. These values are often high enough to affect circuit performance so the technician should know the resistance of the meters he uses. Some people get away with using an ohmmeter but it is hardly recommended. The ohmmeter may burn out the meter or damage it.

Figs. 1 and 2 illustrate a technique which will give the meter resistance with an accuracy better than 1%. If followed exactly, there is no danger of burning out the meter. The series potentiometer in Fig. 1 is chosen according to the meter being measured. Its value must be high enough to reduce current in the circuit below the rating of the meter. For instance, if you wish to measure the resistance of a 0 to 1 microammeter, the resistance should be greater than $R = \frac{1.5\text{ v}}{1 \times 10^{-6}\text{ amp}} = 1.5$ megohms. For a 0 to 1 milliammeter it should be greater than 1,500 ohms.

After choosing the potentiometer, *set it to its maximum value.* Then hook up the circuit of Fig. 1. Vary the potentiometer slowly and carefully until the meter reads full scale. Then place a second potentiometer across the meter as in Fig. 2. You will have to guess at the value of this parallel potentiometer. As a first try, use a 500-ohm unit for milliammeters and a 5,000-ohm unit for microammeters. Vary it until the meter reads exactly half scale. Since the battery and the series potentiometer will act approximately as a constant-current source, half the current is now passing through the meter and the other half through the potentiometer. Remove the parallel potentiometer and measure its resistance. The result will be the resistance of the meter.

For more accurate results, use the circuit of Fig. 3. It is essentially the same as Fig. 2 except that another meter has been added in series with the battery. The rating of this meter should be equal to the meter being tested or slightly higher. The procedure is now the same as before with one difference: While varying the parallel potentiometer, maintain current in the series meter at its initial value by slightly changing the series potentiometer. In this way, you make the battery act as a constant-current source. The accuracy of this method of calculating the resistance of the meter is only limited by the accuracy with which the meter itself indicates half scale. END

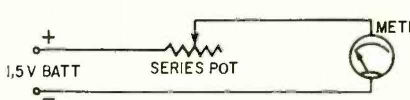


Fig.1

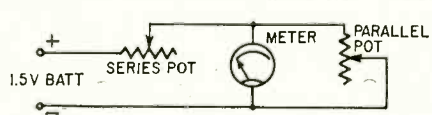


Fig.2

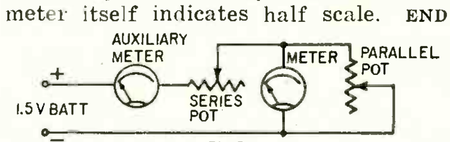


Fig.3

STEREO PREAMP

COVER STORY

Has EVERYTHING

By
DANIEL
MEYER*

Including all-transistor circuit, step bass and treble controls, optional phase reversal, compact printed circuits, professional quality, and moderate cost

SPECIFICATIONS

Power: 12 volts dc, 15 ma

Frequency response: Flat ±½ db 20–20,000 cycles; down 1 db at 10 and 50,000 cycles

Gain: Measured at 1,000 cycles with volume control set to maximum and balance control at 50% of rotation position

Phono: 8-mv input for 1.0-volt output; maximum input 40-mv
Tape: 4-mv input for 1.0-volt output
Mike: 8-mv input for 1.0-volt output
FM, AM: Variable with level controls from 0.8-volt input for 1.0-volt output to 10-mv input for 1.0-volt output
Auxiliary: 0.4-volt input for 1.0-volt output

Tone controls: ±12 db at 50 and 10,000 cycles; 4-db steps switch-selected

Loudness compensation: Continuously variable from 0 to —30 db contour

Rumble filter: 3 db down at 50 cycles; 20 db down at 20 cycles

Scratch filter: 3 db down at 7 kc; 20 db down at 20 kc

Noise: At least 60 db below 1.0-volt output at any input (measured with inputs shorted)

Maximum output: Approximately 1.5 volt rms

Channel separation: 45 db at 1 kc

Output impedance: Less than 1,000 ohms at any output and under any possible control setting

Distortion: Less than 1% second- or third-harmonic distortion 20–20,000 cycles at output level of 1.0-volt rms

Gain vs temperature: +1 db at 120°F, over gain at 70°F

Gain vs voltage:
0 db reference to 12-volt supply
—1.1 db with 10-volt supply
+1.1 db with 15-volt supply

This preamp was designed as a professional-quality unit that can be custom-built from standard, readily available parts. It may be monaural or stereo and with as many additions to the basic tone controls as you desire. Most parts are mounted on etched-circuit boards for ease of assembly and compactness. The preamp and tone control sections of each channel are mounted on one board and the extra features—scratch and rumble filters, phase reversal and loudness control—are mounted on a third board that may be omitted if desired. The specification sheet shows the type of performance to expect.

This is definitely not a project to undertake if you have never built a piece of electronic equipment before, but any-

* Research Engineer, Southwest Research Institute, San Antonio, Texas.

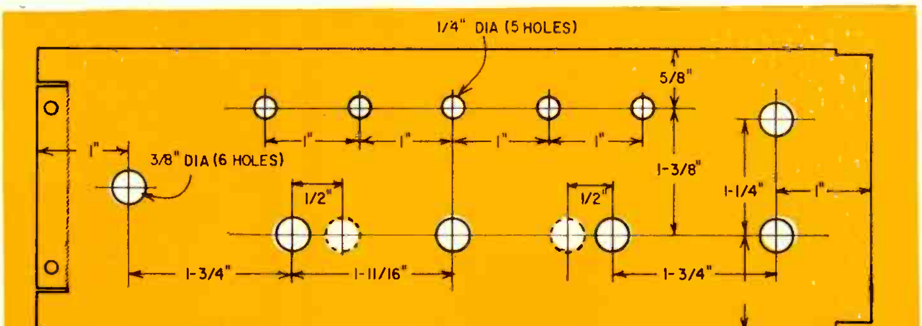


Fig. 1—Template for drilling the front panel.

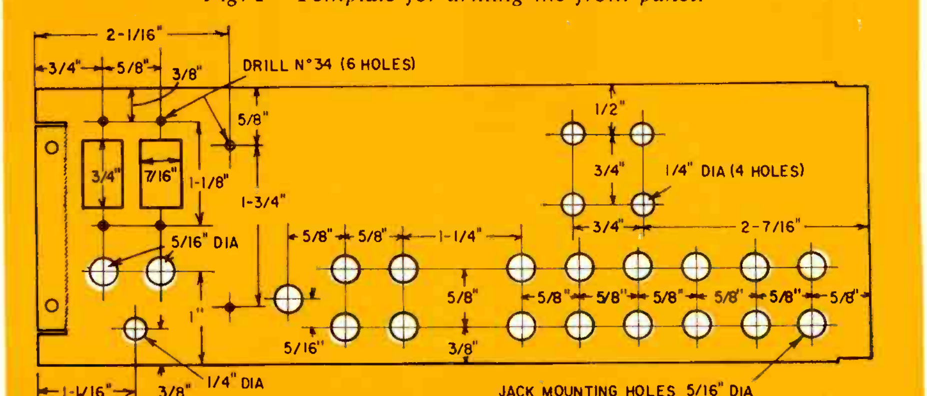
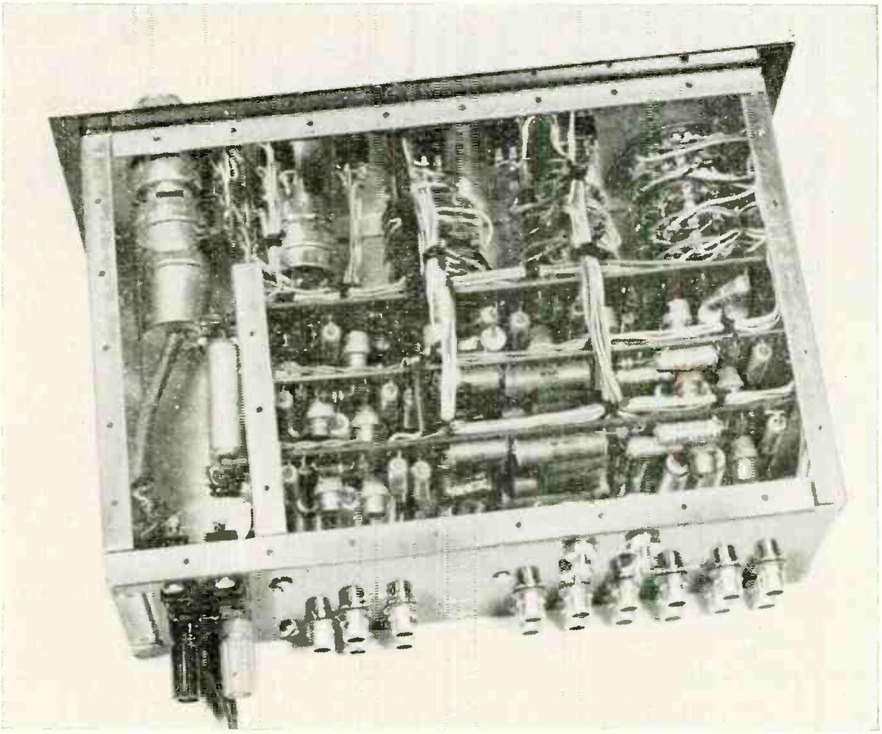


Fig. 2—Drilling template for the rear panel.

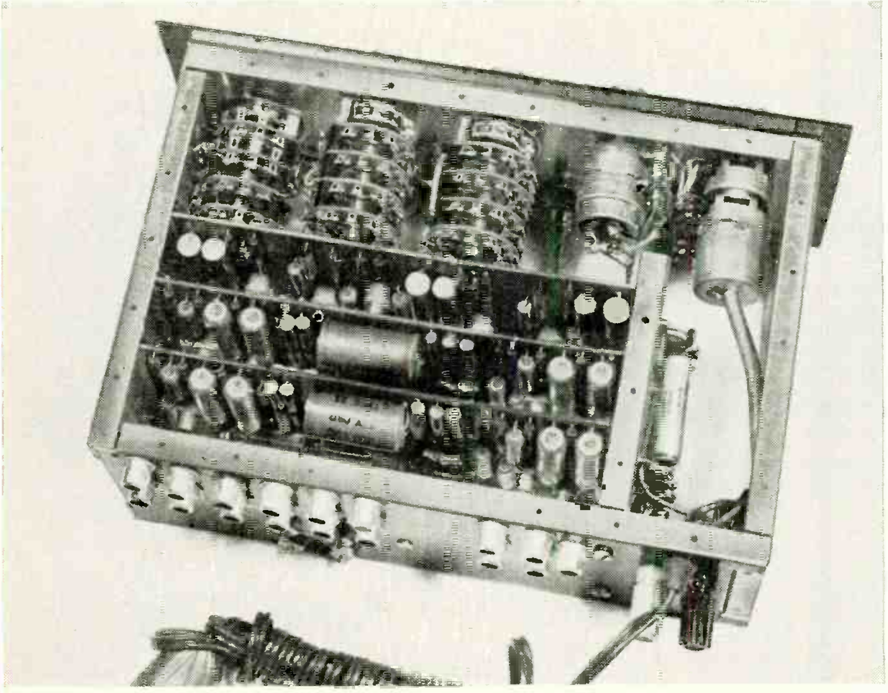
one who has assembled a kit or two, or is familiar enough with electronics to read a schematic, should be able to complete the construction successfully. This preamp is not inexpensive. The cost should be between $100 and $125, depending on how many features you include in your unit. Any other preamp with similar features will cost as much (probably more) and, if a vacuum-tube type, will be twice as large.

Start by drilling or punching the holes in the chassis panels. Figs. 1, 2, and 3 show location of the various holes. Notice that the templates are for a stereo preamp with all optional features. If you do not intend to include everything, leave out the holes not needed. If you omit the loudness control, position the tone control holes as indicated by dotted circles on the front panel drawing (Fig. 1). If the filters are omitted, only the second and fourth switch holes are needed. If a monaural version is planned, the balance control is not needed and the volume-control hole should be drilled symmetrically with the selector-switch hole on the other end of the panel.

Prepare the drilled rear panel for marking before any parts are mounted.



Top view (above) shows details of wiring and parts placement. Underside (below) is very similar to top view.



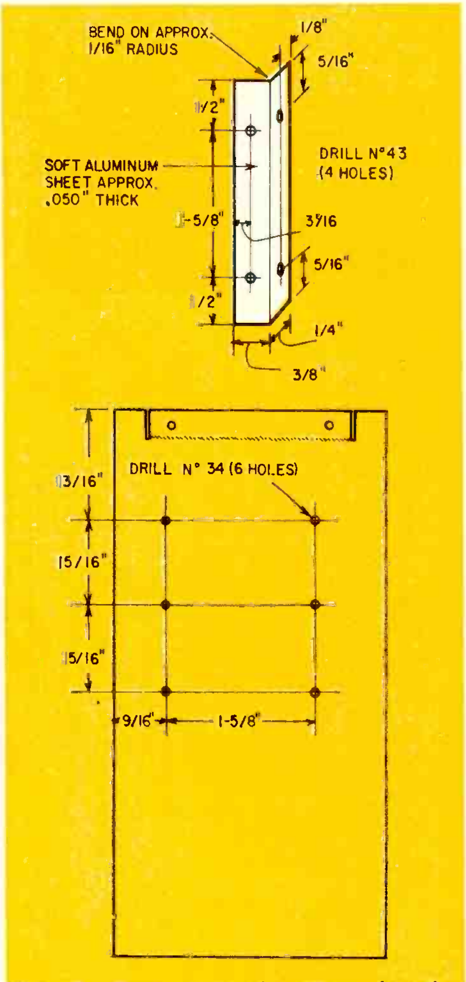


Fig. 3—How to make circuit-board mounting brackets and right side of preamp case. Left side of case is undrilled See-Zak R-36.

Cover the panel with a piece of Scotchcal* the same size as the panel. This is a vinyl plastic with pressure-sensitive adhesive on the reverse side, available at most display advertising businesses.

If a marked front panel like that shown on the original unit is wanted, punch a piece of aluminum sheet stock with the same hole pattern used on the chassis front and cover the punched sheet with Scotchcal. Markings on the front and rear are decals. After these are in place, give the whole surface a light coat of clear plastic spray to seal the decals to the plastic. The front is held in place by the nuts on the controls. Washers should be used between the nuts and the plastic surface to prevent pulling or tearing. The knobs may be of any available type, or can be selected to match the knobs on other equipment.

Assembling the preamp

Mount the parts on the front and back panels as shown in the photos. Tone-Control switches S4 and S5 must be modified slightly before they are in-

* Trademark of Minnesota Mining & Manufacturing.

stalled. They should be disassembled and the spacers between the wafers replaced with ¼ inch long spacers. Selector switch S1 should be assembled with ¼ inch spacers instead of the spacers supplied with the index assembly. All jacks on the back panel except the phono input jack are mounted with insulating washers. The back panel may now be wired and the resistors shown in the photograph installed.

If a center-channel output is used, wire it as shown in Fig. 4. This and all other wiring in this preamp should be done with low voltage No. 24 wire such as Alpha type 1688. If anything larger is used, the various bundles will get too large to handle easily and may not fit in the available space. It is also helpful if several colors of wire are used. I used about 15 different color-coded wires. This will make it much easier to identify the various wires in the bundles.

In wiring the back panel, run a separate lead from each jack grounding lug to the ground lug on the phono

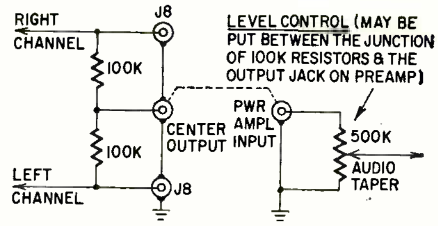
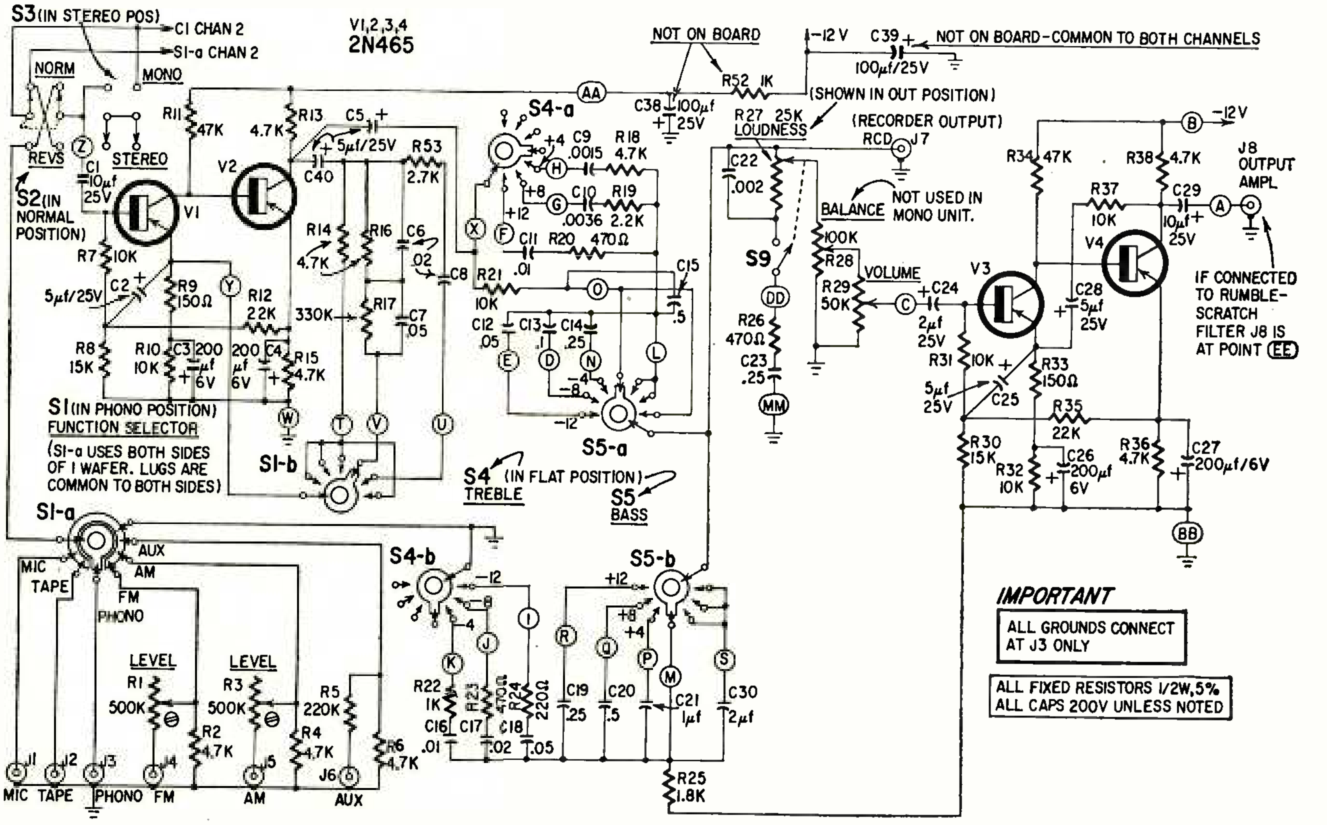


Fig. 4—Wiring for optional center channel output.

jack. Make all other ground connections in the preamp to this point to prevent



R1, R3—pot, 500,000 ohms, linear, Centralab type JL
R2, R4, R6, R13, R14, R15, R16, R18, R36, R38—4,700 ohms
R5—220,000 ohms
R7, R10, R21, R31, R32, R37—10,000 ohms
R8, R30—15,000 ohms
R9, R33—150 ohms
R11, R34,—47,000 ohms
R12—22,000 ohms
R17—330,000 ohms
R19, R43, R47—2,200 ohms
R20, R23, R26—470 ohms
R22—1,000 ohms
R24, R42—220 ohms
R25—1,800 ohms
#R27—dual pot, 25,000 ohms per section with spst switch, IRC Q11-120, M11-120, 76-2
*R28—dual pot, 100,000 ohms per section, IRC SK-1, B17-128, M13-128
#R29—dual pot, 50,000 ohms per section, IRC K-5, KS-2, B13-123
R35—22,000 ohms
R39—1,500 ohms
R40, R41—33,000 ohms
R44—100 ohms
R45, R46—3,900 ohms
*R48—33,000 ohms
*R49—15,000 ohms
*R50, R51—1,000 ohms
†R52—1,000 ohms
All fixed resistors ½-watt 5%
C1, C29, C36—10 µf, 25 volts, electrolytic, subminiature (Illinois type SMT or Sprague TE 1204 or equivalent)
C2, C5, C25, C28—5 µf, 25 volts, electrolytic, subminiature (Illinois type SMT or Sprague TE 1212 or equivalent)
C3, C4, C26, C27—200 µf, 6 volts, electrolytic, subminiature (Illinois type SMT or Sprague TE 1104 or equivalent)
C6, C8, C17, C34—.02 µf, 200 volts, 5%, mylar; Tex-Cap type 25
C7, C12, C18—.05 µf, 200 volts, 5%, Mylar; Tex-Cap type 25
C9—.0015 µf, 5%; Arco DM-19—362J
C10—.0036 µf, 5%; Arco DM-19—362J
C11, C16—.01 µf, 200 volts, Mylar; Tex-Cap type 25
C13—0.1 µf, 200 volts, 5%, metallized Mylar; Tex-Cap type 31
C14, C19, C23—0.25 µf, 200 volts, 5%, metallized Mylar; Tex-Cap type 31
C15, C20, C31, C32—0.5 µf, 200 volts, 5%, metallized Mylar; Tex-Cap type 31
C21—1 µf, 200 volts, 5%, metallized Mylar; Tex-Cap type 31
C22—.002 µf, ceramic, 10%
C24, C33—2 µf, 25 volts, electrolytic, subminiature (Illinois type SMT or Sprague TE 1201 or equivalent)
C30—2 µf, 200 volts, 5%, metallized Mylar; Tex-Cap type 31
C35—.002 µf, 200 volts, 5%, Mylar; Tex-Cap type 25
*C37—10 µf, 25 volts, electrolytic, subminiature (Illinois type SMT or Sprague TE 1204 or equivalent)
†C38—100 µf, 25 volts, electrolytic subminiature (Illinois type SMT or Sprague TE 1211 or equivalent)
†C39—100 µf, 25 volts, electrolytic, subminiature (Illinios type SMT or Sprague TE 1211 or equivalent)
†C40—5 µf, 25 volts, electrolytic, subminiature (Illinois type SMT or Sprague TE)
J1 through J8—phono jacks (Switchcraft 3501FP with S-2207 and S-1564 insulating washers)
‡S1—6 position rotary switch; assembled from Centralab PA-300 index (1), PA-30 1-pole 11-position shorting switch section (2), and PA-40 1-pole 11-position all unused contacts shorted (2)
S2, S3, S6, S7—dpdt toggle switches, miniature Lafayette SF-76 or Alco Electronics)
*S8—dpdt toggle switch, miniature (Lafayette SW-76 or Alco Electronics)
S4, S5—4-pol 7-position rotary switch (modified Centralab PA-1014) (see text)
†S9—spst on R27
V1, V2, V3, V4, V5, V6—2N465 (Motorola)
*V7—2N465 (Motorola)
†Chassis—Built from the following "See-Zak" parts: R-39 (2); R-36 (2); R-34 (1); P-69 (2) (Rimac Electronics, 10929 Vanowen St., North Hollywood, Calif.)
†Ac mains outlets (Alden No. 402-ACE or Herman Smith 1229)
†Power supply binding posts (E. F. Johnson 111-102 and 111-103)
†Spacers—¼ inch long (for rotary switches) (Birnbach or Herman Smith)
†Knobs, to suit
†Black plastic film for front and rear panels (Scotchcal type 3655)
†Decals (Walsco 2105 or equivalent)

To build a stereo preamp you will need two of each part except for those marked as explained below.

#For a monaural unit, use single-section pots in place of the specified dual units.
*In a stereo unit, only one of each of these parts is needed; they are not used in a mono set.
†Only one of each for stereo or mono unit.
‡Number of parts for stereo preamp shown.

If you cannot obtain the Mylar Tex-Cap units locally, Texas Capactitors, 4301 Langley Road, Houston 16, Tex., will supply them direct.

Though not our usual policy, we have specified particular makes of components. Equivalents can be used only if they are exactly the same size as the specified units.

Complete circuit of the basic stereo preamp. Only one channel is shown. Move J8 to point EE on noise-filter schematic when filters are used.

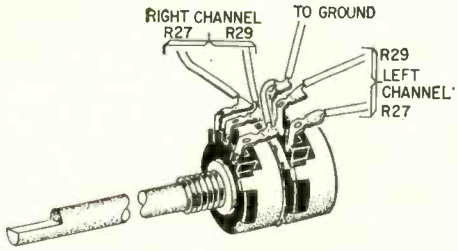
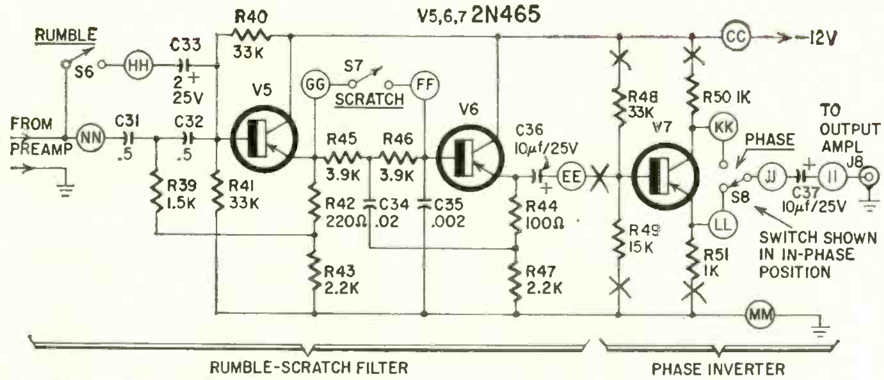


Fig. 5—Balance control wiring.



X= BREAK IN THESE 5 PLACES IF PHASE INVERTER IS NOT TO BE USED

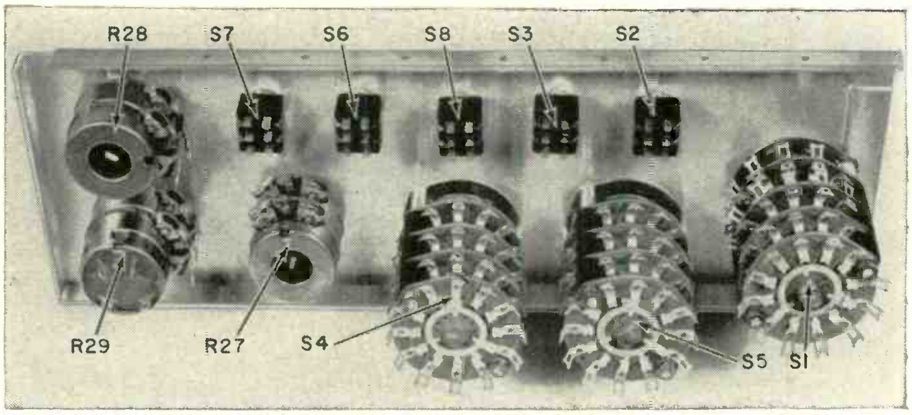
(EE) IS CONNECTED DIRECTLY TO J8 IF PHASE INVERTER IS NOT TO BE USED

Circuit for the scratch and rumble filters and phase reversal stage. Parts list is combined with that for the main unit.

hum loops. After wiring the panel, pull the wires that go to the selector switch together into a bundle and tie them in several places. Be sure to leave these wires long enough to reach the selector switch on the front panel.

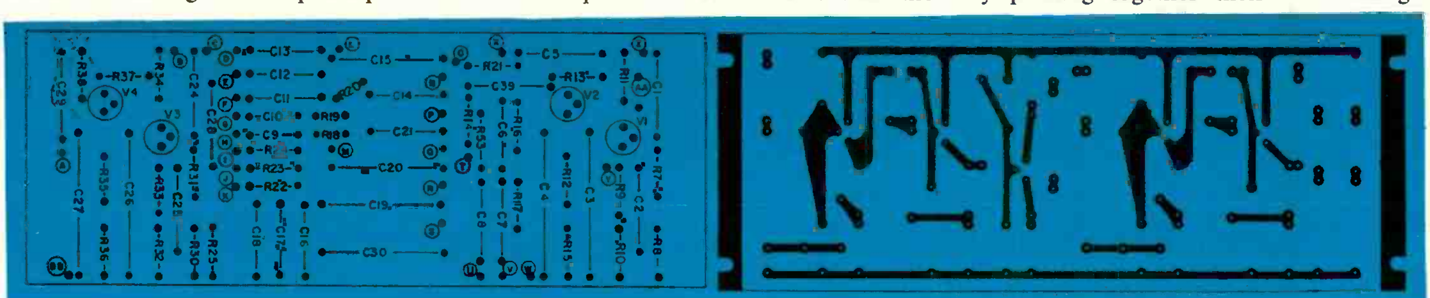
The printed-circuit boards are made from patterns shown, or undrilled circuit boards may be purchased already etched. Mount parts on printed-circuit boards as shown in the diagram. The transistors in the original unit were mounted in sockets, but may be soldered in place if preferred.

After all components are soldered on the boards, solder the wires to the power supply and the various switches to the boards. The wires go into the boards on the back or copper side. Eyelets were used in the wire holes on the original unit to insure a solid contact and reduce the chances of pulling a piece of the copper pattern off the board if a wire were pulled too hard. Cut the wires to the length necessary to reach the points they will connect to. Bring together the wires going to each switch and tie them as shown in the photographs. The wires that connect the VOLUME, BALANCE and LOUDNESS controls and the wiring between the REVERSING and STEREO-MONO switches should be put in as indicated on the schematic. The BALANCE control is wired as shown in Fig. 5. The preamp is now ready for assembly.

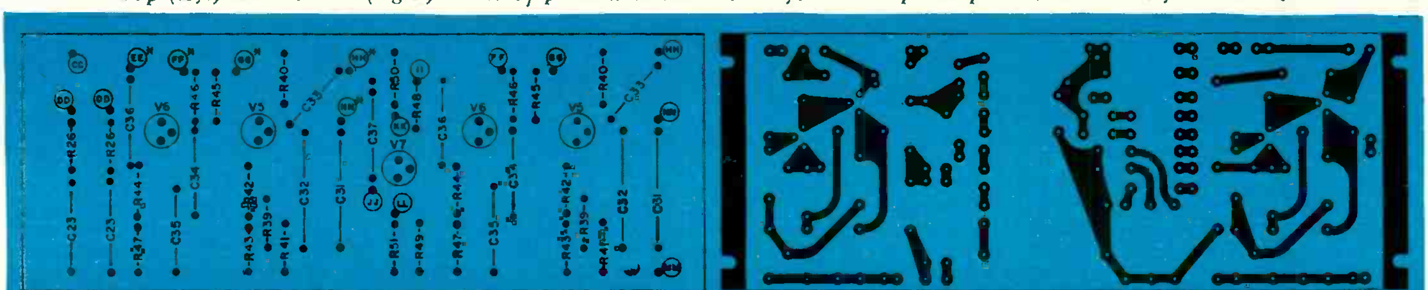


Parts placement on the front panel.

Fasten the mounting brackets to the ends of the printed-circuit boards with 4-40 x ¼-inch sheet-metal screws. Adjust these brackets in the slots on the ends of the boards so that all boards (with brackets on) are the same length. Now screw the right-side panel and the divider panel to the brackets with the same type screws. Place a terminal strip to mount C38 under the top screw used to hold the front and rear boards on the divider panel. The left-side panel has a terminal strip mounted near the rear of the panel that is used as a tie point for the ac connections. The front, rear and side panels are now assembled by pushing together their interlocking

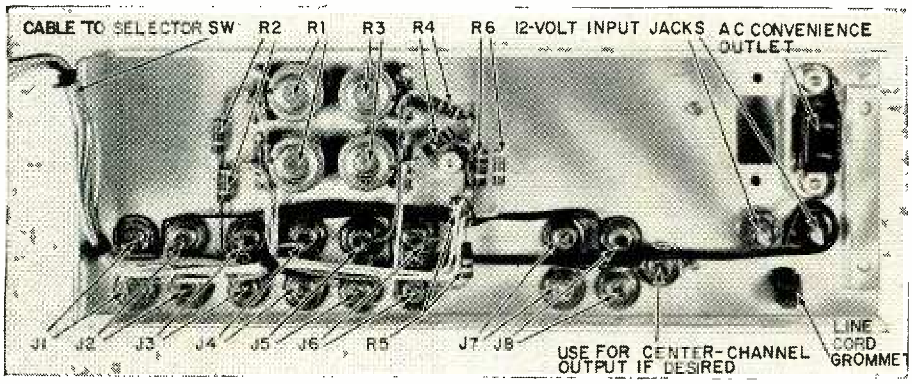


Top (left) and bottom (right) views of printed circuit board for stereo preamp. It is shown half actual size.



* INDICATES CONNECTIONS TO SECOND CHANNEL AMPLIFIER (THIS CHANNEL DOES NOT INCLUDE PHASE INVERTER)

Top (left) and bottom (right) views of printed board for phase inverter and tone controls (half actual size).



Parts placement on the rear panel.

PRINTED CIRCUIT BOARDS

Labeled, undrilled printed-circuit boards for this preamp can be obtained from the author—Daniel E. Meyer, 430 Redcliff Drive, San Antonio 16, Tex. The cost is $1.50 per board. To build a stereo preamp, you will need three boards—two preamp boards and one tone-control phase-inverter board.

Transistor	Emitter	Base	Collector
V1	1.4	1.6	4.2
V2	4	4.2	7
V3	1.4	1.6	4.2
V4	4	4.2	7
V5	5.4	5.6	12
V6	5.2	5.4	12
V7	3.2	3.4	8.5

All voltages negative with respect to chassis

edges. Fasten the divider panel to the back panel with two sheet-metal screws.

The on-off switch on the volume control is a dpdt unit. One set of contacts controls the 12 volts to the preamp. The other controls 117 volts to the accessory outlets. This enables you to turn on your power amplifier when you turn on the preamp.

The ac wiring to the switch is run through a piece of spring stock from the terminal strip on the left panel to the rear of the volume control. The shield over the switch is a Centralab KR-5. The remaining wiring can now be done. Remember to return all ground wires from the boards and switches to the phono input. *Do not connect any wires to the chassis at any other point.*

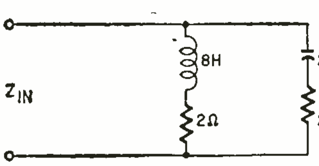
In this article we have presented complete construction data. Next month we will describe an optional ac supply for the preamp along with a picture of how the circuit operates. END

What's Your EQ?

Three puzzlers for the student, theoretician and practical man. They may look simple, but double-check your answers before you say you've solved them. If you've got an interesting or unusual answer send it to us. We are especially interested in service stinkers or engineering stumpers on actual electronic equipment. We are getting so many letters we can't answer individual ones, but we'll print the more interesting solutions (the ones the original authors never thought of). We will pay $10 and up for each one accepted. Write EQ Editor, Radio-Electronics, 154 West 14th St., New York, N. Y.

Answers for this month's puzzlers are on page 91.

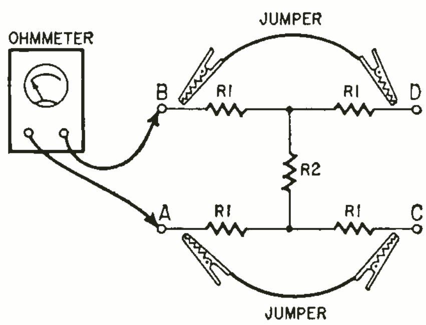
What's the Impedance?



In this parallel circuit, at what frequency is the impedance at a maximum? (Note well that the capacitance is 2 *farads,* not microfarads.)—*Harold F. Tolles*

A Pad Puzzle

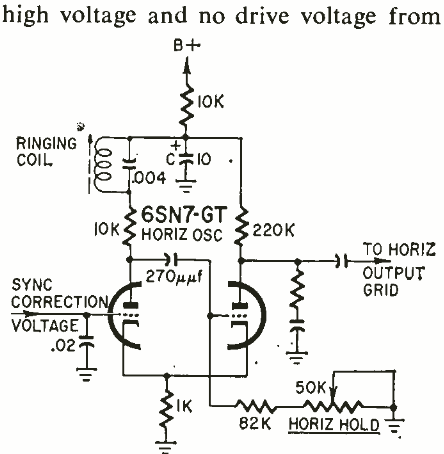
Five resistors are connected in a typical H-pad circuit. An ohmmeter connected between A and B shows a resistance of 308 ohms. A second measurement is taken with two jumpers in the circuit. One jumper is connected from A to C and the other jumper from B to D. The ohmmeter now shows 188 ohms. Find the values of R1 and R2, if



the four resistors marked R1 are equal. —*Kendall Collins*

More TV Trouble

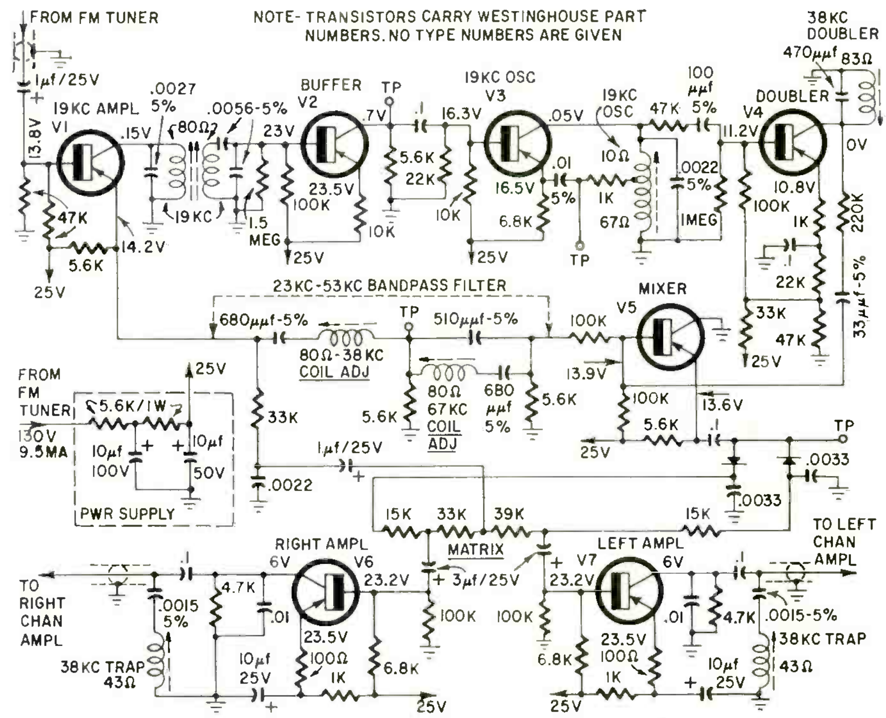
The picture locked in horizontally but it was critical. Tearing and jitter as well as intermittent bending made the picture unwatchable. Suspecting electrolytic C, we checked the waveform across it with a scope. Instead of being clean as it should have been, various random pulses, continually changing, indicated that the electrolytic was open. Certain that we had found the trouble, we installed a new electrolytic. When we turned the set back on, there was no high voltage and no drive voltage from



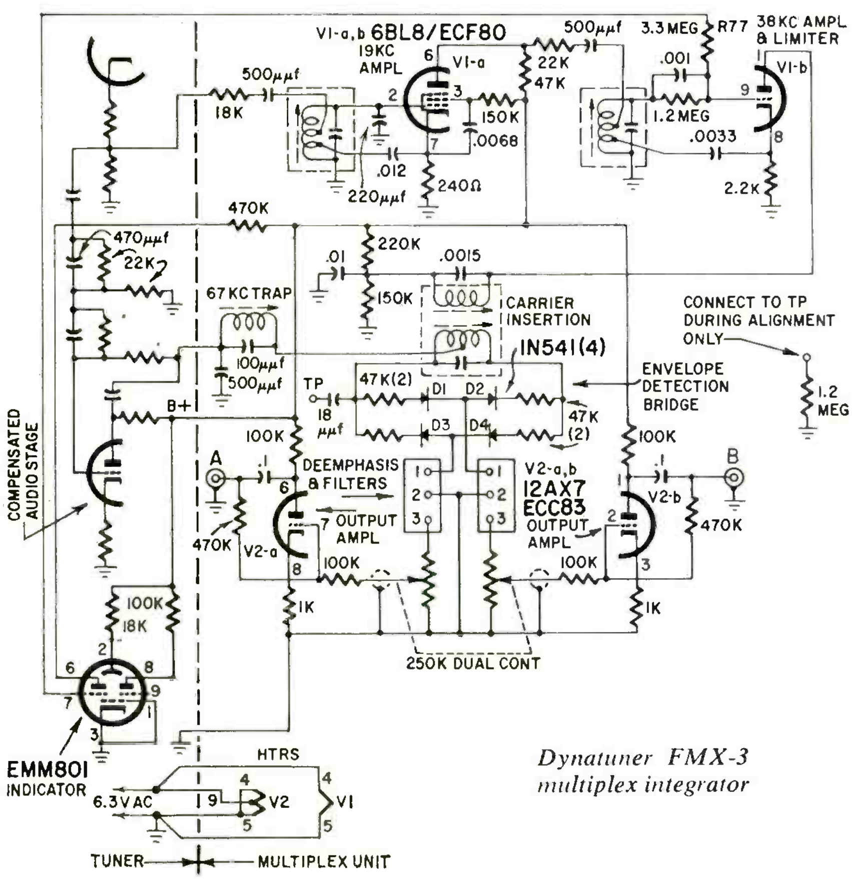
the horizontal oscillator on the horizontal output grid. Disconnecting the new electrolytic, the raster came back on but still with the old trouble. The new electrolytic was good. What was the trouble?—*Wayne Lemons*

2 New FM Stereo Multiplex Circuits

THIS CIRCUIT ON ITS OWN SUBCHASSIS IS added to Westinghouse FM tuners. Its 19-kc amplifier feeds a buffer stage that controls a 19-kc oscillator. The oscillator's output is fed to a doubler to produce the needed 38-kc subcarrier. The 38-kc signal is then combined in a mixer stage with the composite audio which has been passed through a 23-kc to 53-kc bandpass filter. Note that this filter contains a 67-kc trap to insure that no spurious 67-kc SCA signal will get through to interfere. Two diodes in the mixer's output circuit split the signal, matrixing it into appropriate right- and left-channel amplifiers and then on to the stereo hi-fi amplifier. Seven transistors in all are used. Note that a 38-kc trap is included in the output circuit of each of the right- and left-channel amplifiers to eliminate any 38-kc signal that may have gotten through the mixer and amplifiers to the output.

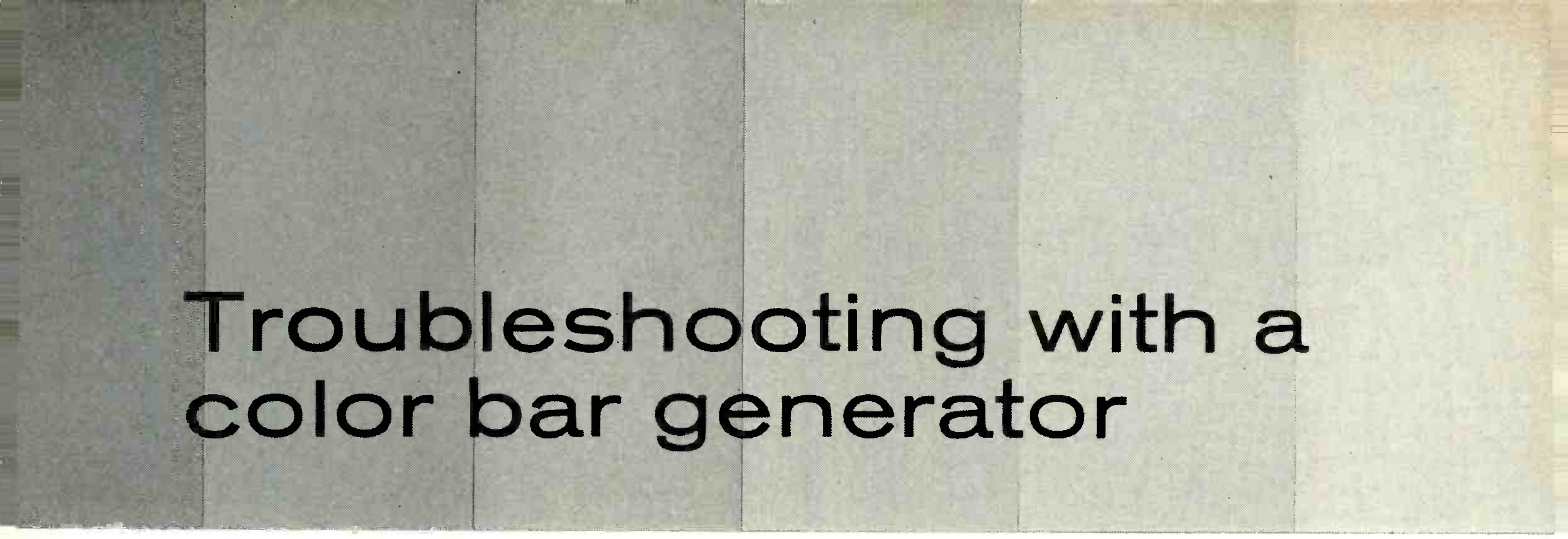


Westinghouse H-350 H-350A, H-351 FM stereo adapter (chassis V2517-1, 2, 3)



Dynatuner FMX-3 multiplex integrator

THIS CIRCUIT BUILDS ONTO THE DYNAKIT FM-1 tuner chassis and integrates with it. It uses a 19-kc amplifier fed to a 38-kc amplifier after doubling, which also serves a limiting function, to minimize noise due to fluctuations in the received 19-kc pilot strength. The reconstituted 38-kc subcarrier is mixed with compensated and amplified audio (up to 53 kc) after any 67-kc modulation present is removed. The recombined signal is fed to an envelope detection diode bridge. The bridge output is fed through de-emphasis and carrier elimination filters to the ganged volume controls and output amplifiers. When a stereo broadcast is received, 38 kc from the grid of the 38-kc amplifier is fed through resistor R77 to the indicator tube, so that one of the beams of the indicator tube indicates when stereo is being received. The other indicator beam performs its normal tuning function. The circuit has been designed with some special features to facilitate stereo alignment, without the need for a signal generator, by following the routine outlined in the manual. When there is no stereo broadcast, the carrier does not get mixed with audio, and the envelope bridge is inactive, paralleling the two amplifier inputs on the common audio. END



Troubleshooting with a color bar generator

It can help you to find color circuit troubles

By **ROBERT G. MIDDLETON**

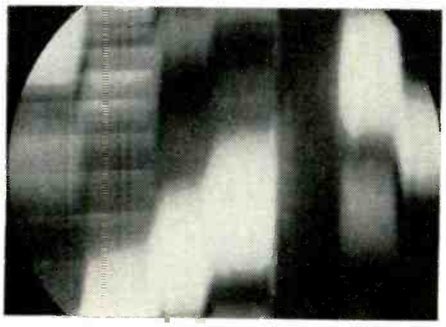


Fig. 1—Loss of color sync produces this pattern on color picture tube.

Fig. 2—Typical normal color sequence.

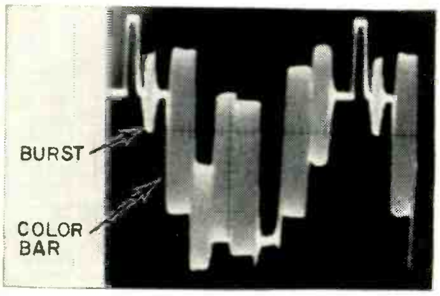


Fig. 3—Waveform of complete color signal.

COLOR PICTURE ANALYSIS IS USEFUL UP to a point. When a color bar pattern is broken up into diagonal strips (which may or may not "roll" vertically) as in Fig. 1, color sync loss is clear-cut. We go to the color sync section at once. But if the color bar generator produces the pattern in Fig. 2, while the TV screen displays a sequence of distorted and mixed hues, is the trouble in the color sync section, the chroma demodulators, matrices, or in a network common to two sections?

In most incorrect color reproduction "across the board," the sequence of hues changes when the tint (or equivalent) control is turned, without giving any useful clues for pinpointing the trouble. We still don't know whether the subcarrier oscillator is being "pulled" short of breaking color sync lock, or whether the oscillator output is being used incorrectly. This basic question is answered by chroma signal substitution, with the color generator set to supply a complete color signal (Fig. 3).

The video signal is injected at the video detector output. This is preferable, because the rf and i.f. circuitry is bypassed in the test. So if a normal color bar pattern now appears on the picture-tube screen, we'll look for trouble in the rf and i.f. sections. On the other hand, if we see abnormal color bars, the chroma section must be checked out.

At this point, we substitute a synchronized subcarrier signal from the color bar generator in the color sync section, to determine whether "pulling" is taking place and causing the abnormal color reproduction. This test voltage is automatically locked with the bar signal, because both are derived from a common source in the generator. To make the test, apply the 3.58-mc output from the generator to the grid of the subcarrier oscillator tube in the receiver (Fig. 4). You don't have to unplug the oscillator crystal.

Now, the output from the subcarrier oscillator tube is locked, and its phase is fixed. The subcarrier phase is independent of any defects in the reactance tube or phase detector circuitry. To put it another way, we can now make definitive checks of the chroma demodulators and matrices. First, try turning the tint (color phasing) control through its range, to see whether a normal color bar pattern can be displayed. If it can, the trouble is in the reactance tube or the phase detector section—forget about the chroma demodulators and matrices.

No normal pattern

If a normal color bar pattern cannot be displayed, there are two other possibilities. Here, we cannot *assume* that the trouble is in the chroma demodulators or matrices, because the phase of the injected subcarrier voltage is arbitrary and the color-phasing control may not have enough range to "bring it in." Therefore, the first job is to find out if we can display a sequence of normal

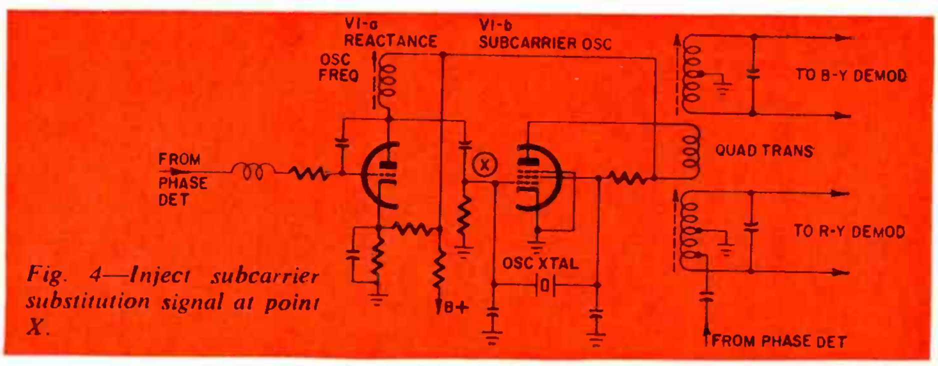


Fig. 4—Inject subcarrier substitution signal at point X.

hues, but a sequence *which does not start at the beginning of the horizontal scan.*

Now switch the generator to CHROMA. This eliminates the Y-signal from the otherwise complete color signal. Note that the pattern of Fig. 1 was obtained with the function control in its CHROMA position—hence the normally white bar appears dark. Eliminating the Y-signal does not change the indentifiable hues in the color bars, though they lack the brightness provided by a complete color signal. Now, turn the color phasing control through its range, and observe the chroma bar pattern.

If the chroma demodulators and matrices are functioning normally, you will see a normal chroma bar pattern at some setting of the color phasing control. However, the red bar, for example, might not start at the left-hand edge of the screen—it might start at the middle. If it starts at the middle, check hues of successive bars just as if the red bar were in its usual location. In other words, the chroma bar *sequence* is not changed in any way, but the *start* of the sequence is moved by some arbitrary distance on the horizontal scan. This indicates that the defect is in the phase detector, reactance tube or subcarrier oscillator section. The chroma demodulators and matrices are cleared of suspicion.

If you cannot get the chroma bar display, there is a defect in the chroma demodulators or matrices. Since the subcarrier oscillator and control circuits have been cleared, disconnect the 3.58-mc injection lead. Leave the video signal lead from the generator connected at the video detector output, and turn the generator function switch to its R—Y position. Observe the pattern on the picture tube while turning the color-phasing control. If you can obtain a correct R—Y chroma bar, the R—Y circuitry is OK. But if you cannot obtain the R—Y hue at any setting of the color phasing control, there is a defect in the R—Y channel or its associated circuits.

Then make a similar test, using the B—Y generator output. Note whether a correct B—Y hue appears at some setting of the color phasing control. Finally, apply a G—Y/90° signal to see whether the normal orange hue can be reproduced These are particularly useful tests, because they show which, if any, of the three chroma channels is capable of normal operation.

On older receivers

These preliminary findings are evaluated with respect to the chroma circuitry in the particular receiver. This is comparatively easy in older color receivers. Fig. 5 shows how the demodulated outputs are fed through buffer amplifiers into a G—Y matrix. In this configuration, the reproduction of correct R—Y and B—Y bars with distortion of the G—Y hue indicates that we should make voltage and resistance measurements in the G—Y section. A leaky capacitor in the matrix grid circuit is also a possibility. If an R—Y bar is correctly reproduced but B—Y and G—Y bars are distorted, check the B—Y demodulator. Note that an off-value resistor, open or leaky capacitor or open peaking coil in this stage will distort both the G—Y and B—Y outputs, because G—Y is compounded from B—Y and R—Y signals.

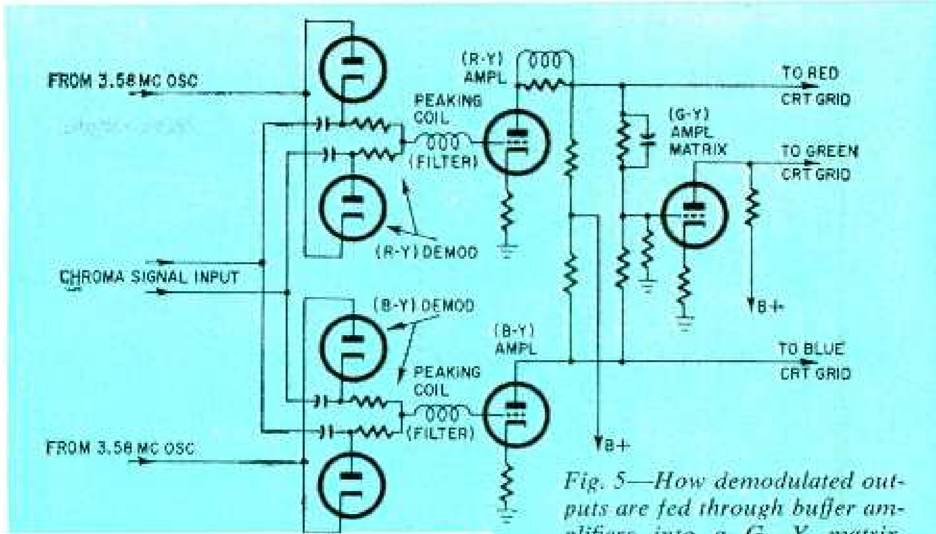


Fig. 5—How demodulated outputs are fed through buffer amplifiers into a G—Y matrix.

Again, in Fig. 5, if the B—Y hue is correctly displayed but R—Y and G—Y hues are distorted, the trouble is in the R—Y stage. Look for defects in the R—Y amplifier as well as the R—Y demodulator. If the plate peaking coil in the R—Y circuit is open, for example, circuit continuity is maintained through the damping resistor but the R—Y bar is weak or absent due to signal loss through the resistor. The bandpass amplifier is eliminated from suspicion in these situations, because at least one chroma bar is reproduced normally. If you are unable to obtain normal display of any one of the three basic chroma signals, the bandpass amplifier becomes suspect too.

A definitive test is advisable to either clear the bandpass amplifier or pinpoint the difficulty to this section. Disconnect the generator from the video detector output and apply the signal at the output of the bandpass amplifier (Fig. 6). Set the generator on CHROMA. If there is a defect in the bandpass amplifier, a normal chroma bar display now appears on the picture-tube screen. Incorrect hues confirm trouble in the chroma demodulator or matrix sections. Look for a shorted capacitor common to both chroma demodulators, which will upset the action of both stages, as well as the following matrix.

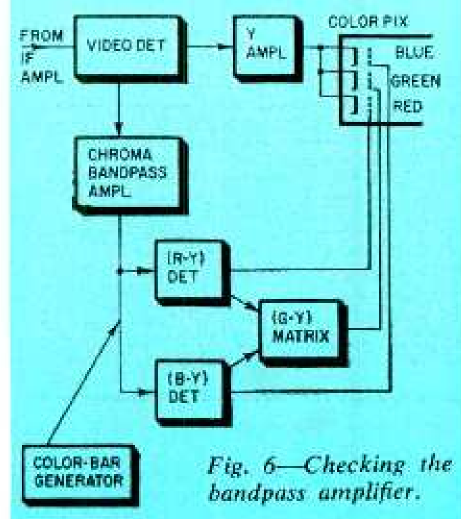


Fig. 6—Checking the bandpass amplifier.

More modern sets

Most recent color receivers use X and Z demodulators (Fig. 7). Although chroma circuitry is somewhat simplified, interaction is extensive and must be contended with when shooting trouble. Check for leaky or shorted capacitors *at the outset;* this fault usually disturbs the operation of the entire system. An open capacitor can be almost as troublesome. Experience has shown that if the fault has been caused by an *interlectrode short in a tube,* all resistors in the circuit must be carefully checked. The circuitry is dc-coupled throughout, and a heavy B-plus demand by one tube can be expected to overheat and change the values of several resistors. To insure against recurrence of this headache, the technician can replace the off-value resistors with wirewound types of ample power ratings.

If you are a beginner in the color service field, remember the basic principle that some video detectors have positive-going and others negative-going output. Signal polarity *must be observed* in making any video signal tests. Color generators have an output function switch, with —video and +video positions. If you make a mistake and

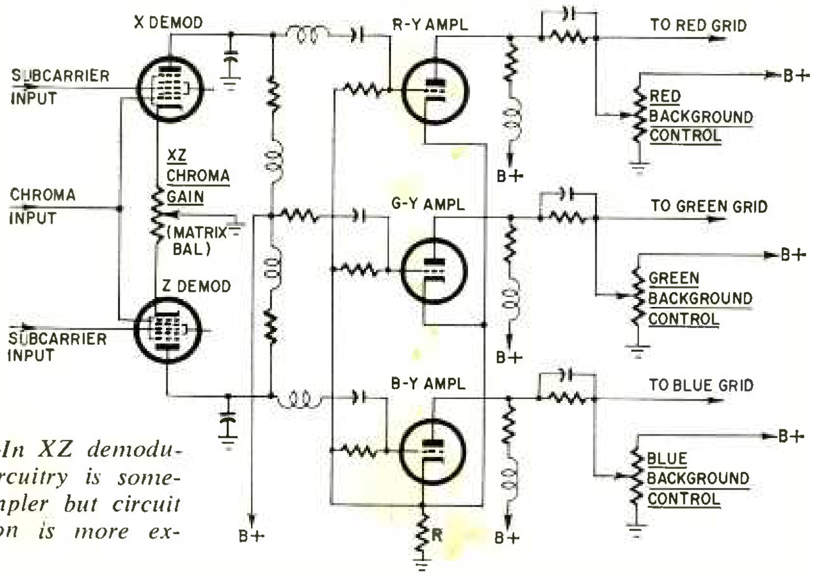


Fig. 7—In XZ demodulator, circuitry is somewhat simpler but circuit interaction is more extensive.

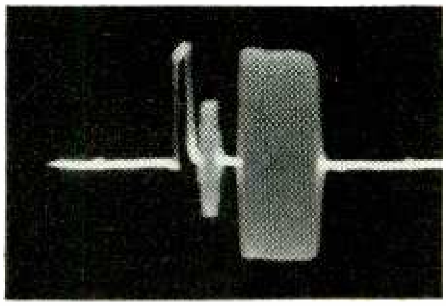


Fig. 8—R−Y chroma signal, single-bar presentation.

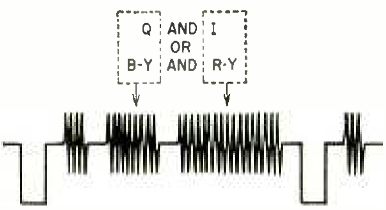


Fig. 9—Simultaneous B−Y and R−Y bars. Note that bars are not of equal size.

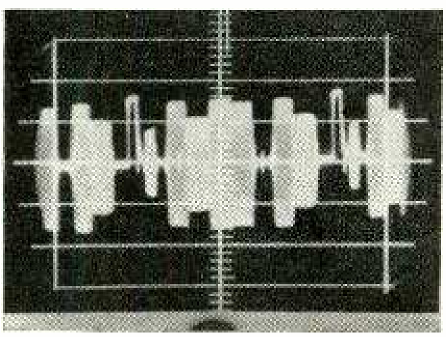


Fig. 10—Chroma-component signals for green, yellow, red, magenta, cyan and blue.

feed +video into the output of a detector which normally develops −video, there will be no horizontal sync, the bandpass amplifier will operate incorrectly (or not at all), and the color killer will operate erratically.

Another basic consideration is the signal level. It is controlled by the attenuator setting. Do not overload the circuits under test by using excessive signal output. Conversely, do not use a subnormal signal level or you will get pale hues and an appearance of low gain in the chroma section. All procedures covered so far refer to checks made with a Simpson 458 generator.

Types of presentation

Some color bar generators have individual switch positions for R−Y, B−Y, I, Q, etc., signals and display only one chroma bar at a time, as seen from the scope pattern in Fig. 8. On the other hand, a color bar generator may provide two chroma signals simultaneously—one bar being narrower than the other (Fig. 9). This provides identification in any test where you might not know whether a B−Y or R−Y bar is being displayed. The B−Y (or Q) bar is only half as wide as the R−Y (or I) bar, whether viewed on the picture-tube or scope screen.

Most generators also provide a series of six chroma bars corresponding to the primary and secondary colors (Fig. 10). Note carefully that the chroma-component signal for red is *not* exactly the same as R−Y, and that the chroma-component signal for blue is *not* exactly the same as B−Y. There is a phase difference which, though small, is required for reproduction of true colors. Phase differences cannot be readily determined at 3.58 mc with ordinary service scopes, and hence we need some method of ready identification of the various chroma signals.

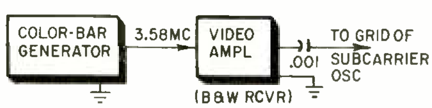


Fig. 11—A good video amplifier in a black-and-white receiver will step up the generator signal.

Boosting chroma output

Some color generators have a comparatively high output; others have some high-level and some low-level outputs, and a few have low-level outputs on all functions. Hence, when substituting a 3.58-mc signal in a "dead" subcarrier oscillator circuit, you may have to boost the generator output. This can be done easily (Fig. 11). A video amplifier in or from a good black-and-white TV is a useful utility wide-band amplifier.

Connect the generator output to the grid of the video amplifier tube, and run a test lead from the video amplifier output (usually the picture-tube cathode) to the signal-injection point in the color receiver. Generally, the grid of the subcarrier oscillator tube is a suitable signal-injection point. We stress the use of a good black-and-white receiver, because the video amplifier should have full gain at 3.58 mc. If the signal-injection point in the color set is properly chosen, so that the video amplifier output circuit is not loaded excessively, the amplifier frequency response will not be seriously impaired. On the other hand, you'll be disappointed if you try injecting the 3.58-mc signal into a cathode circuit in the color receiver, because loading becomes excessive.

Rainbow generator

The output from a rainbow type generator is an offset color subcarrier with a frequency of 3.56 mc. Hence, we do not find an output suitable for oscillator signal-injection tests. Nevertheless, this is a highly useful generator and simpler to operate than the NTSC type. Viewing a scope screen, we see 11 bursts between successive horizontal

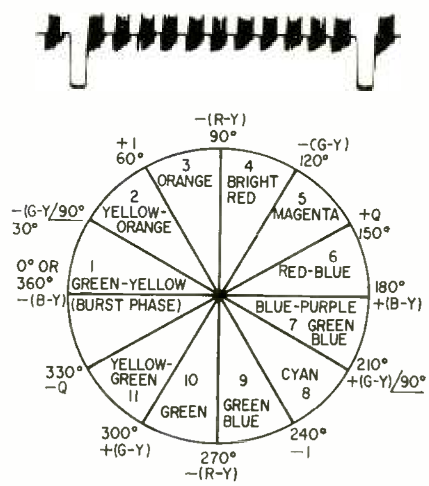


Fig. 12—There are 11 bursts between sync pulses.

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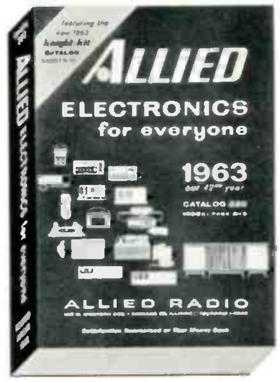

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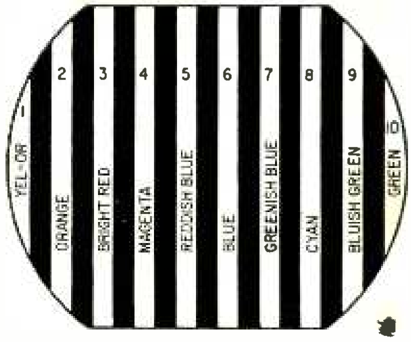
sync pulses (Fig. 12). The first is used for color sync, leaving 10 bursts to drive the chroma circuits. Observe in Fig. 12 how consecutive bursts follow around the "color wheel", the colors normally displayed on a color picture tube.

Yellow-green is usually off screen, be‑‑ lost during the burst-keying interval. Now, let us look at Fig. 13. Here, the first burst (color burst) is ignored, and the visible bars are numbered from 1 to 10. The upper diagram shows the proper sequence of colors. The lower diagram illustrates the normal scope patterns at the outputs of the R—Y and B—Y chroma demodulators. All bars have the same width, and we identify the various phases by "counting bars."

Thus, the sixth bar should cause a null from the R—Y demodulator, and the B—Y demodulator should have two nulls: one at the third and one at the ninth. If the proper nulls do not appear, chroma troubleshooting is called for. The first and seventh bars normally null at the output of a G—Y demodulator, because they are G—Y/90° signals. Of course, if we tackle an IQ system in a vintage receiver, the I demodulator is expected to null on the Q signal, and vice versa.

The high utility of various color bar generators can be appreciated only by practical bench experience. A color bar generator is comparable to a scope—it has a forbidding appearance to the beginner, but after adequate experience in its operation it is indispensable in practical troubleshooting. END



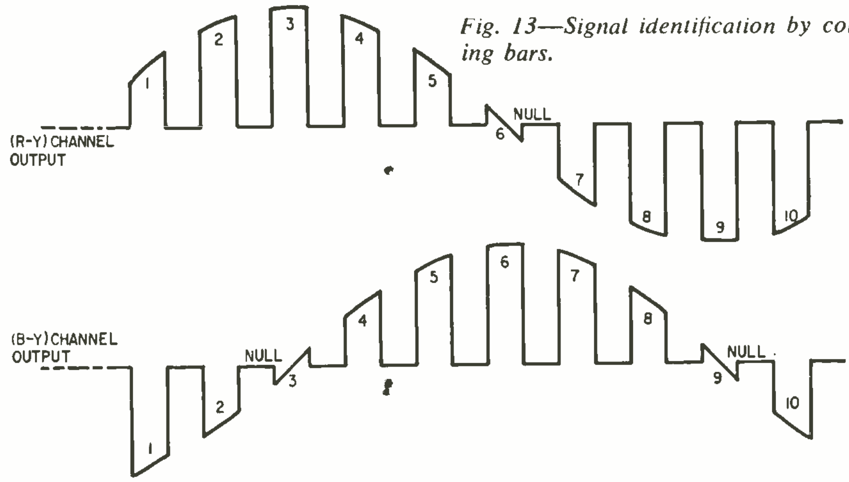


Fig. 13—Signal identification by counting bars.

SEEING THE HIGH-RESISTANCE GROUND

HOW HIGH IS A "HIGH-RESISTANCE ground"? Might be just a fraction of an ohm. And even that much can be just *too* high where zero resistance is a must.

Measuring fractions of an ohm is just about impossible without just the right instruments, so high-resistance trouble often is checked out by hopefully reheating *all* suspected joints or by searching for the bad joint with a short jumper whose resistance may be higher than that of the bad joint!

There's a simple way to look for the trouble and to *see* it—literally. Just give the unwanted "piece" of an ohm a controlled chance to differentiate a square wave as you watch the action on your scope. The basic differentiator circuit is in Fig. 1.

Select C and the frequency of the square-wave input so that a value of R less than 1 ohm will give a short time constant. For example, using C = 5 μf, a 0.2-ohm resistance gives a 1-μsec time constant. One cycle of 100-kc input requires 10 microseconds, and the width of the square wave's top, therefore, is five times the 1-μsec constant.

Now all that remains to be done is to connect scope, square-wave generator, and C so that the high-resistance ground can be inserted in the test circuit without the burden of unwanted resistance such as the fraction of an ohm in every good test lead. Fig. 2 shows this is done.

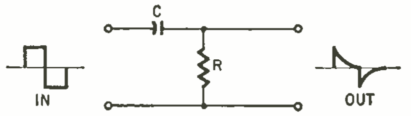


Fig. 1

Probes A and B (Fig. 2), if ideal, would have zero length or zero resistance. Impractical to accomplish, but they can be kept sufficiently short. For probe A, cut one lead of the capacitor as short as possible, leaving just enough to tack on one of the scope leads. For probe B, use a piece of heavy bus wire, or simply tack the generator lead to the tip of the scope's direct probe. In this way, the scope sees only the potential change across whatever resistance may be placed between the probe tips.

1. Select a square-wave frequency and value of capacitance so that time constant is about one-tenth of one cycle ($T = RC = 0.1 \times 1/\text{freq}$).
2. Construct probes to assure zero resistance:
   (a) From C to one probe tip—connect one scope lead to this tip (A in Fig. 2).
   (b) From tip of other probe to junction with the other scope lead (B in Fig. 2).
3. Adjust generator and scope for a stable square-wave pattern while the probes are separated. Use the least sensitive position of the scope's vertical attenuator that will permit trace amplitude to fill the screen.
4. Now touch probes together and examine the display. Zero resistance shorts out the square wave—the trace drops to a straight line. *Any* resistance at all will differentiate the square wave and produce the typical spikes. Increase sensitivity of scope input and examine again (be sure to reduce sensitivity again before separating probes). This step establishes a reference pattern. Resistance in the probes and setting of vertical gain controls will determine whether it is a "pure" straight line, or one with tiny spikes at the square-wave frequency. Be sure to check sync—the sharp drop in trace amplitude may require a slight adjustment of the sweep controls.
5. The test circuit is ready. Adjust controls as in step 3, then touch probes across the suspected joint.

Straight line? . . . the joint is "clean."

Spikes? . . . there's the high-resistance ground.

Square wave with overshoot? . . . means long R-C, hence high, high, resistance.

I have detected resistance as high—excuse it, please,—lower than .02-ohm using clip leads and a capacitor. And it takes more time to describe how than to set the reference pattern and test a few joints.

May high-resistance-ground trouble never come your way, but when you suspect it is there . . . try *seeing* it.
—*Wm. H. H. Wilkinson*

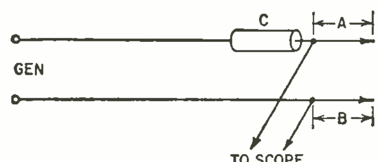


Fig. 2

Improving a Commercial 2-Transistor Receiver

By ELLIOTT A. McCREADY

The sensitivity and selectivity of these toy radios can be pepped up

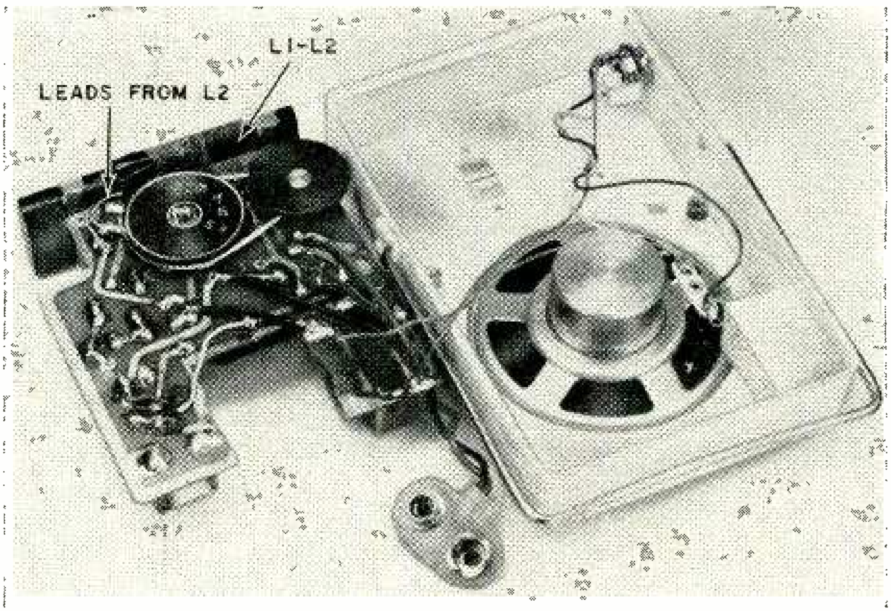
FOR THE PAST YEAR OR TWO, MANY DRUG stores and supermarkets have been selling a variety of small, imported transistor receivers. The lowest-priced of these little radios is a novelty, two-transistor job which sells for less than $10. The performance of this little set is amazing, considering how few transistors and other components it has.

However, it still leaves a lot to be desired. Sensitivity is fair to good in the upper portion of the broadcast band but poor at lower frequencies. Selectivity isn't the best either—strong adjoining local stations tend to slop over into each other. For this reason I never seriously considered buying one of them when I went shopping for a transistor radio for my daughter's Christmas.

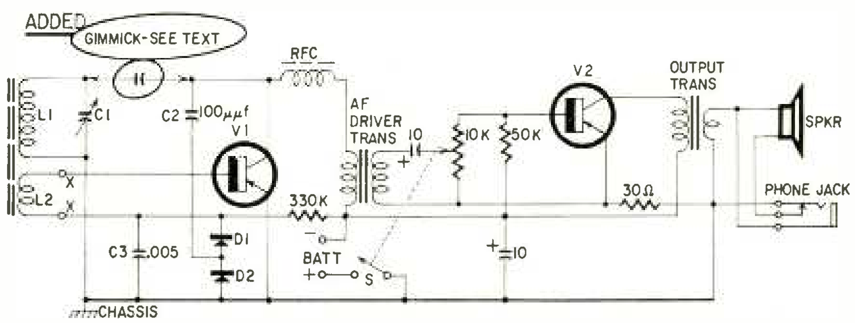
Some time ago an article in this magazine described a two-transistor reflex receiver with a regenerative rf stage (RADIO-ELECTRONICS, Sept. 1960, page 57). Being a regenerative fan from 'way back, I decided this circuit was worth a try. But there were certain drawbacks. First, the miniature components were not available locally. Second, I didn't have a current radio catalog.

It looked as if I was in for at least a two-week wait before I could start construction. Then the fog cleared and I remembered those little two-transistor imports I had seen in the stores. All I had to do was buy one of them, cannibalize it and—with any luck at all—I would have enough parts to complete my project in short order.

With this in mind I purchased one, removed the back and the printed-circuit board, and started tracing the circuit. I soon discovered that this receiver was a straight and simple reflex with one stage of audio. As soon as I found that out, I realized that I should be able to merely convert the thing with a minimum of rewiring rather than start from scratch.



Leads may need reversing. This is where they terminate on this model.



Schematic of the author's radio is typical of the species.

As it turned out, the conversion was much simpler than I had expected. While the converted receiver is considerably different schematically from the one that appeared in RADIO-ELECTRONICS, the principle is the same, and the operation of the little radio is improved at least 100%. Sensitivity is now good throughout the entire band, and selectivity approaches that of a superheterodyne.

The circuit

Since I converted this receiver, I have had the opportunity to check the schematics of several brands of these two-transistor imports. Without exception, they have turned out to be straight reflex. Any minor variations in circuitry have been mostly confined to the audio stage.

The operation of a reflex receiver can be seen from the schematic. Rf from the tuned circuit L1–C1 is picked up by L2 and fed to the base of transistor V1. The amplified rf from the collector of V1, blocked from the output by the rf choke, is fed to diodes D1 and D2 through C2, a small capacitor that will pass rf but not audio. The rf energy is rectified by the diodes, and the resulting af returned to the transistor base via L2.

Bypass capacitor C3 effectively grounds the lower side of L2 for rf, but is not large enough to short out the audio enroute to the transistor. The *af* energy is now amplified by V1 and passes readily through the rf choke to the audio stage for further amplification.

Now, if we can find a way to feed some of the *amplified rf* back to the base of the transistor for reamplification, we can, not only increase the sensitivity of the circuit tremendously, but improve selectivity as well, as anyone who is familiar with the regenerative receiver knows. Of course, we must limit the amount of feedback or the circuit will oscillate.

The modification

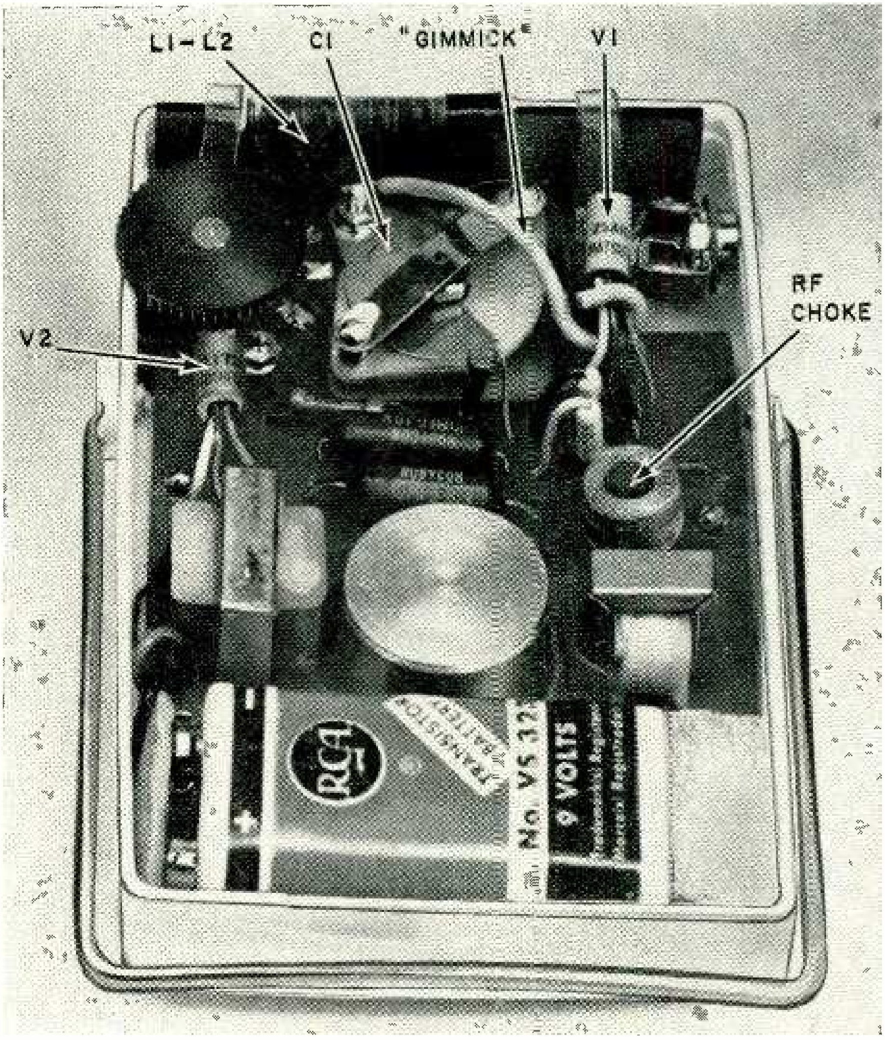
Back to the diagram: the simplest way of feeding rf back to the transistor input is to connect a capacitor between the stator of C1 and the collector of the transistor V1. This capacitor is in the order of a couple of $\mu\mu$f, and consists of a "gimmick" made of a short piece of insulated wire soldered to the stator of C1 and wrapped around the collector lead of V1 (see photo). Two or three turns should be adequate to start, and in most cases can be connected without removing the printed circuit board.

Before proceeding further, turn the receiver on and tune through the entire band. If the set oscillates, skip the next paragraph.

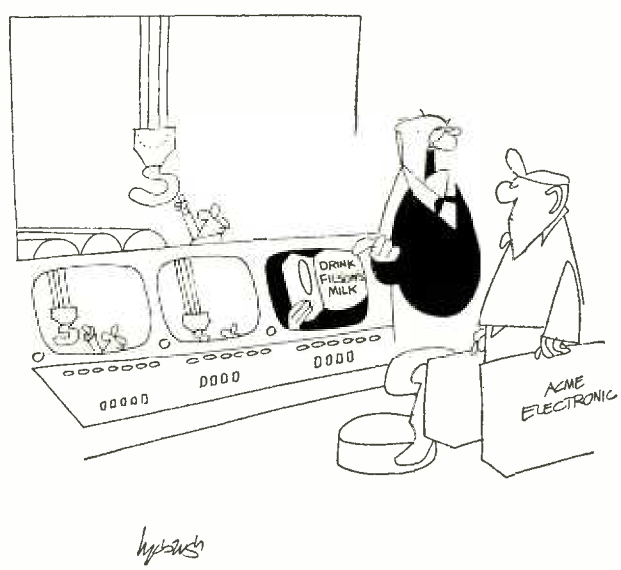
If, after adding the "gimmick", receiver sensitivity and selectivity appear to drop, the rf being fed back to the transistor is out of phase. Correct this by removing the printed-circuit board and reversing the leads of L2 at points marked X–X. Oscillation should now occur when the receiver is turned on and the tuning capacitor rotated. Turn the dial slowly and listen for whistles as stations are tuned in.

Finally, remove turns from the "gimmick" until the receiver operates just below the point of oscillation when the tuning capacitor is rotated through its entire range. This is the optimum feedback adjustment (my receiver uses one loosely coupled turn). Coupling may need to be adjusted when the receiver battery is replaced.

The modified reflex will pick up and separate all the strong locals with excellent speaker volume. By using the earphone which comes with the receiver, many out-of-town stations can also be received. END



How the "gimmick" is added.



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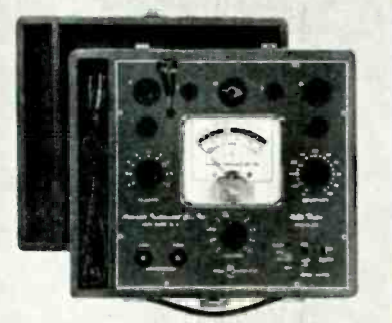

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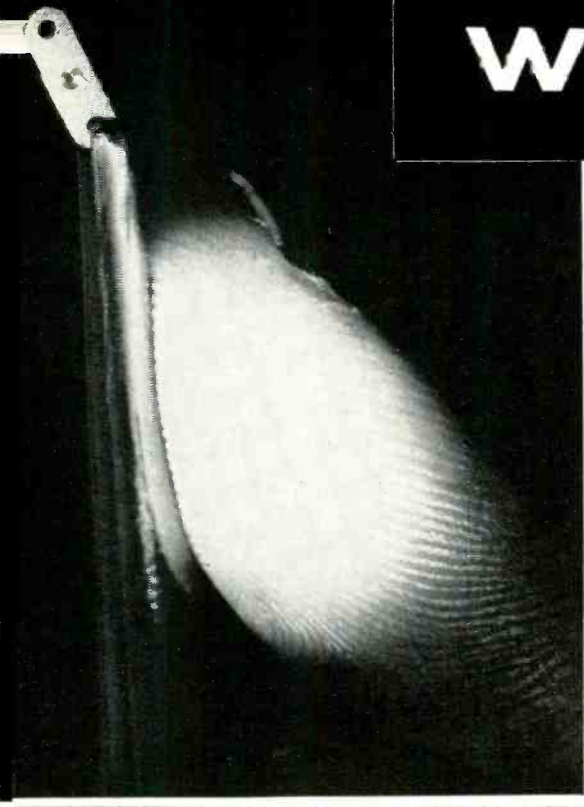
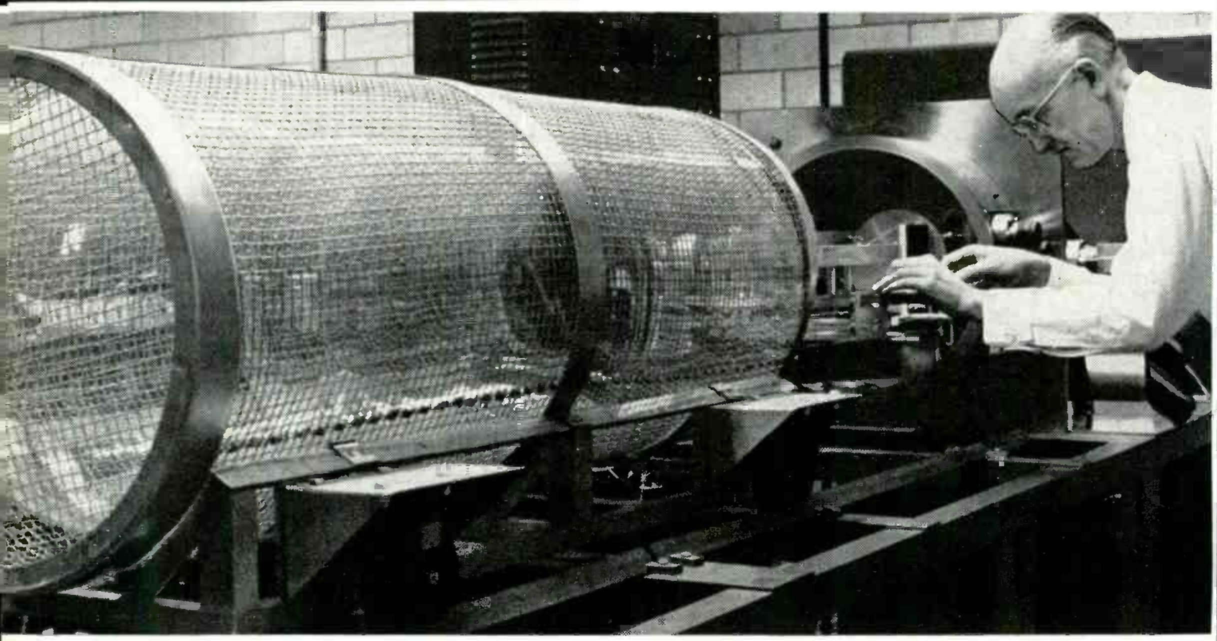
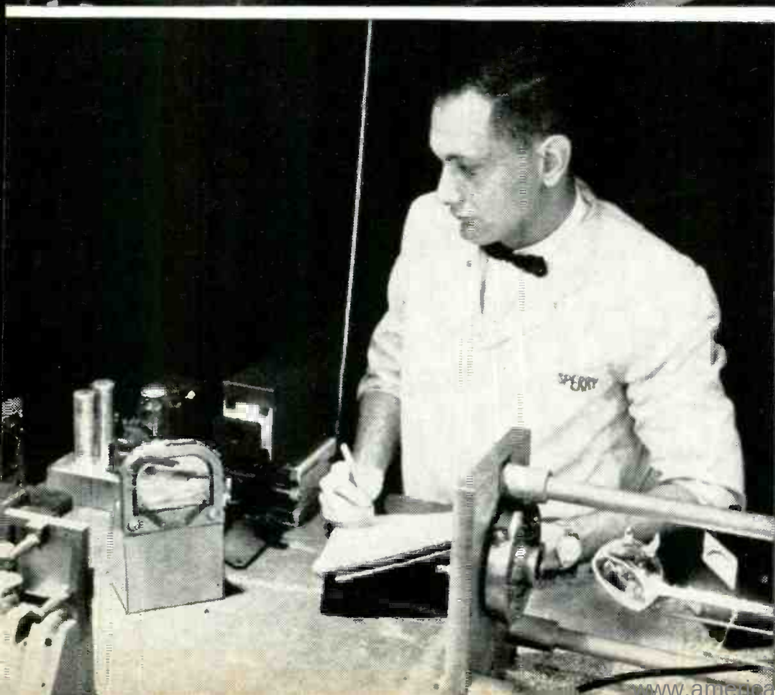


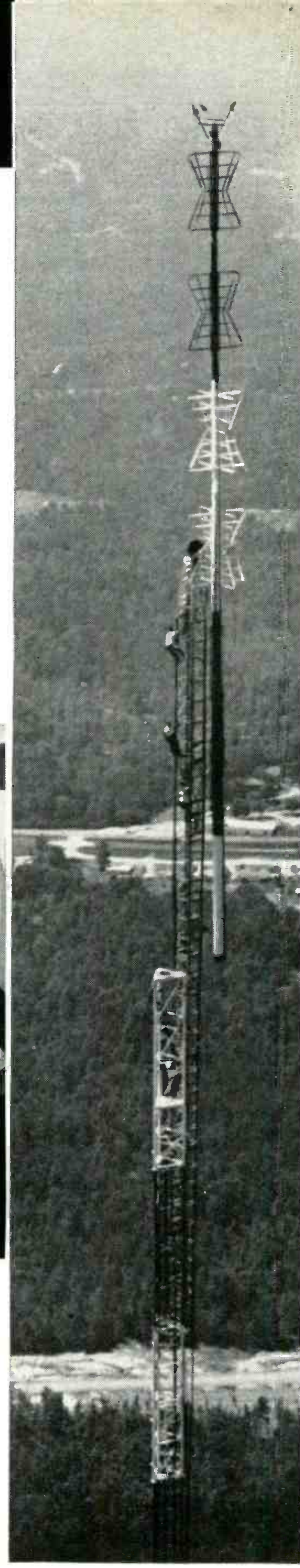
TINY GALLIUM ARSENIDE DIODE will transmit 20 TV pictures on a single beam of intense infrared light. The diode is just behind the small hole in the center of the tweezer-held mounting strip through which the infrared light is emitted. The device was developed by the MIT Lincoln Laboratory.

BETTER CRT'S come out of research aided by this man-sized vacuum chamber at Westinghouse. Inside is a cathode-ray gun similar to the one in a TV picture tube. It operates under ideal conditions permitting accurate study of the behavior of cathode-ray beams.





LASER FOR DOPPLER RADAR? This experimental device, a modified Michelson interferometer using a laser as an energy source, makes what Sperry Gyroscope calls a laser-doppler radar. It is said to measure motion over the range of 5 miles per second to less than 1/10,000 inch per second.



TALLEST MAN-MADE STRUCTURE (at this moment) is this 1,749-foot broadcasting tower. Shown here just as the last section was being swung into place, the tower is now being used by WRBL-TV and WTVM of Columbus, Ga. RCA supplied the two antennas. Stainless Inc., is putting them up.

Inventors of Radio

Heinrich Rudolf Hertz

By **DEXTER S. BARTLETT**

HEINRICH RUDOLF HERTZ, BORN AT HAMburg on Feb. 22, 1857, began to attend the lectures of Kirchoff and Von Helmholtz at Berlin in October 1878 and was able to plunge into original research on a problem of electric inertia. For the best solution, a prize was offered by the philosophy faculty of the university. He succeeded in winning with his paper on the "Kinetic Energy of Electricity in Motion." His next investigation, on "Induction in Rotating Spheres," was offered as his dissertation for the doctor's degree, which he obtained with the rare distinction in those days of Summa Cum Laude. Later in the same year he was assistant to Helmholtz in the physical laboratory of the Berlin Institute. During the 3 years he held this position, he carried out researches on elastic solids, hardness, evaporation and the electric discharge in gases. In 1883 he went to Kiel, and there began the studies in Maxwell's electromagnetic theories that made him famous.

James Clerk Maxwell, who was always saying, "What's t' go o' that," sowed the seed with his mathematical theorems:

1. If electric waves could ever be generated, they would travel at the speed of light.
2. Light is essentially electromagnetic and not a mechanical phenomenon.
3. The refractive index of a substance is intimately related to its dielectric coefficient.
4. Conductors of electricity must be opaque to light.

It remained for Hertz to prove these 20 years later. Hertz actually made these experiments between 1885 and 1889, when he was professor of physics at the Carlsruhe Polytechnic. He used an oscillator and resonator, as shown in the diagram. With the resonator held in his hand he moved about the laboratory, and within certain distances from the oscillator, he found that a small spark would jump across the gap in his resonator, or wire loop. The latter was tuned to be in resonance with the frequency of the waves radiated from the oscillator by varying its diameter. This was the very first spark-gap transmitter and receiver.

In this way Hertz verified the opinion of Maxwell and, for probably the first time in history, determined the wavelength of the electric waves he was using. He also established the close relation between those waves and light waves. He found that when electric waves, radiated from his oscillator, were directed against a metal mirror connected to the resonator, there would be a spark across the resonator gap. But, if he held sheet iron between the oscillator and the resonator, there would be no spark. This he considered as a shadow. He believed that the iron absorbed the waves because it was opaque to them as it was to light. He also claimed that the electric waves each have a North and South polarity which causes them to proceed in a given direction by the laws of attraction and repulsion. He checked diffraction with a prism and lenses of pitch. Polarization was checked with a screen composed of parallel wires placed between oscillator and resonator and rotated.

Hertz' best known discoveries were not his only ones. He contributed eighteen papers on various subjects to German periodicals. He also found that, if the spark gap is made of certain appropriate substances, ordinary light would cause the spark to jump more easily. This was the beginning of photoelectric cells.

In 1875, Prof. Elihu Thomson, also, experimentally discovered electric-magnetic waves. On the first floor of a Philadelphia high school, he had a grounded induction coil connected to an insulated still for an antenna and drew long sparks between his pencil and door knobs, even on the sixth floor. This was 12 years prior to Hertz. Although Thomson was a brilliant inventor and scientist, he did not pursue his research further. Even earlier than this, in 1869, Dr. Mahlon Loomis had described electric vibrations, but without any clear knowledge of the theory behind them. See "Radio Telegraphy in 1866," RADIO-ELECTRONICS, April 1959.

In 1889, Hertz was appointed Professor of Physics at the University of Bonn. There he continued his researches on the discharge of electricity in rarefied gases, only just missing the discovery of X-rays, and produced his treatise *Principles of Mechanics*, which is still in print. This was his last work, for after a long illness he died at Bonn on Jan. 1, 1894, a month before his 37th birthday.

Helmholtz thought him the one of all his pupils who had penetrated farthest into his own circle of scientific thought, and looked to him with the greatest confidence for the further extension and development of his work.

END

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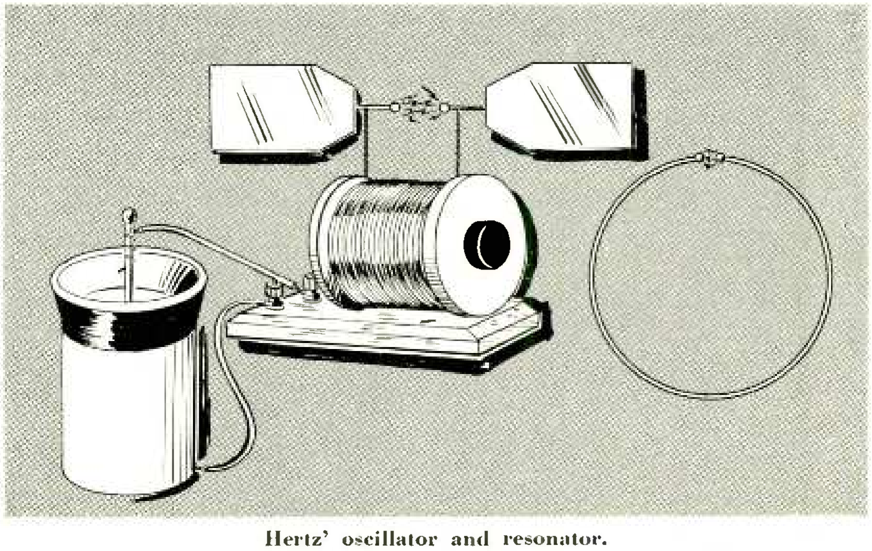
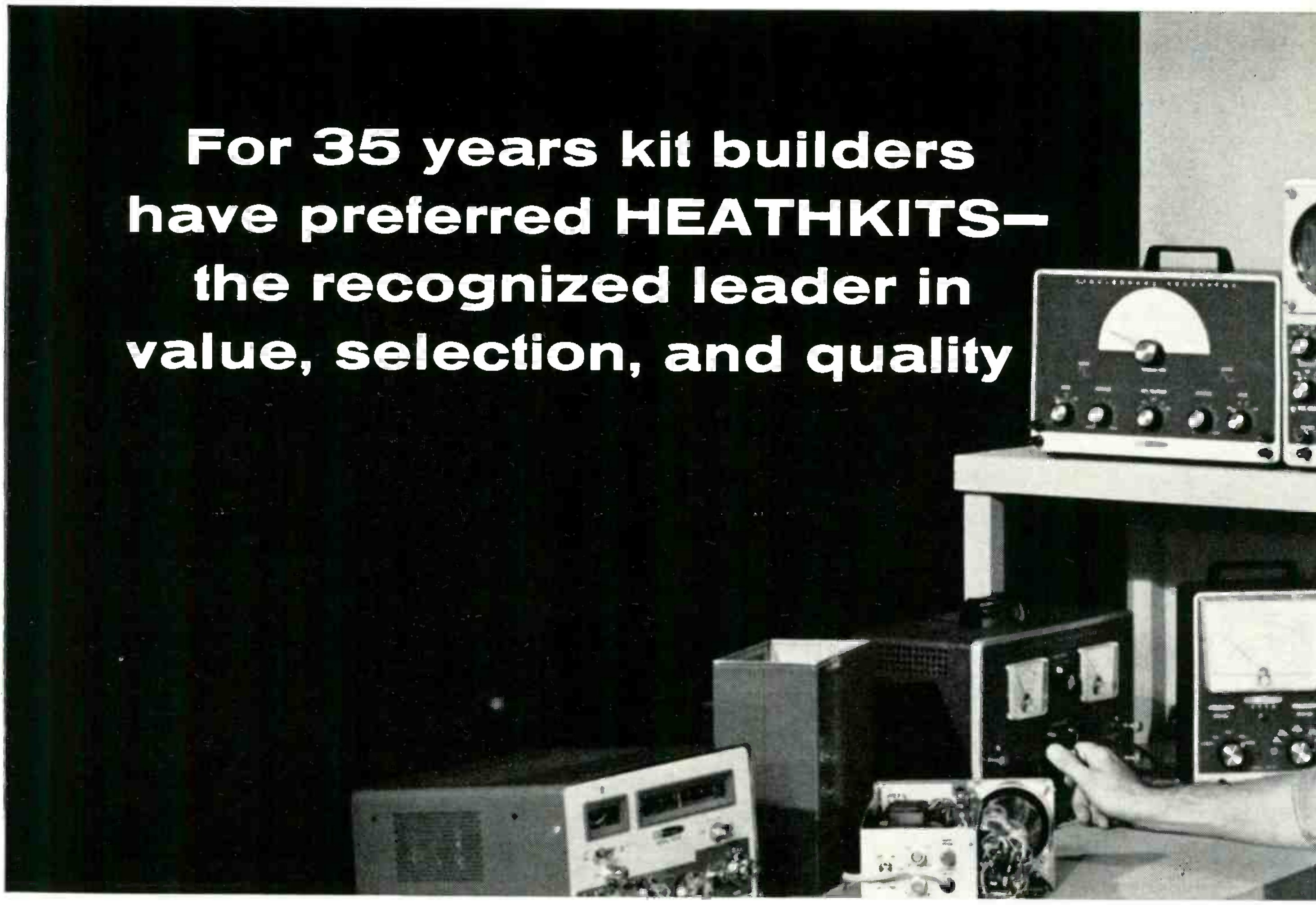


Hertz' oscillator and resonator.



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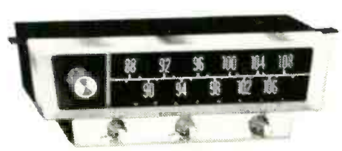

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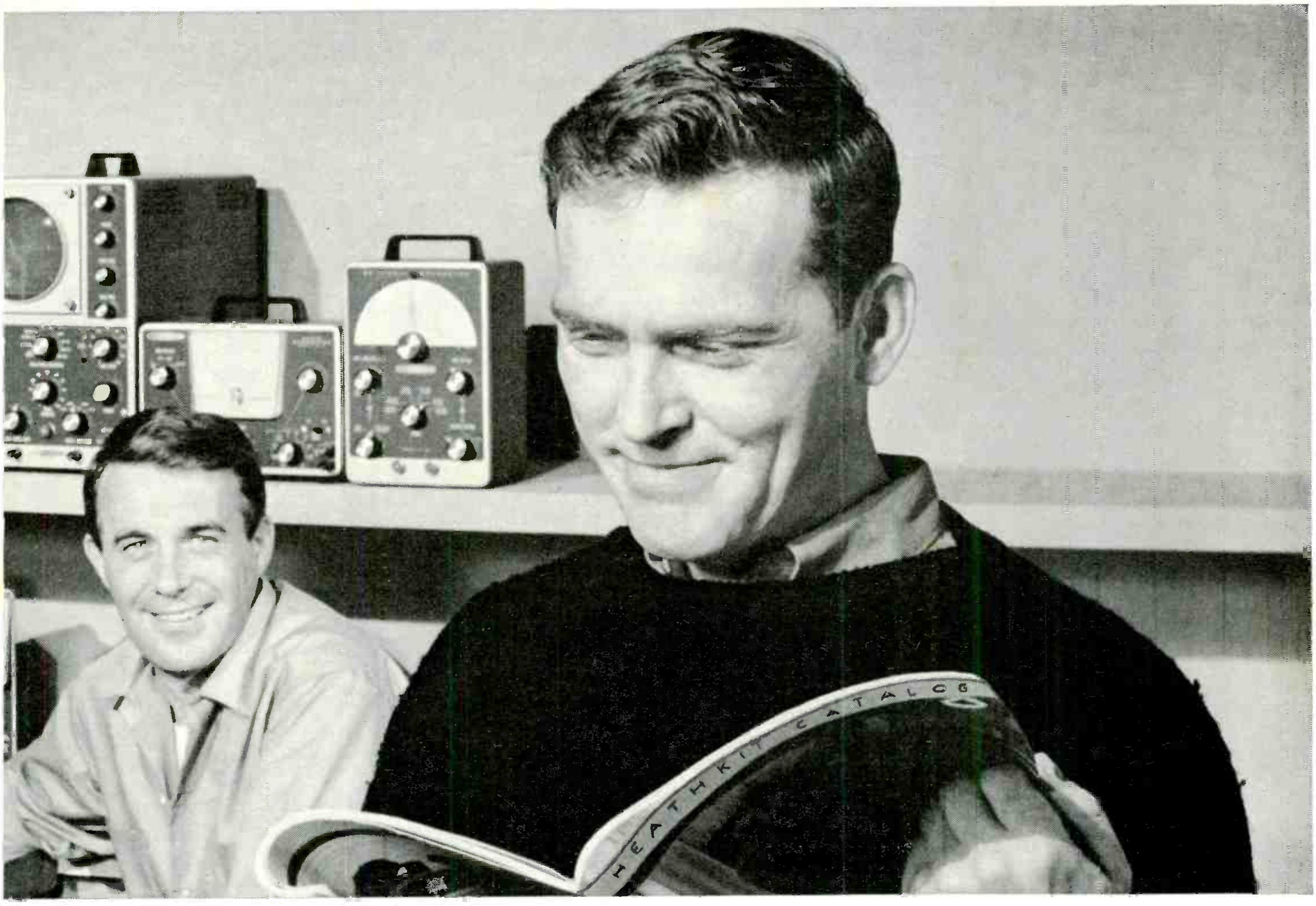

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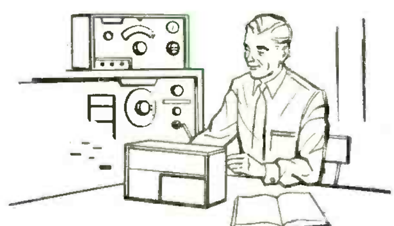

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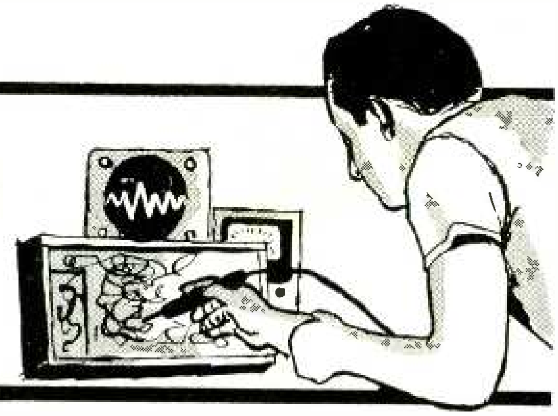
SERVICE CLINIC

By JACK DARR
SERVICE EDITOR



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

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

THERE IS ONE VERY IMPORTANT ADJUSTment in color TV installation that is often neglected. Not the convergence, the purity, the color temperature or the high voltage—the customer! Remember what a time we used to have when black-and-white TV first came in? Lots of people didn't know the difference between the vertical and horizontal holds.

We have the same problem today, with color TV, and we'd better get used to paying some attention to it. If we'll spend just 15 minutes with the new color TV user when the set is first installed, we'll save a lot of nuisance calls later, and make the user a lot better satisfied with color.

Color TV installation today has been tremendously simplified, compared to what it was only 4 or 5 years ago. Now it is possible to install a set and make all the technical adjustments within 15 minutes. I've done it, not once, but several times. So, since we have a little time left over, what better use could we make of it than training the customer in operating his set for the best reception?

You can work out your own "routine" according to your ideas, but here's the one our shop uses: After we pick the location for the set (away from too much direct light—colors look a lot brighter!), we set up the dot generator and check the convergence, etc. The customer should always be present while this is being done; most of 'em will be anyway, out of curiosity. So here's an important point: act very nonchalant. This is just an everyday thing in your life. These adjustments are complicated, but not difficult. This attitude helps alleviate the customer's unconscious fear of not being able to operate this polychrome monster. (Customers can be scared of color, too.)

For the last adjustment, set the color temperature. *Get the owner to help you.* NEVER set the color temperature and tell him (or her), "That's white." *Ask* him. Say politely, "Would you mind sitting over there where you can see the screen and telling me when I get it white?" Then go ahead with your adjustment. There's a psychological point here. If she or he has chosen the screen color, they're not nearly so apt to call you back the next day and complain," This thing looks greenish."

After it's set up, turn the color off or tune in a black-and-white picture. Now run through the operation on B/W, comparing it to the controls on the old set. Run 'em through the tuning, brightness, contrast, etc. adjustments several times. If there's a teen-ager present, let him set it up, tune it and so on. (He probably will anyhow.)

With black-and-white zeroed in, turn on a color program with the color turned *off*. (If you were smart, you delivered the set when there was a daytime color show on.) Schedule your deliveries so that you'll have plenty of time to get there and get set up before the color show starts.

With the color show ready, tune it in and *then* turn up the color. You get a better dramatic effect this way! Now, explain the operation of the two color controls. Show them what each does, and make them adjust them. Concentrate on explaining how simple color TV is to tune and operate. Change channels and show them how the set cuts the color off, then brings it back automatically. Be sure to show them the fine tuning and how it affects color.

Don't give them the big scientific routine about how mistuning the mixer-oscillator affects the position of the color burst on the response curve! Say something simple, like our pet line: "You know how you can move the fine tuning and lose the sound or the picture? Well, color's the same way. So set the fine tuning till you get the best color!"

Emphasize the *simplicity* of the whole operation. After all, they've been tuning their old black-and-white set for quite awhile now, and they *can* tune for color without any trouble if you'll tell them in simple words just how to do it.

Divide your color installation time. Figure about 15 minutes to adjust the set, and up to a ½-hour to adjust the customer! Much better results than the other way.

Vertical retrace lines

I can't get the retrace lines out of a RCA color TV set, model CT-66OU. I've checked the electrolytic in the video stage; no help. The lines are intermittent, and sometimes cover the whole screen.—H. P., Molalla. Ore.

Vertical blanking in this series chassis is fed to the red cathode, and thence to the rest through the voltage divider (Fig. 1). Check for the vertical blanking spike at the red cathode with a scope. With a normal picture, you ought to get something like Fig. 2. The vertical blanking pulses here should have an amplitude of 130 volts peak to peak. The blanking is fed through the R-C network shown in Fig. 1. If blanking pulses are missing, trace back to the plate of the 6AQ5, to see where the pulse is getting lost.

This trouble could also be caused by vertical oscillator instability. If the

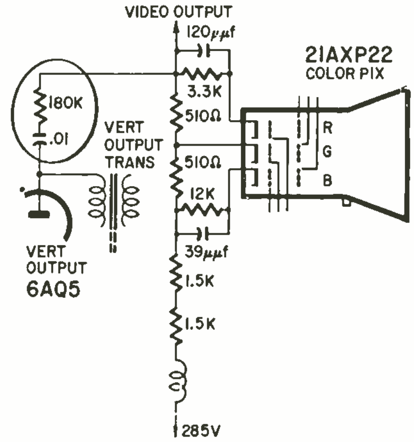


Fig. 1—Retrace blanking circuit of RCA CTC4 chassis.

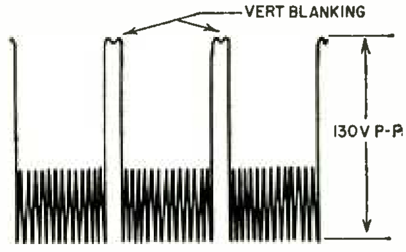


Fig. 2—Waveform on 21AXP22 cathodes.

6AZ8 1st video i.f., and vertical oscillator tube is slightly weak, this chassis has a tendency to roll. Just before it does, retrace lines show up. So, try replacing the 6AZ8 and resetting the vertical height and linearity.

Tape recorder problem

On a tape recorder in for service the "normal" neon lamp stays lit all the time. The "overload" lamp seems to work OK. Recording and playback are OK, but the lamp stays on.—J. C., Kingston, Ontario, Canada

Fig. 3. shows a partial schematic of these lamps. The average NE-2 fires at about 65 volts. However, there is a

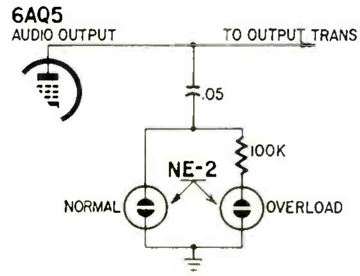


Fig. 3—Basic circuit of dual neon-lamp normal-overload indicators in tape recorder.

slight difference between individual lamps. This could be the cause, but I would be more apt to suspect leakage through the .05 capacitor which couples the ac signal from the 6AQ5 plate. This would apply a dc bias on the lamp, and cause it to fire before it should.

Check this for leakage. Also, there is one other unlikely possibility—supersonic oscillation in the recorder is firing the lamp. Since you say the machine works OK, this is not too likely. However, you can find out very quickly—check it with a scope.

Service data needed

I have an E. H. Scott Phantom De Luxe radio, and I can't find any service data for it. I've looked in both major data services, without success.—E.G., Port Arthur, Tex.

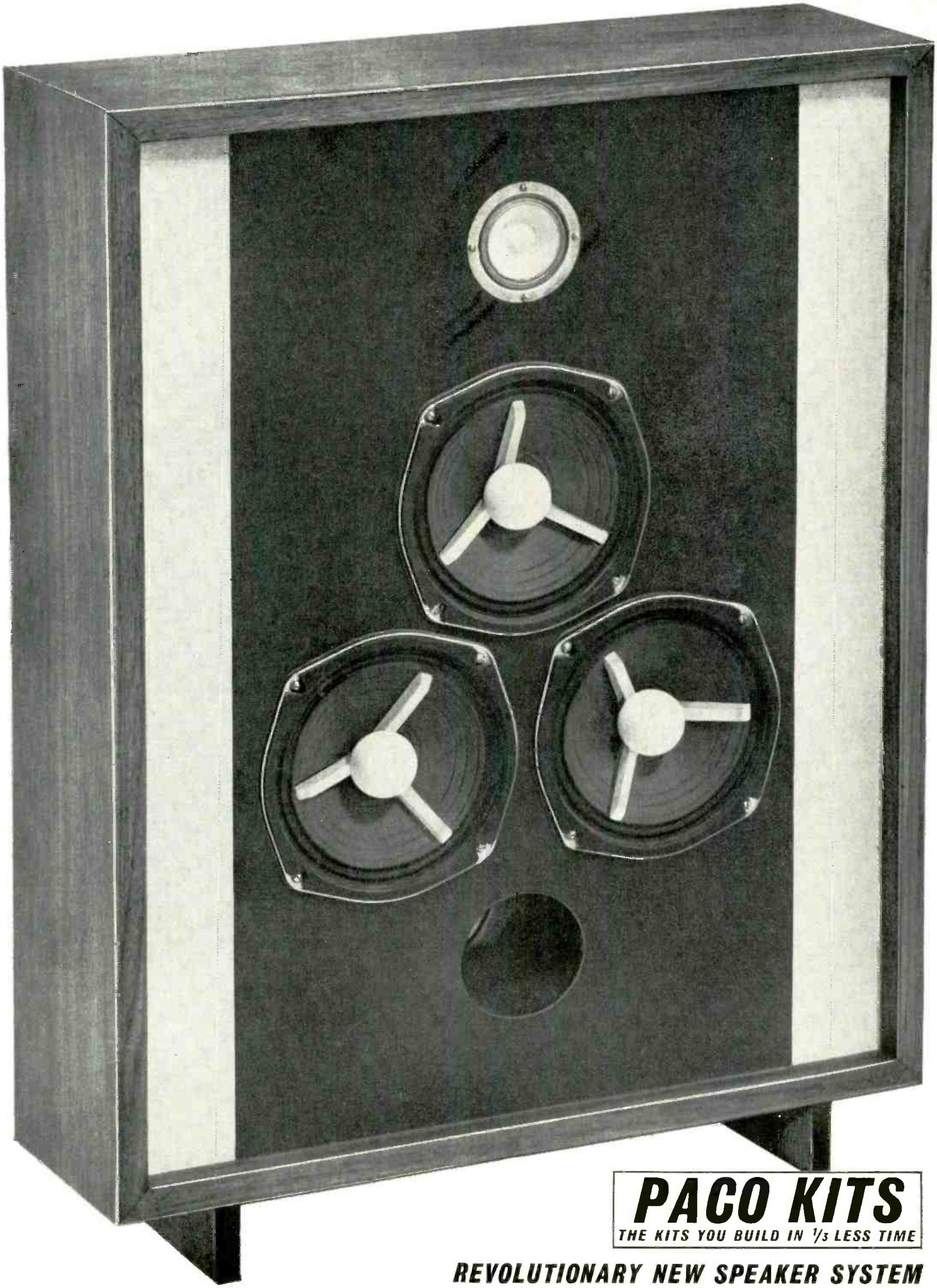
First, let me say that you really have A RADIO there! I have one of the same model, and it is really something! As to service data, you've been looking in the wrong places. Full service data for this is given in John F. Rider's *Trouble-Shooters Manual,* Vol. 15, pages 15-33 through 15-45.

Sweep alignment problem

I am using a Heathkit O-12 wideband scope, with a TS-4A sweep and marker generator. I get a fairly good flat response curve on the low channels, but I can't get a curve on the high channels. Could I use a broad-band amplifier on the scope or sweep generator to correct this?—F. G. W., Framingham, Mass.

This is fairly common in all types

(Continued on page 70)



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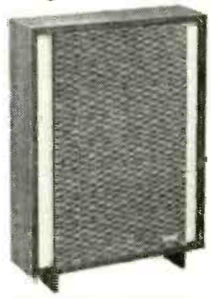

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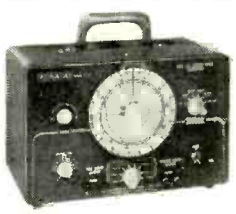

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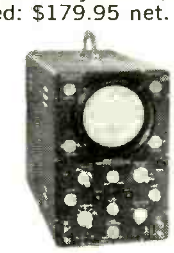

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(Continued from page 67)

of sweep-alignment equipment. If you're taking the tuner response curve from the looker point in the mixer grid, you have very little amplification ahead of it. So to get usable deflection on the scope, you may have to get more amplification.

Two things contribute to this, in your case. The wide-band scopes do not have the gain of the narrow-band types and most sweep generators use second or third harmonics to generate the high-channel signals. Your second harmonic is only half the amplitude of the fundamental, and the third harmonic only half of *that*, so your signal isn't going to be too great in this range!

One trick often used in cases like this is to step down the video i.f. until you can get enough amplification. Connect the scope to the grid of the first i.f. amplifier. If this doesn't give enough amplitude, go on to the plate. If you can see any distortion in the curve, the tuned circuits in this stage can be strapped out—shorted temporarily with pieces of wire—making the stage, in effect a resistance-coupled amplifier!

I.f. ringing

The second and third video i.f. transformers in a 1948 RCA KCS-28 were replaced with corresponding transformers from a 1960 model. Now I have five pictures! My scope shows no variation in horizontal or vertical sweeps. People come from miles around to see this, helped no doubt by my fellow technicians!—W. P., Wheeling, W. Va.

This is the result of severe ringing in the i.f. The original transformers (Fig. 4) are actually single-tuned, capacitance-coupled types. The secondary winding here is a trap, as you can see.

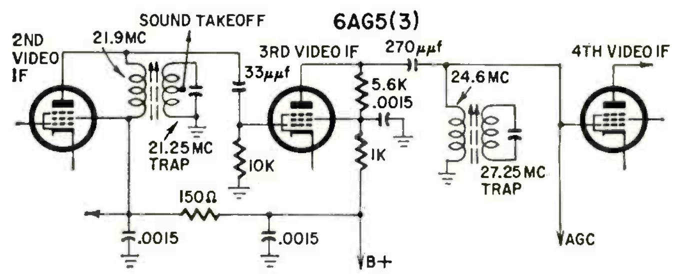

Fig. 4—Video i.f. stage of RCA KCS-28. The "secondary" of each transformer is a trap.

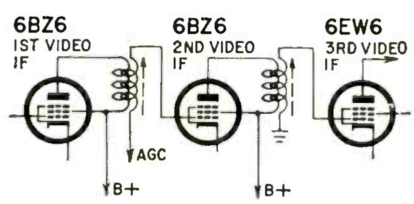

Fig. 5—I.f. transformers in 1960 RCA are bifilar wound and very closely coupled. Excessive voltage gain causes ringing when they are used in circuits not designed for this type transformer.

The i.f. transformers used in the 1960 series, such as those shown in Fig. 5, from a KCS-128 chassis, are bifilar wound and *very* closely coupled. These are true two-winding transformers. Trapping in this circuit is separate.

So, the answer to this will probably be replacement with a lower-gain transformer, unless you can get out the ringing by sweep alignment and reconnecting the transformers as used in the KCS-128 circuit.

Intermittent shrinkage

In a Zenith 29JC20 color TV chassis, we get color jitters, tearing of the color bar pattern into jagged strips and

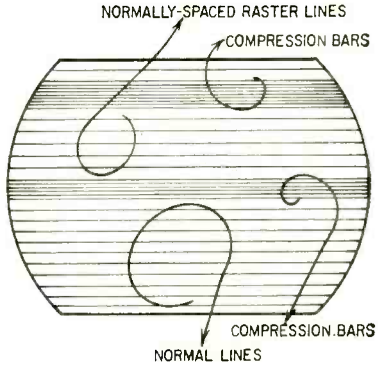

Fig. 6—Raster on Zenith color set when 20-μf electrolytic is open.

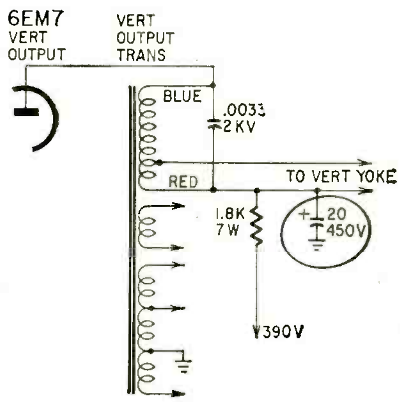

Fig. 7—Partial circuit of vertical output stage in Zenith 29CJ20 color chassis.

a pair of compressed bars on the raster (Fig. 6). This is intermittent, and we haven't been able to catch it yet.—R. R., Redwood City, Calif.

This is caused by an intermittent electrolytic capacitor, and the most likely suspect is the 20-μf 450-volt unit in the B-plus end of the vertical output supply (Fig. 7). Since the vertical output transformer in all color sets is the source of the waveforms used for convergence, etc., this circuit is very particular as to filtering. Any trouble at all around here can cause very peculiar effects. Check with a low-capacitance probe on your scope, to be sure.

Intermittent high voltage

A Crosley 356 chassis has intermittent high voltage, and the picture won't stay in sync. Off channel, I get a lot of white flashes on the screen.—R. S., Patchogue, N. Y.

The most likely cause would be an intermittent horizontal oscillator. Try feeding a drive signal from an operating TV set into the 6CD6 grid, through a small capacitor. If this stops the flashing and jumping high voltage, check the oscillator circuit. Another possibility would be misadjustment of the horizontal locking range control.

Check the damper circuits for signs of arcing, also the high-voltage filter capacitor. END

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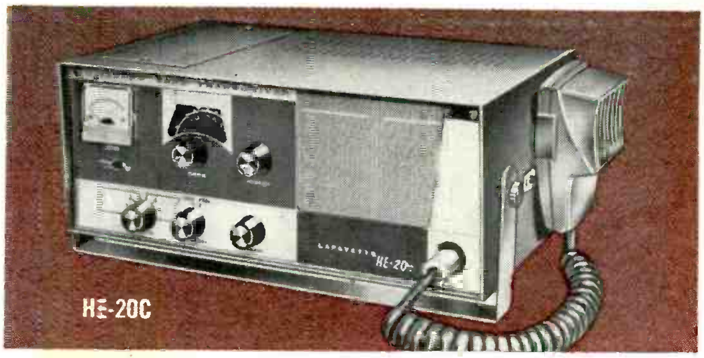

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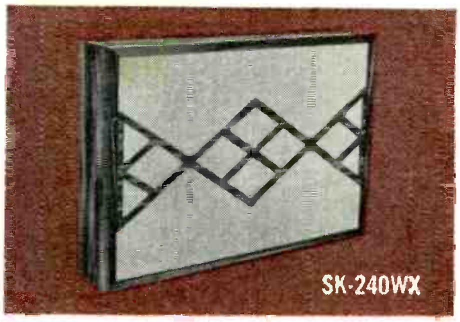

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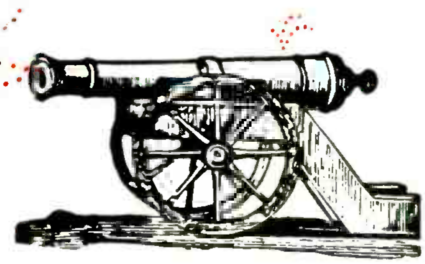

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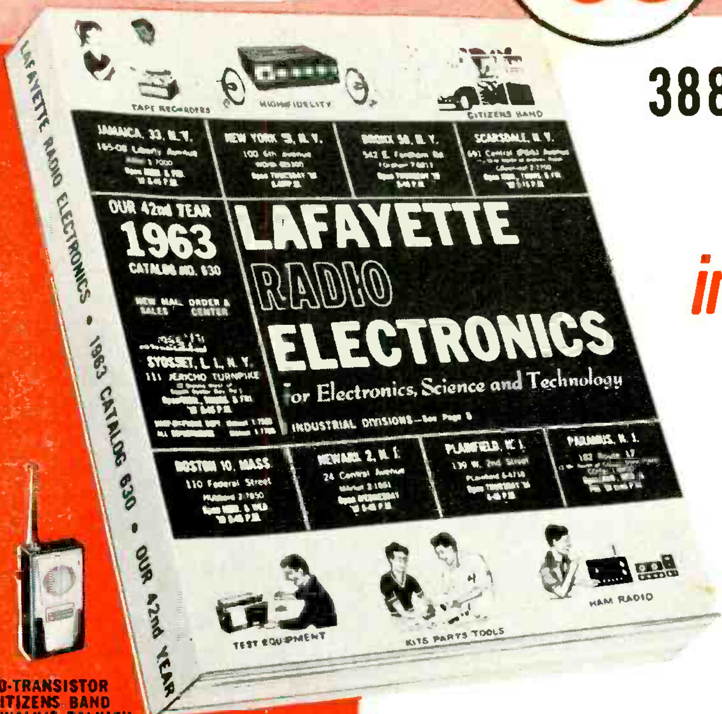

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Make COMPLEX Problems SIMPLE

Thevenin's theorem simplifies circuit analysis for matching impedance and calculating distribution systems

By JOHN R. COLLINS

While no single method of analysis is ideal for all purposes, Thévenin's theorem provides solutions for many types of problems. Telephone engineers use it to match impedances in communication networks, and power engineers to simplify complex distribution systems. It has many applications to electronic circuits, too, and electronics technicians will find it offers a new tool for solving radio problems.

Basically, Thévenin's theorem is a method of reducing a complicated network to a simple circuit consisting of a voltage source and series impedance. It is applicable to both ac and dc circuits in steady-state operation and, although only resistors are used in the examples which follow, the system works equally well with circuits containing capacitors, transformers and coils. The method is clear and direct—you never have to wonder how to begin. A complicated circuit is converted to a simple circuit in two steps:

First: To find the voltage of the new circuit, disconnect the load and calculate the voltage appearing across the load terminals of the original circuit.

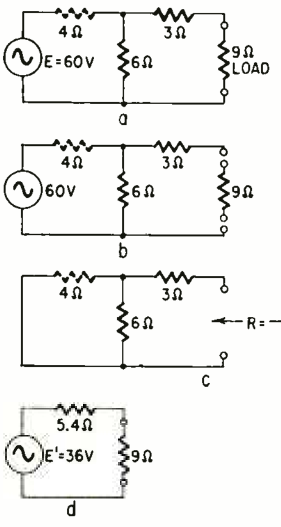

Fig. 1—Series-parallel circuit. b—To calculate E′ we open-circuit the load. c—To calculate R, look at the circuit from load end with generator shorted. d—Simplified equivalent circuit.

Second: To find the series impedance of the new circuit, remove the voltage source (or sources, if there are more than one) from the original circuit, replace it with an impedance equal to the internal impedance of the voltage source, and calculate the impedance that the load "sees." (If internal impedance is negligible, the voltage source can be replaced with a short circuit.)

Application to circuits

The method is illustrated with the network in Fig. 1-a, a series-parallel resistive circuit. The source is a 60-volt generator that has an internal resistance of 4 ohms, shown here as a series resistor. The load is a 9-ohm resistor.

As a first step, we disconnect the load (Fig. 1-b) and calculate the voltage across the load terminals. With the load open-circuited, no current flows through the 3-ohm resistor. The voltage at the load terminals, therefore, is equal to the voltage drop across the 6-ohm resistor. Since the entire 60-volt source is dropped across 10 ohms (that is, 6 ohms + 4 ohms), the voltage drop across each ohm is 60 divided by 10, or 6 volts. Across the 6-ohm resistor, then, the voltage drop is 36 volts, and this becomes the voltage of the new circuit, which we designate E′.

Stated another way, since 6 ohms represents 6/10 of the total series resistance, 6/10 of the source voltage will be dropped across it. This calculation can be simply expressed as follows:

$$E' = \frac{6}{6+4} \times 60 = \frac{6}{10} \times 60 = 36 \text{ volts}$$

As a second step, the voltage source is removed, replaced by a connecting wire (Fig. 1-c), and the impedance is calculated looking from the load terminals. This operation places the 4- and 6-ohm resistors in parallel, and their equivalent resistance is found by dividing their product by their sum. Thus,

$$R = \frac{4 \times 6}{4+6} = \frac{24}{10} = 2.4 \text{ ohms}$$

When this equivalent resistance is added to the 3-ohm series resistance, we obtain a total resistance (looking from the load terminals) of 5.4 ohms.

The new circuit resulting from the above calculations appears in Fig. 1-d. It is a simple circuit made up of a 36-volt source and a 5.4-ohm resistor in series with the 9-ohm load resistor. The current through the load is readily calculated by Ohm's law:

$$I = \frac{E}{R} = \frac{36}{5.4+9} = \frac{36}{14.4} = 2.5 \text{ amps}$$

If you analyze the original circuit, you will find that the current through the 9-ohm resistor is also 2.5 amperes, so the two circuits are equivalent *as far as the load is concerned.* Although we are usually interested primarily in the effect on the load, it is sometimes objected that Thévenin's theorem gives a limited picture of circuit performance, since it presents the circuit only from the standpoint of the load.

This objection is at least partly overcome by the fact that any circuit element can be selected to be the load.

Fig. 2 shows how the same circuit would be handled if we consider the 6-ohm resistor as the load. With the load open-circuited (Fig. 2-a), the voltage appearing at its terminals is equal to the voltage drop across the 3- and 9-ohm resistor combination. Since the combination represents 12/16, or 3/4, of the total series resistance, we multiply this fraction by the circuit voltage, as in the previous example:

$$E' = \frac{3+9}{4+3+9} \times 60 = \frac{3}{4} \times 60 = 45$$

The next step is to remove the

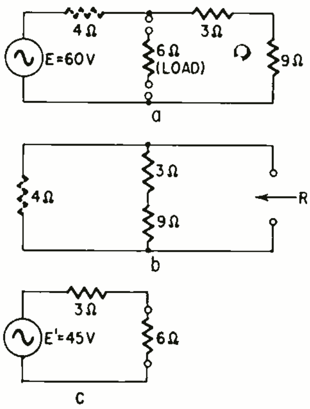

Fig. 2—Here we use the same circuit arrangement as in Fig. 1, but assume the 6-ohm resistor as the load.

voltage source, replace it with a connecting wire, and calculate the impedance looking from the load. The circuit is redrawn in Fig. 2-b to show how this is done. Replacing the voltage source by a connecting wire brings the 4-ohm resistor in parallel with 12 ohms, made up of the 3- and 9-ohm resistor combination. The equivalent resistance is calculated as the product divided by the sum:

$$R = \frac{4 \times 12}{4 + 12} = \frac{48}{16} = 3 \text{ ohms}$$

The equivalent circuit (from the standpoint of the 6-ohm resistor) is shown in Fig. 2-c—a 45-volt source connected to the load through a 3-ohm resistor. The load current, computed by Ohm's law, is 5 amperes.

Impedance matching

We mentioned earlier that Thévenin's theorem is often used for impedance matching. It can be proved (though we won't do it again here) that maximum power is transferred to the load when the load resistance equals the internal circuit resistance. In the first example, therefore, maximum power would be transferred if a 5.4-ohm load were used instead of the 9-ohm load, and in the second example if a 3-ohm load were used. This kind of analysis is of great importance in designing telephone and other networks where small signals must be handled economically.

If the internal impedance of the circuit is made up of both resistance and reactance, maximum power is transferred when the load resistance is equal to the circuit resistance, and the load reactance is equal but opposite to the circuit reactance. This means that if the circuit reactance is inductive, the load reactance should be capacitive for maximum power transfer. This principle is illustrated in Fig. 3.

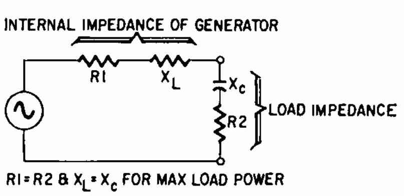

Fig. 3—Impedance matching for maximum power transfer.

Electron-tube circuits

Thévenin's theorem is applied to electron-tube circuits by replacing the tube with a generator having a voltage equal to μe_g, where μ is the amplification factor of the tube, and e_g is the signal voltage applied to the grid. The dynamic plate resistance r_p of the tube constitutes the internal resistance of the generator.

To illustrate this method, let's consider the amplifier stage shown in Fig. 4-a, consisting of a triode tube (half a 6SN7) connected in the conventional way. If the tube is replaced by an equivalent generator, the circuit can be redrawn as in Fig. 4-b. The values of μ (20) and of r_p (6,800) we obtain from a tube manual. For simplicity, we assume that the amplifier operates in the mid-frequency range where the reactance of capacitor C is negligible.

This is Thevenin's Theorem

The current in a terminating impedance connected to any network is the same as if the network were replaced by a generator with a voltage equal to the open-circuit voltage of the network, and whose internal impedance is the impedance seen by the termination looking back into the network. All generators in the network are replaced with impedances equal to the internal impedance of these generators.

Following the procedure outlined above, we first disconnect the load (in this case, the grid-leak resistor R_g) and calculate the voltage across its terminals, which will be equal to the drop across R_p. The source voltage is $20e_g$ (that is, 20 times whatever signal voltage is applied to the grid), and it is in series with r_p and R_p. The drop across R_p, then, is in proportion to the fraction.

$$\frac{R_p}{r_p + R_p}$$

The voltage of the new circuit is calculated as in previous examples:

$$E' = 20e_g \times \frac{R_p}{r_p + R_p}$$

$$= 20e_g \times \frac{100{,}000}{106{,}800} = 18.8e_g$$

This means that the voltage of the new circuit will be 18.8 times whatever voltage is applied to the grid.

Next we remove the generator from the circuit, replace it with a connecting wire, then calculate the circuit resistance as it appears to the load (Fig. 4-c). This computation is made as in previous examples:

$$R = \frac{r_p \times R_p}{r_p + R_p} = \frac{6{,}800 \times 100{,}000}{6{,}800 + 100{,}000}$$

$$= 6{,}367 \text{ ohms}$$

Slide-rule accuracy is enough for this purpose, and the calculation can be made rapidly. The final circuit is shown in Fig. 4-d.

In previous examples, we calculated the current through the load. In an amplifier, however, we are more concerned about the voltage drop across the load. This is found by determining the fraction of total resistance represented by the load resistance, and multiplying that fraction by the source voltage. Since in this instance the fraction is $\frac{250{,}000}{256{,}367}$, it is obvious that practically all the voltage will be dropped across the load—which is as it should be. The actual amount can be computed with the slide rule:

$$E_{load} = 18.8e_g \times \frac{250{,}000}{256{,}367} = 18.3e_g$$

This means that if, say, a signal of 0.5 volt is applied to the grid, the voltage across the load resistor will be 18.3×0.5, or 9.15 volts.

If the reactance of the capacitor is not negligible at the operating frequency, it must be calculated from the formula,

$$X_c = \frac{1}{2\pi fC}$$ and considered in series with the load risistor. If this reactance is large, a large part of the voltage will be dropped across it instead of the load resistor. This will curtail the amplification seriously. The remedy, of course, is to use a larger coupling capacitor.

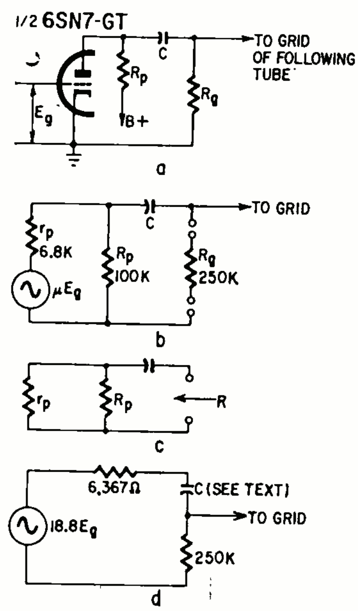

Fig. 4—Resistance-coupled amplt... stage. b—Modified circuit. c—Calculation of the series resistance. d—Equivalent circuit.

You will notice that no attempt was made to match the load resistor to the circuit resistance to obtain maximum power transfer. To do so would greatly reduce the voltage amplification, even though the power transfer would be increased, and in this instance we are primarily concerned with obtaining a high output voltage. END

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1DN5	.55	6AX4	.66	6SH7GT	1.02	12D4	.69
1G3	.79	6AX5	.74	6SJ7	.88	12DE8	.83
1J3	.79	6BA6	.50	6SK7GT	.95	12DL8	.88
1K3	.79	6BC5	.61	6SL7GT	.84	12DQ6	1.04
1R5	.77	6BC8	1.04	6SN7GT	.65	12DS7	.84
1S5	.75	6BE6	.55	6SQ7	.94	12DT5	.76
1T4	.72	6BF5	.90	6T4	.99	12DT7	.79
1U5	.65	6BF6	.44	6T8	.85	12DT8	.78
1X2B	.82	6BG6	1.70	6U8	.83	12DW8	.89
2AF4	.96	6BH8	.98	6V6GT	.54	12DZ6	.62
3AL5	.46	6BJ6	.65	6W4	.61	12ED5	.62
3AU6	.54	6BJ7	.79	6W6	.71	12EG6	.62
3AV6	.42	6BK7	.85	6X4	.41	12EK6	.62
3BC5	.63	6BL7	1.09	6X8	.80	12EL6	.50
3BN6	.75	6BN6	.74	7A8	.68	12EZ6	.57
3BU8	.78	6BQ6	1.12	7AU7	.65	12F8	.66
3BY6	.58	6BQ7	1.00	7EY6	.75	12FA6	.79
3BZ6	.56	6BU8	.70	7Y4	.69	12FM6	.50
3CB6	.56	6BX7	1.11	8AU8	.90	12FR8	.97
3CS6	.58	6BZ6	.55	8AW8	.93	12FX8	.90
3DG4	.85	6BZ7	1.03	8BQ5	.60	12GC6	1.06
3DK6	.60	6C4	.45	8CG7	.63	12J8	.84
3DT6	.54	6CB6	.55	8CM7	.70	12K5	.75
3GK5	.99	6CD6	1.51	8CN7	.97	12L6	.73
3Q4	.63	6CG7	.61	8CS7	.74	12SF7	.69
3S4	.75	6CG8	.80	8EB8	.94	12SK7	.95
3V4	.63	6CL8	.79	8FQ7	.56	12SL7	.80
4BQ7	1.01	6CM7	.69	9CL8	.79	12SN7	.67
4CS6	.61	6CN7	.70	11CY7	.75	12SQ7	.91
4DT6	.55	6CQ8	.92	12A4	.60	12U7	.62
4GM6	.60	6CR6	.60	12AB5	.60	12V6	.63
5AM8	.79	6CS6	.57	12AC6	.55	12W6	.71
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5BK7	.86	6CY5	.70	12AF3	.73	18FW6	.49
5BQ7	1.01	6CY7	.71	12AF6	.67	18FX6	.53
5BR8	.83	6DA4	.68	12AJ6	.62	18FY6	.50
5CG8	.81	6DE6	.61	12AL5	.47	19AU4	.87
5CL8	.76	6DG6	.62	12AL8	.95	19BG6	1.39
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5EA8	.80	6DK6	.59	12AT6	.50	19T8	.85
5EU8	.80	6DN6	1.55	12AT7	.76	21EX6	1.49
5J6	.72	6DQ6	1.10	12AU6	.51	25AX4	.70
5T8	.86	6DT5	.81	12AU7	.61	25C5	.53
5U4	.60	6DT6	.53	12AV6	.41	25CA5	.59
5U8	.84	6DT8	.94	12AV7	.82	25CD6	1.52
5V6	.56	6EA8	.79	12AX4	.67	25CU6	1.11
5X8	.82	6EB5	.73	12AX7	.63	25DN6	1.42
5Y3	.46	6EB8	.94	12AY7	1.44	25EH5	.55
6AB4	.46	6EM5	.77	12AZ7	.86	25L6	.57
6AC7	.96	6EM7	.82	12B4	.68	25W4	.68
6AF4	1.01	6EU8	.79	12BD6	.50	32ET5	.55
6AG5	.70	6EV5	.75	12BE6	.53	35C5	.51
6AH4	.81	6EW6	.57	12BF6	.60	35L6	.60
6AH6	1.10	6EY6	.75	12BH7	.77	35W4	.42
6AK5	.95	6FG7	.69	12BK5	1.00	35Z5	.60
6AL5	.47	6FV8	.79	12BL6	.56	36AM3	.36
6AM8	.78	6GH8	.80	12BQ6	1.16	50B5	.69
6AQ5	.53	6GK5	.61	12BR7	.74	50C5	.53
6AS5	.60	6GK6	.79	12BV7	.76	50EH5	.55
6AT6	.49	6GN8	.94	12BY7	.77	50L6	.61
6AT8	.86	6H6	.58	12BZ7	.86	70L7	.97
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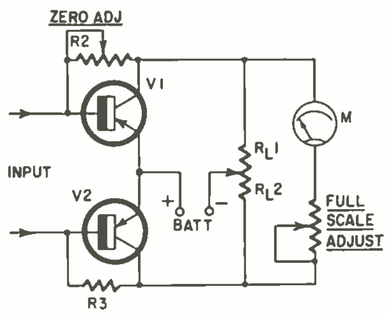
transistor meter amplifier gives you 200,000 ohms per volt

By R. B. HOSKING

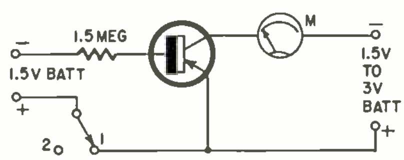
I MADE SEVERAL ATTEMPTS TO ADD A transistor amplifier to my homemade multimeter as soon as the transistor be-came popular and circuits started ap-pearing in magazines. They were uni-formly discouraging. Temperature ef-fects were intolerable for reasonable accuracy. Then I saw a paper, "A Stabilized DC Differential Transistor Amplifier," by Depian and Smith, in the AIEE *Communication & Electronics Journal*, May 1958. The basic circuit is that of Fig. 1. All relationships were given in the paper, but no practical values were suggested in this material.



FOR TEMPERATURE COMPENSATION

$$\frac{R_L{}^1}{R_L{}^2} = \frac{I_{CEO}{}^2}{I_{CEO}{}^1} = \frac{R2\alpha 2}{R3\alpha 1}$$

Fig. 1—The fundamental circuit.



I_{CEO} = μA WITH SWITCH AT 2

I_c = " " " " 1

α = $I_c - I_{CEO}$ = CURRENT AMPL

Fig. 2—Transistors can be meas-ured and roughly matched with this setup.

Theoretically, the equations of Fig. 1 show that transistors with different amplification factors can be used and that temperature effects can be nullified if both transistors are at the same tem-perature. Experiment, however, showed that if one transistor had a higher am-plification than the other, severe zero-point drift resulted. I finally realized that one collector current was greater than the other and so became warmer, thus upsetting zero balance. I therefore set up the circuit of Fig. 2 to measure transistor parameters. Exact matching is not necessary—if transistors are with-in 10% of each other, stability is ex-cellent.

Fig. 3 is the final circuit, which I built into my home-made 20,000-ohm/volt multimeter, amplifying 10 times. It can, of course, be changed to meet the needs of different types of meters. I provided an external control for the zero adjust but left the full-scale adjust inside the case, as only occasional ad-justments are needed to compensate for aging batteries.

Adjustment is simple. Disconnect R2 and R3, connect the battery and adjust R5 for zero meter reading. Re-connect R2 and R3 and adjust R2 for zero meter reading again. Adjust R7 for proper full-scale reading with a measured input current from a high-re-sistance source.

The multiplier resistor, R1, is 200,-000 times the full-scale voltage for any particular range. For the 1.5-volt scale, it will be 300,000 ohms, for example. I used the multipliers in my instrument by using range resistors 10 times larger. In many cases it will probably be simpler to put in a new set, using 1% deposited carbon types.

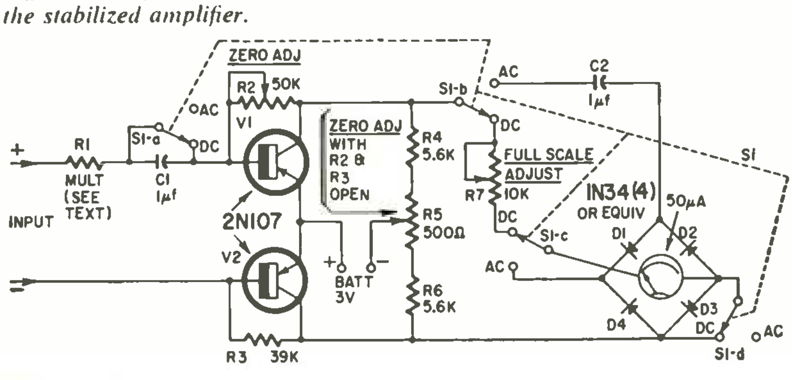
R2 and R3 are the compensat-ing feedback and bias resistors that stabilize the amplifier and compensate for the effects of temperature on un-equal transistor gains. R2 is made variable to zero-adjust the meter. R5 counteracts differences between the transistors, and is adjusted with R2 and R3 out of circuit. R7 is the full-scale or calibrating adjustment. I adjust it by measuring the voltage of a dry cell on a known accurate voltmeter, then setting the full-scale pot to bring the indication to the same point. This gives me a reading at the full-scale end of the meter. Be sure to zero-adjust the meter before setting the full-scale ad-justment.

The amplifier will handle direct and alternating currents. C1 and C2 are switched into the circuit to block dc when measuring ac. The diode bridge rectifies the amplified ac and feeds it to the meter. A hand-calibrated ac scale can be added to the meter or you can prepare a calibration chart. An ac-voltmeter and Variac or similar vari-able-voltage transformer are used for calibration. Sensitivity on the ac range is about 160,000 ohms per volt. You can measure as low as .01 volt full scale with R2 adjusted for zero resistance.

This meter circuit has one short-coming. Continuous readings cannot be made without disturbing the zero point. This is because one transistor is draw-ing more current than the other, raising its temperature. A small heat sink com-mon to both transistors reduces this ef-fect and readings up to 1 minute do not cause any trouble. The amplifier itself can be left on continuously without causing any significant zero shift.

The component values are not crit-ical. Amplification can be increased by increasing R4, R6 and the battery voltage, increasing feedback resistors R2 and R3 or by using higher-gain transistors. END

Fig. 3—Complete circuit of the stabilized amplifier.



R1—Multiplier(s), see text
R2—pot, 50,000 ohms
R3—39,000 ohms
R4, R6—5,600 ohms
R5—pot, 500 ohms
R7—pot, 10,000 ohms
C1, C2—1 μf, 600 volts or higher, depending on maximum dc in circuit being measured
S1—4 pole 2-position rotary
V1, V2—2N107 or equivalent
D1, D2, D3, D4—1N34's or any other suitable units
BATT—3 volts

EDITORIAL *(Continued from page 29)*

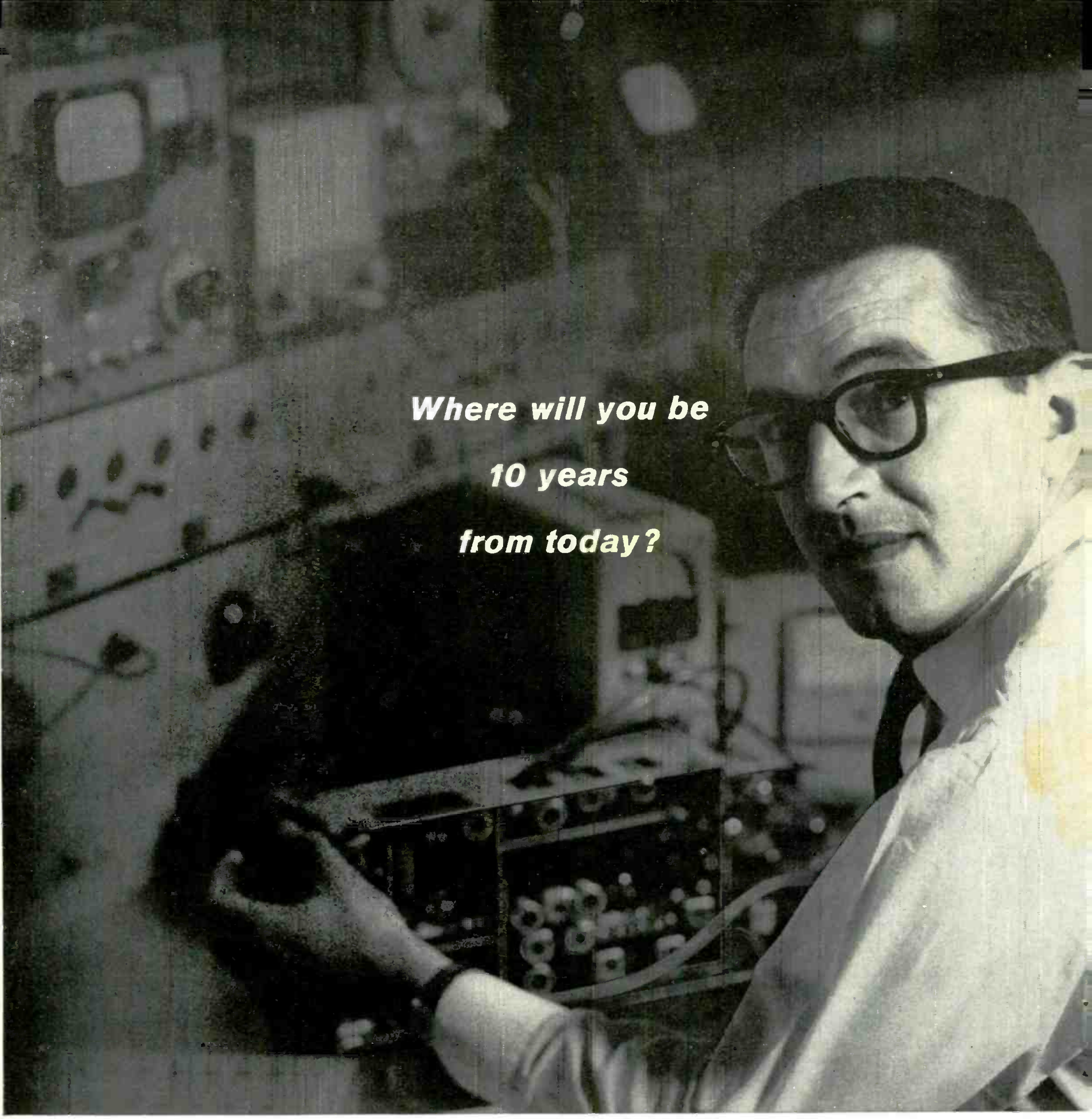
ear damage. For mild hearing loss, greatly refined electronic aids will be . . . implanted in the ear canal, or the middle ear, and provide a lifetime of operation with harmless atomic cells . . .

George D. Watkins: (member IRE) . . . It may be possible to isolate, develop and breed strains of living cells which perform simple logic functions. The role of the new bio-electronic engineer would then be to synthesize (grow) from these basic units larger organisms which could perform extremely complex operations. . . . Some of the desirable features of the living cell circuit would be the self-healing aspect, the extreme miniaturization, and efficiency. The unique power supply required (nutrient) would also offer some possible advantages . . . A living cell circuit might be planted in the body and live off its nutrients with no additional power supply requirement.

Dr. V. K. Zworykin, honorary vice president, Radio Corporation of America, RCA Laboratories, Princeton, N. J.: . . . [As] Mr. Jones reports for his annual health checkup [he] inserts his coded Social Security card into a slot for identification of the examination record. A series of standardized questions concerning his physical condition are then flashed on a screen in front of him and he records his answers by means of yes–no pushbuttons. Weight, temperature, respiration rate, electrocardiogram, reflexes and other data are registered directly. Blood, breath and urine specimens are inserted into analytical machines, which add corpuscle counts and chemical data to the record. . . . The examination record is transmitted in coded form to the regional electronic health record storage center, where it comes to form part of Mr. Jones' permanent health record . . .

Marvin Camras, senior engineer, Armour Research Foundation, Technology Center, Chicago, Ill.: . . . Money is no longer a medium of exchange. All purchases are now charged directly to one's bank account whenever one presents his magnetic credit card. At the same time the latest balance and a record of what has been purchased is placed on the card for one's personal record. Wages and earnings are also credited continuously . . .

Dr. Simon Ramo, vice chairman of the board, Thompson Ramo Wooldridge, Inc., Los Angeles, Calif.: . . . Every practicing attorney might have in his office a convenient electronic connection to a huge national central repository of all of the facts, rules, procedures and precedents that he needs. The system will scan, select, reject and present the equivalent results of thousands of trained [law] searchers covering decades of records over the entire nation in a split second . . . END


Where will you be
10 years
from today?

are YOU equipped for INDUSTRIAL JOBS?

By TOM JASKI

YOU'VE BEEN DOING TV-RADIO REPAIR WORK FOR YEARS AND now you'd like to expand into that profitable industrial field you've been hearing so much about. But does your shop have the kind of equipment you'll need to do industrial servicing? Do *you?* Probably not.

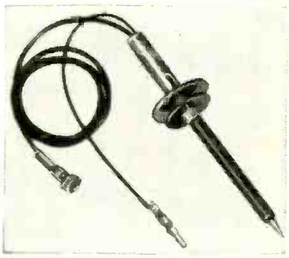
Education-wise, you shouldn't have very much to worry about. The circuits may be a bit different but whether in industrial equipment or a TV set, the principles are the same. But circuit *tolerances* are not! If your data sheet shows that the voltage at the plate of the video output tube in a TV set should be 250, but you measure 225 or 275, you won't worry about it. This is normal tolerance. Besides, the error may be in your meter and not in the set.

This won't hold up in industrial work! While not all industrial gear is precision apparatus, enough of it is to rule out your TV test equipment. Take a flip-flop circuit as a typical example. Voltages are very critical indeed. A few volts either way can make the difference between a flip-flop that flips and flops and one that just flops. Or say you're checking the frequency of a dielectric heater. Can you do it with any instruments you have now? Don't forget, it must be right on frequency to operate legally and most efficiently.

This doesn't mean you have to throw away all your present test equipment if you want to do industrial work, but it does mean that you'll have to do some careful calibrating. Voltmeters can be calibrated against accurately known voltages, ohmmeters against precision resistors. Frequency meters and generators can be checked against WWV or any other standards you can lay your hands on. Scope sweeps can be checked against already calibrated generators.

Where and how can you get the standards you need? Try your local high school or college. The science department might be very willing to help out. They might even do the calibration for you as a student project. Or you may be able to get an industrial lab to do the job.

As your industrial work increases, you will probably want to buy some new test equipment to ease your work. An EPUT (*E*vents *P*er *U*nit *T*ime) counter and timer is about the handiest single instrument I can think of. It can help you accurately check frequencies, timing devices, tachometers and such items as how many times a relay closes in a second.



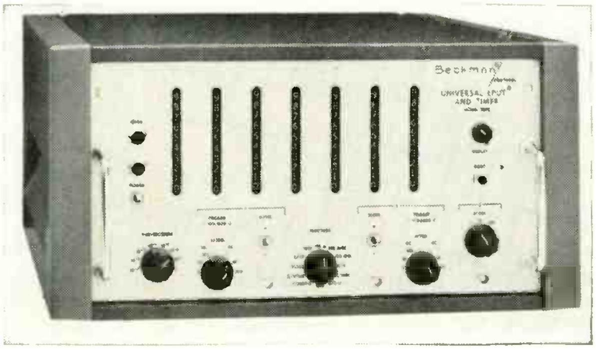
Kit vtvm—will it satisfy industrial requirements? It can, if you do a careful calibrating job.

General Radio precision resistors. Excellent for meter calibration, 1-ohm unit is accurate to 0.15%, others to .05%.

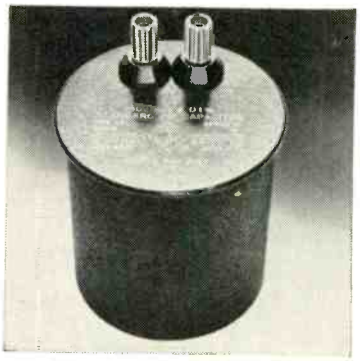
Industrial-quality meters, scopes and signal generators will probably be next, depending on the particular type of industrial work you find yourself doing.

While you should also consider the possibility of using kit type instruments, remember that their accuracy depends on you, the builder. This requires a new kind of thinking, thinking in precise quantitative terms, which is the first step on the way to outfitting for first-class industrial service work.

END

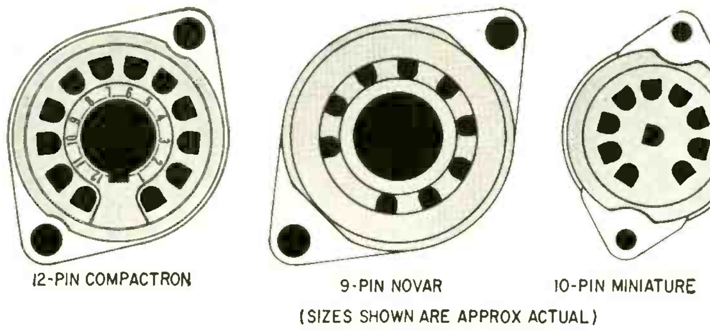


An EPUT counter and timer. It's made by Beckman. Before investing in this kind of expensive instrument, investigate your needs very carefully.



General Radio precision capacitor can help you calibrate capacitance meters and bridges.

EQUIPMENT REPORT



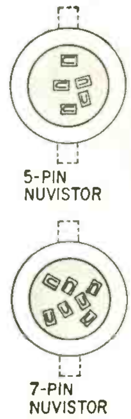


Fig. 1—New tube sockets introduced in the last couple of years make tube-tester adapters a necessity.

tube tester ADAPTERS

By WAYNE LEMONS

ONE REAL PROBLEM THAT CONfronts service technicians is creeping obsolescence of expensive test equipment, especially tube testers. In the past year or so, several new tube types have been developed. Their sockets differ radically from their predecessors', hence it is impossible to test them with older tube testers—you can't plug them in. Fig. 1 shows many of these new socket configurations.

It would seem reasonable that, since these tubes do not differ electrically (at least as far as testing is concerned) from older type tubes, we should be able to test them with our old testers if we have socket adapters and know the setup procedures. This is also the thinking of several manufacturers. Many adapters are available but, to show representative approaches to the problem, we'll discuss three: Precision model G-140, Seco part No. 1171 and Sencore model TM-116.

Sencore TM-116 plugs into octal socket on tube tester.

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Now, examine the tweeter! It has the look and sound of fine laboratory equipment! The heavy die-cast frame and jewel-like machining insures a lifetime of uniform response. And note the polyurethane suspension system that's years ahead of the rest! It's the secret of the remarkably smooth response to 15,000 cps! Note the handy level control on the back of the Regina 200 for exact personal control of tonal balance.

Measuring only 5-5/8 inches deep, 24-3/8 inches high, 16-3/8 inches wide, the new E-V Regina is a beautifully easy answer to your stereo speaker placement problems. And it's easy on the pocketbook, too . . . just $89.50 net with oiled walnut finish.

Hear the biggest sound in slim-lines . . . the new Electro-Voice Regina 200 at your E-V dealer's today!

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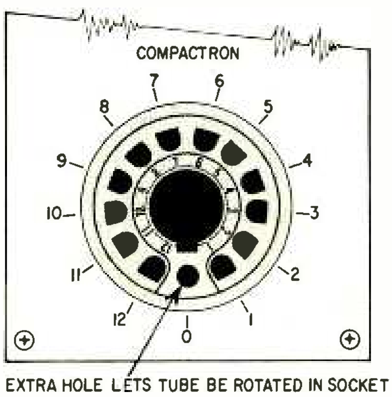


Fig. 2—Precision G-140's compactron socket is unusual—it's got a thirteenth hole.

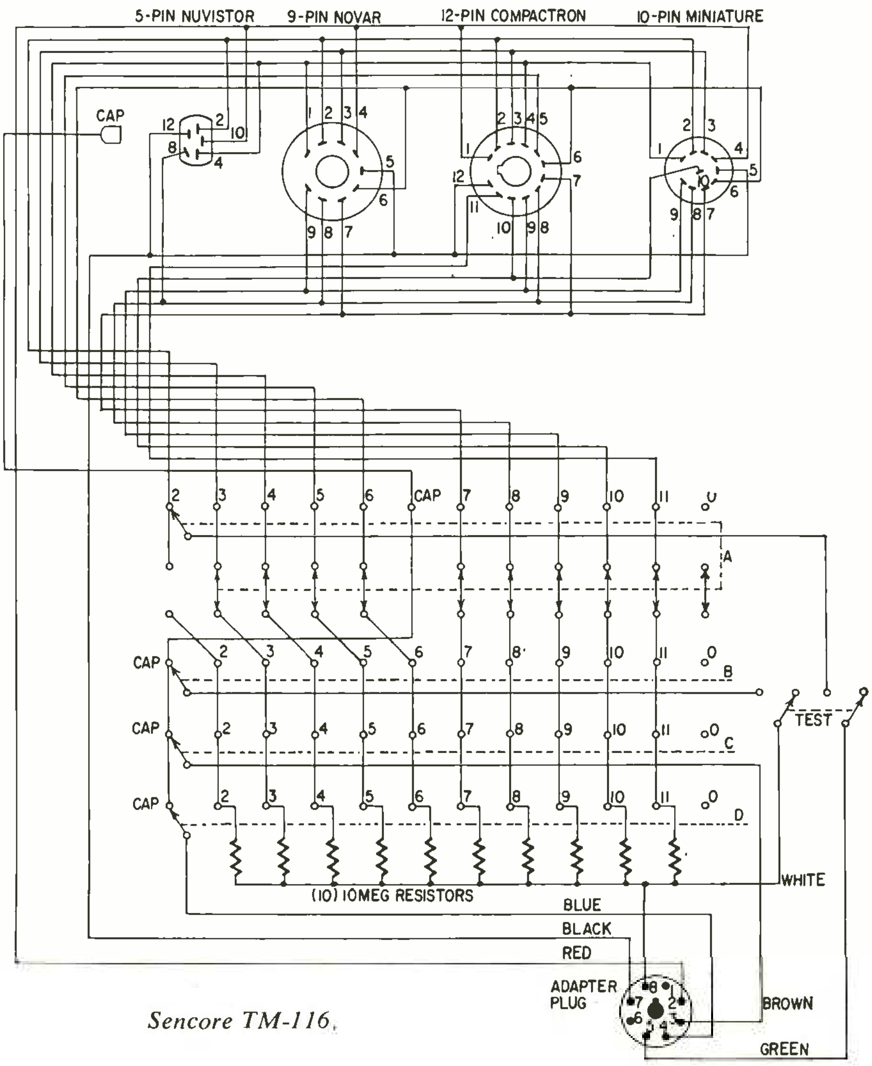
Precision model G-140.

The Sencore modernizing panel is more elaborate than either of the other two and is also considerably larger. The adapter cable plugs into an octal socket and may be used with just about any tube tester.

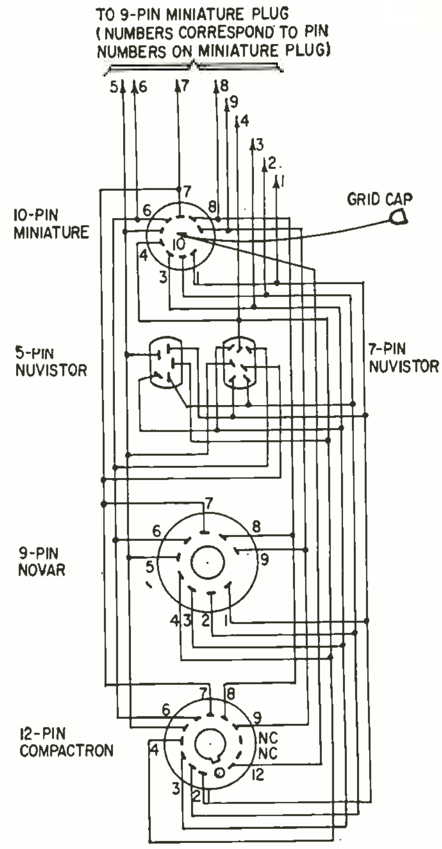
Four rotary switches set up the correct pin connections and permit testing each section of the tube separately. A push-to-test button is also included.

Two setup charts are packed with the instrument; one to be carried with the unit and one to go with the tube tester. Tests on all tubes are made with the adapter plug in the 6J5, 6V6 or 35Z5 socket. Heater and bias adjustments are made depending on the tube to be tested.

SENCORE model TM-116
Price—$24.95
Size—7¾ x 4⅛ x 1⅝ inches
Cable—17 inches, 8-wire terminated in octal plug
Tests—Novars, 10 pins, compactrons, nuvistors



Sencore TM-116.



Precision G-140 adapter circuit

PRECISION model G-140
Price—$12.95
Size—5¼ x 2 x 1⅛ inches
Cable—25 inches, 10-wire terminated in plug
Tests—Novars, 10 pins, 5- and 7-pin nuvistors, compactrons

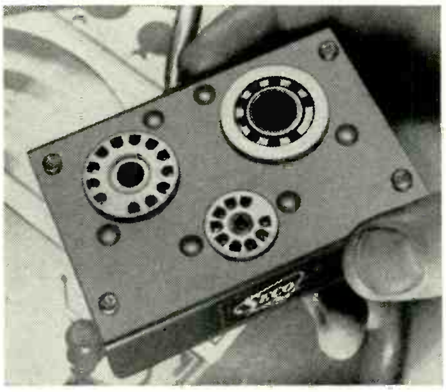
The Precision adapter is somewhat less elaborate. It is made for several of the Precision and Paco testers. It can also be used with testers of other manufacturers.

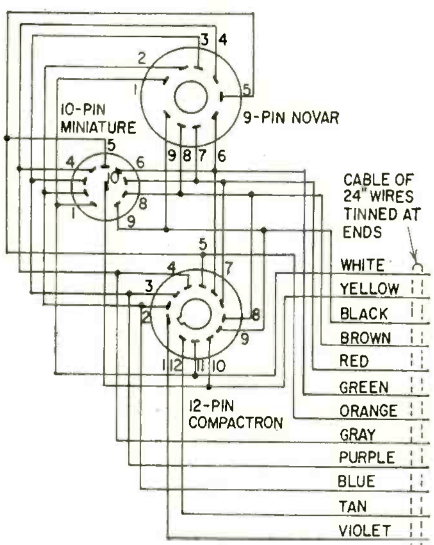
Instead of being soldered in, the adapter cable is terminated in a nine-pin plug with a "grid cap" connection on top. The nine-pin plug is inserted in the nine-pin miniature socket of the tube tester. In this way, 10 connections are picked up. This leaves one problem: compactrons have *12* pins! Obviously this leaves 2 pins that would not be connected to the tube tester. Precision solved this problem rather ingeniously without resorting to an external switch in the adapter.

In Fig. 2 note that the compactron socket is numbered around its circumference from 0 to 12. Note also that in this adapter there is an extra hole (at 0) where there is normally a blank space to act as an insertion key and prevent the tube from being inserted wrong. This means that a compactron tube can be inserted in the adapter socket any one of 13 ways. For example, the blank (key) of the tube can be inserted so that it is at 0, 1, 2, 3, etc.

The test data included with the adapter tell where the blank should be. In this manner, the tube itself becomes an external switching device so that all its sections can be tested.

The Seco adapter represents the simplest approach. It is made to update a specific tester—their model 107. The adapter cable is permanently soldered in, according to the directions included. It is small enough to be stored in the cord compartment of the 107. This adapter does not have a nuvistor socket. Part No. 1071N is available for this. It installs in one of the spare socket holes on the tester panel. Color-coded wires are then soldered to a nearby socket.





SECO
Price—(part No. 1171)—$4.95
Size—3½ x 2⅜ x ¾ inches
Cable—22 inches, 12-wire color-coded (soldered in)
Tests—Novars, 10 pins, compactrons
Part No. 1071N socket for testing nuvistors, $1.00 from factory

The small Seco tube tester adapter adds three new sockets.

Though tube test adapters may not be convenient in every respect, they are an ideal way to get years of added service out of an otherwise out-of-date tube tester, especially since it may be a few years before you will be testing these new types in abundance. END

What's Your EQ? Solutions

What's the Impedance

This is known as "The Singular Case of Parallel Resonance" with the relationship $R1 = R2 = \sqrt{L/C}$. If calculated as two parallel impedances, it will be found that Z_{in} is 2 ohms at whatever frequency it may be measured.

A Pad Puzzle

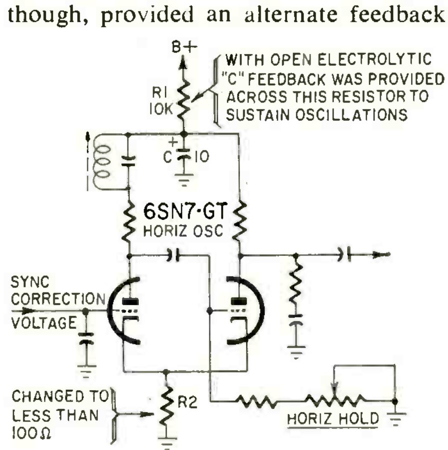
The first ohmmeter reading shows R1 + R2 + R1, a series combination that equals 308 ohms. (R1 and R2 are 120 and 68 ohms. respectively.) This is changed to 2R1 + R2 = 308. The second ohmmeter reading shows ½R1 + R2 + ½R1. This changed to R1 + R2 = 188. Subtracting, we have

$$\begin{aligned} 2R1 + R2 &= 308 \\ R1 + R2 &= 188 \\ \hline R1 \quad &= 120 \end{aligned}$$

and R2 = 188 − 120 = 68

More TV Trouble

Cathode resistor R2 had changed to less than 100 ohms. This, for all practical purposes, eliminated the normal feedback voltage required to sustain oscillation. The open electrolytic, though, provided an alternate feedback

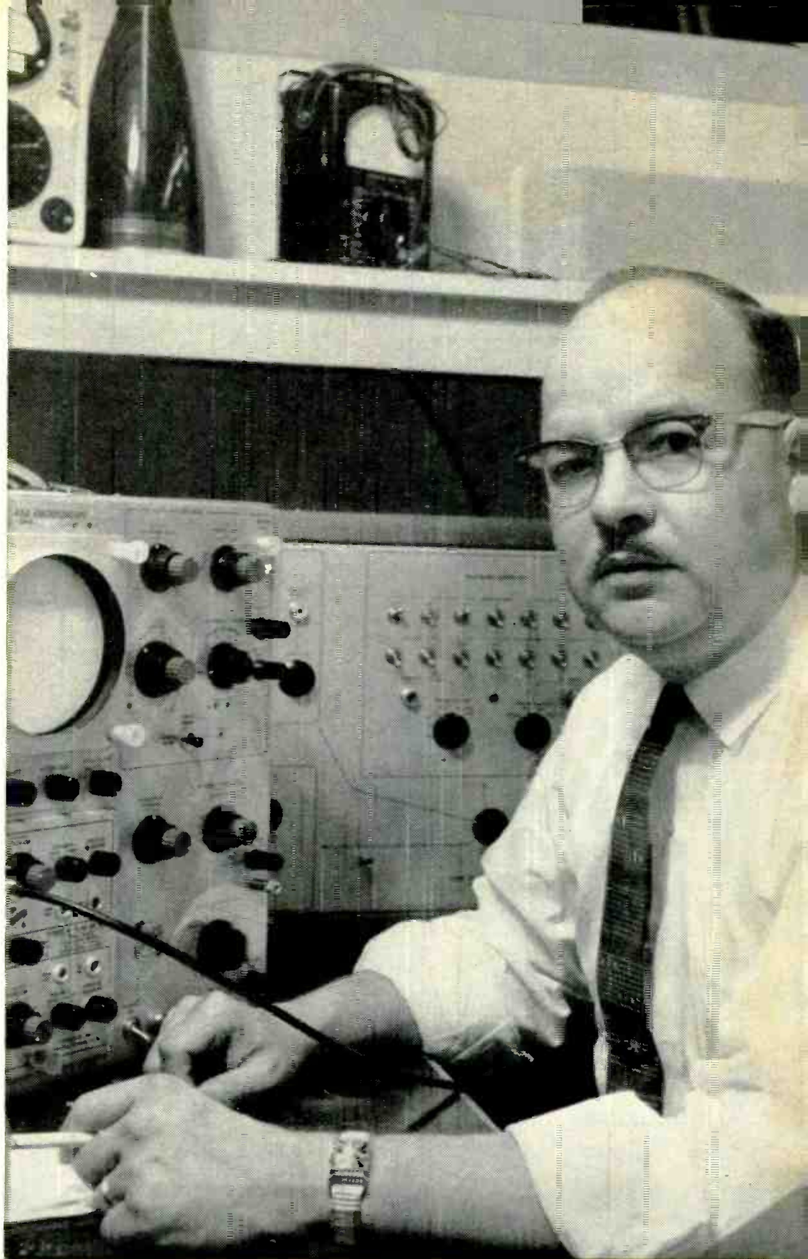


path, since the 10,000-ohm resistor R1 was now common to both triodes. When a new electrolytic was installed, there was no feedback, and the oscillator (and high voltage) ceased operating.

Installing a new electrolytic and a 1,000-ohm cathode resistor solved the whole problem.

are you standing still in electronics while this man advances?

Find out why—and do something about it—if you have the ambition to want a career instead of just a job.



INCREASE YOUR EARNING POWER *while you are on the job. Mearl Martin, Jr. made profitable use of his CREI-acquired knowledge in progressing from Junior technician to licensed Senior Engineer. His present position is Field Support Manager, Marketing Division of Tektronix, Inc.*

LET'S LOOK AT THE FACTS. There's something wonderful about understanding how a circuit works or what a filter capacitor does. If you've ever fixed a TV set, built a radio or used a voltmeter, you've tasted the thrills of electronics.

This excitement may have led you to a job in electronics. But the glamour fades if you are stuck in the same job year after year. You'll be bored with routine and unhappy about prospects for future earnings. You'll discover, as have many men, that simply working in electronics does not assure a good future.

If electronics is the "field of opportunity," how is this possible? No question about it, electronics offers many opportunities, *but only to qualified men*. In any career field, it is how much you know that counts. This is particularly true in the fast moving field of electronics. The man without thorough technical education doesn't advance. Even men with intensive military technical training find their careers can be limited in civilian electronics.

ADVANCED TECHNICAL KNOWLEDGE IS THE KEY to success in electronics. If you have a practical knowledge of current engineering developments, if you understand "why" as well as "how," you have what employers want and pay for. With such qualifications, you can expect to move ahead.

CREI OFFERS YOU, for study at home, a complete program in electronic engineering technology designed to prepare you for a rewarding, well-paying career in electronics. CREI equips you with a practical working knowledge of advanced and up-to-date electronic developments that will put you on the level of specialization where men are most in demand.

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EMPLOYERS RECOGNIZE THE BENEFITS *they receive when employees increase their knowledge through educational programs. Industry need for better educated men increases by the day. Here Mearl Martin discusses education with W. K. Dallas, V.P., Manager, Marketing Division, Tektronix, Inc.*

ASSURE A BETTER FUTURE *with a CREI Home Study Program. Living is better when you prepare yourself for—and get desired promotions. CREI alumnus Mearl enjoys living in a comfortable home in Portland, Oregon. CREI Programs help you make living better wherever you are located.*

GAIN NEW PROFESSIONAL STANDING. *The CREI Home Study Programs help you form new associations with responsible members of your company. Above (L to R) is Mearl Martin with Robert Wruble, Group Manager and Rollie Smith, Field Training Manager at Tektronix, Inc.*

YOUR WHOLE FAMILY BENEFITS *from the success you can achieve from a CREI Home Study Program. They share in it. They enjoy it with you. It helps them realize and understand some of the values of a better education. Above Mearl Martin relaxes at home with his wife and his son and daughter.*

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#24

SW PROPAGATION FORECAST

Sept. 15–Oct. 15 **By STANLEY LEINWOLL***

A program for the International Year of the Quiet Sun (IQSY) has been proposed by the US. Planned for the period of sunspot minimum 1964-65 (see Propagation Forecast, RADIO-ELECTRONICS, December 1961), it will involve measurements and experiments similar as well as complementary to those conducted during the IGY period of maximum sunspot activity.

The program's objectives, especially appropriate to solar minimum, are concerned with problems of the upper atmosphere, the interplanetary medium, solar-terrestrial relations and solar physics. The fields of investigation include ionospheric physics, aurora, airglow, geomagnetism, cosmic rays, aeronomy, meteorology and solar activity.

Scientists of 36 nations have already indicated their intention to participate in the IQSY program, and it is anticipated that most of the 66 nations which participated in the IGY will join this new and equally important joint scientific venture.

Of particular interest to those concerned with high-frequency radio communications will be the ionospheric research program. Several new vertical incidence sounding stations will be installed, in addition to those which have been operating since the IGY. The network of sounding stations will gather data for basic ionospheric research as well as to improve the reliability and accuracy of predictions of communications conditions in the short-wave spectrum. It is also expected that certain sounding stations will cover the spectrum from 250 kc to 30 mc, to increase existing knowledge of propagation conditions for the medium as well as short waves.

The tables show the optimum frequency in mc for propagation of short-wave signals between locations shown during time periods indicated.

Select the table most suitable for your location, read down the left side to the region in which you are interested, follow the line to the right until you are under the appropriate time. (Time is given in 2-hour intervals from midnight to 10 pm, in your local standard time.) This figure is the optimum working frequency, in mc. The best band is the one nearest the optimum working frequency.

	Mid	2	4	6	8	10	Noon	2	4	6	8	10
EASTERN US to:												
West Europe	7	6	6	12	15	16	16	17	14	11	9	8
East Europe	6	6	6	12	14	15	16	13	10	8	7	7
Central America	12	12	11	12	19	20	23	25	26	23	16	12
South America	11	9	11	18	17	17	17	17	17	17	14	12
Near East	6	6	6	12	14	16	16	17	13	9	9	7
North Africa	8	6	7	14	16	16	17	17	15	12	10	9
South & Central Africa	8	8	8	16	19	19	19	19	18	13	10	8
Far East	8	8	7	6	10	10	9	7	11	14	11	9
Australia & New Zealand	11	10	9	9	9	8	8	19	20	20	17	12
CENTRAL US to:												
West Europe	6	7	7	12	13	14	15	14	10	8	7	6
East Europe	7	6	7	12	13	13	12	9	8	7	7	7
Central America	12	11	10	17	20	20	24	26	26	21	13	12
South America	11	10	9	17	18	19	20	21	21	17	13	11
Near East	7	6	6	11	13	13	13	11	9	8	8	8
North Africa	7	6	6	13	15	16	16	14	11	10	8	7
South & Central Africa	8	6	9	14	16	17	17	17	17	15	11	9
Far East	8	7	6	6	10	9	8	16	17	16	15	11
Australia & New Zealand	12	11	10	10	8	9	19	21	21	21	16	12
WESTERN US to:												
West Europe	7	7	6	11	14	14	15	10	9	7	6	7
East Europe	8	6	6	11	13	12	10	9	8	7	7	8
Central America	11	10	12	17	20	20	24	26	26	21	13	12
South America	10	9	8	16	17	18	19	18	18	16	12	11
North Africa	7	6	6	12	13	15	15	13	10	9	7	8
South & Central Africa	8	7	7	16	17	17	18	17	12	9	8	9
Far East	8	7	6	6	10	9	13	16	17	16	14	12
South Asia	8	6	6	6	11	13	13	10	14	16	13	11
Australia & New Zealand	13	11	9	7	8	17	22	23	22	21	18	16

*Radio-frequency and propagation manager, RadioFree Europe.

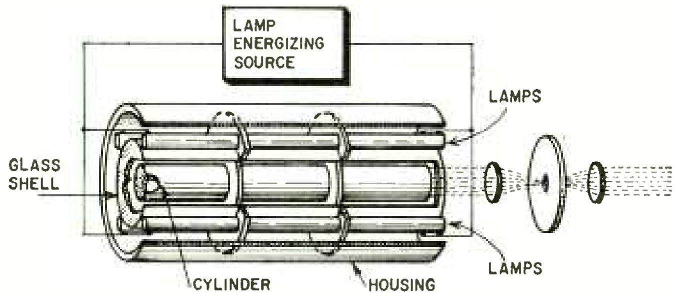
new PATENTS

Light Maser

PATENT NO. 2,929,922

Arthur L. Schawlow, Madison, N. J., and Charles H. Townes, New York, N. Y. (Assigned to Bell Telephone Labs, Inc.)

Masers are useful as low-noise amplifiers, oscillators or frequency standards, usually at microwave frequencies. In one form, a maser contains a gas whose electrons are "pumped" to a high energy level. In dropping back to the lower level, the electrons vibrate at a definite, precise frequency.



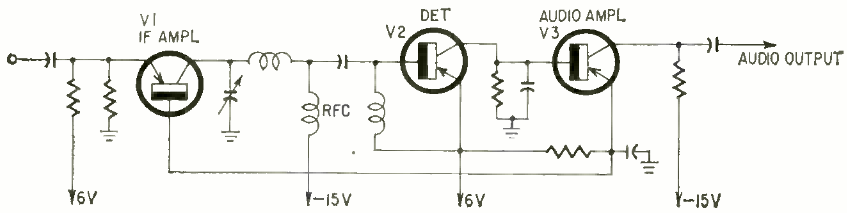
The maser described in this patent is designed for infrared, ultraviolet or visible light. At its center is a hollow cylinder 1 cm in diameter, 10 cm long, filled with alkali metal vapor. A glass shell surrounds the cylinder. Just outside the shell are four potassium lamps which energize the vapor in the cylinder. An outer housing reflects light from the lamps back into the cylinder.

The cylinder ends are reflective, while all other surfaces are transparent. Nevertheless, a small percentage of energy does emerge from the front end of the cylinder and may be focused by an optical system. The output of the maser is nearly monochromatic; that is, its waveform is one pure color or frequency with an extremely narrow bandwidth. Because of this, an extremely sharp focus may be obtained, and the output beam will be extremely narrow.

AVC CIRCUIT

Patent No. 3,012,137

Sumner Riceman, Newton Center, Mass. (Assigned to Raytheon Co.)



V1 feeds its signal to a zero-biased detector. The negative portions of the signal drive V2 to conduction, at which time the base of V3 goes positive. Since the emitter and base of a transistor follow each other in potential, the emitter of V3 also goes positive, as does V1's base.

The stronger the signal, the greater the detector output. This drives V1's base more positive to reduce its gain. Circuit values are selected to produce the needed amount of control.

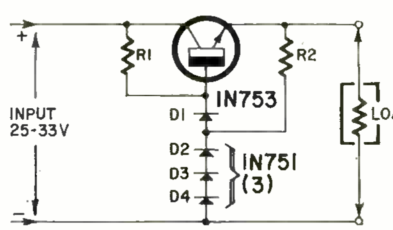
Zener Regulator

Patent No. 3,022,457

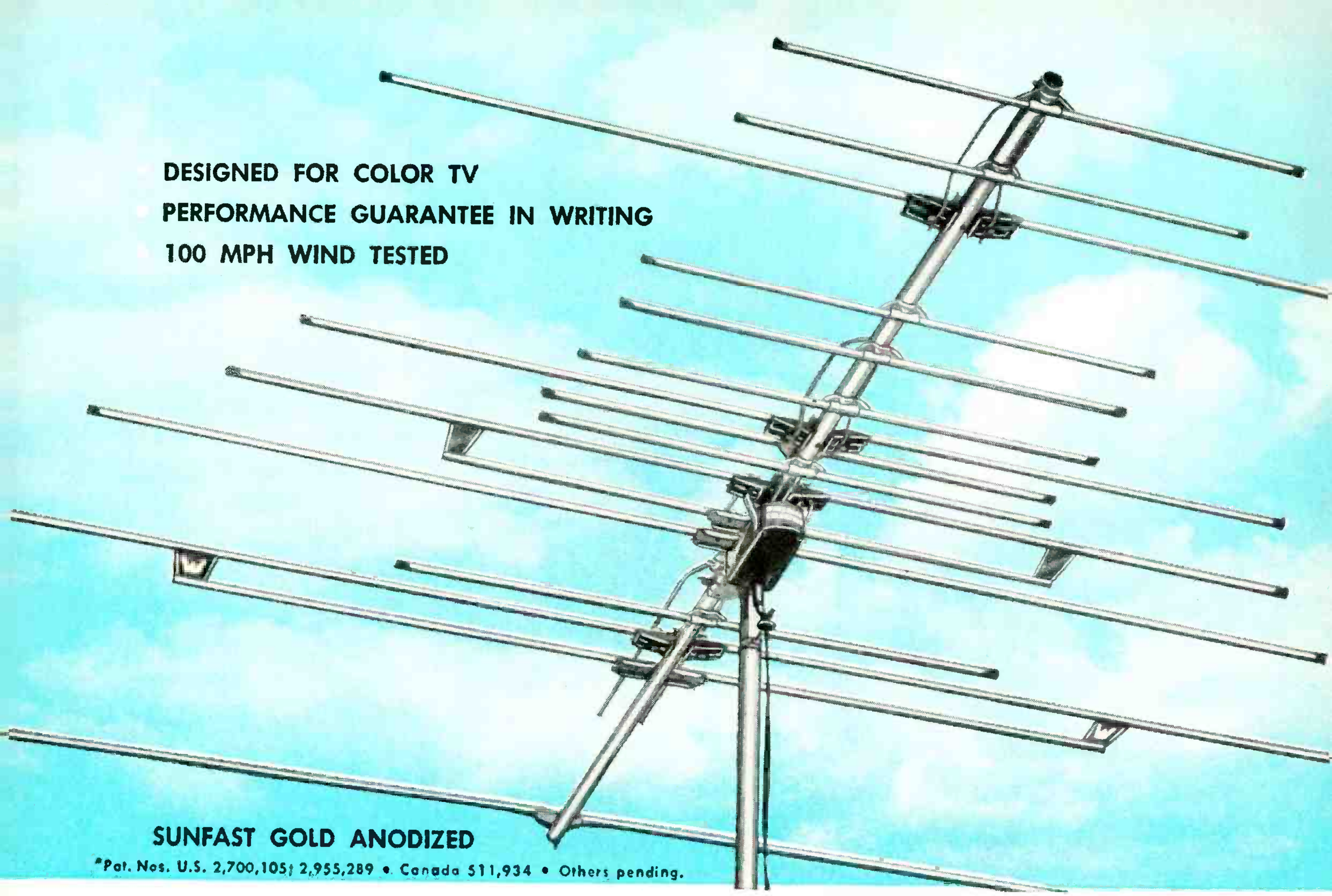
David B. Doan, Austin, Tex. (Assigned to Texas Instruments Inc., Dallas, Tex.)

This circuit provides excellent temperature compensation and voltage regulation over a wide range. The output is 21 volts while the input varies between 25 and 33 volts. Instead of a single Zener diode, there are four units whose Zener values add up to about 21 volts.

D1 is rated at 6.2 volts, the others at 5.1 volts. The 6.2-volt Zener provides optimum regulation, and has a *positive* temperature coefficient. The 5.1-volt Zeners have a *negative* coefficient. The combination cancels temperature effects from 20° to 83°C.



When the input is 25 volts, about 0.1 ma flows through all diodes and R1. This is enough for D1 to regulate, but the other diodes require about 4 ma additional. This is obtained through R2. When the input rises to 33 volts, current through R1 may increase to 1 ma. This is a considerable rise through D1, but the voltage rise across it will be negligible (because the 6.2-volt type has excellent regulation). The other diodes will rise from 4 to 5 ma, which is relatively small. Thus the voltage across them will not change greatly. END



NEW FOR COLOR Winegard COLORTRON

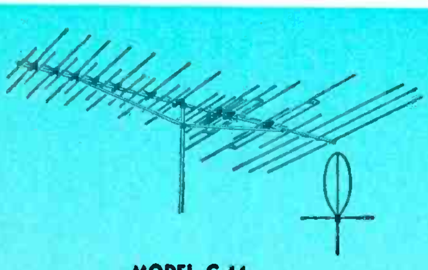
EVOLUTIONARY — The finest TV antenna design ever engineered is the time-proven Electro-Lens all channel Yagi. This patented basic design, with its cross-phased driven elements and intermixed director system, was introduced by Winegard to the industry in 1954 and has never been surpassed. Now, through continuous research and product development, a new, improved Electro-Lens Yagi has evolved—the NEW WINEGARD COLORTRON—bringing this acknowledged design to a new peak of perfection.

4 COLORTRON MODELS $24.95 to $64.95 There are 4 new COLORTRON yagis to cover every reception need, from suburbs to distant fringe areas . . . setting new industry standards for reception results and mechanical construction. They are the only outside antennas that carry a *written factory guarantee of performance* with full factory back-up of consumer satisfaction.

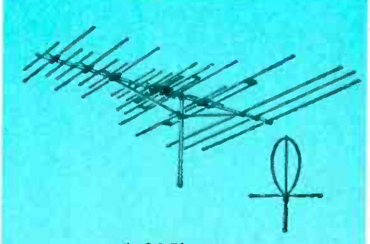
PERFECT COLOR ANTENNA — COLORTRONS have an almost flat frequency response (plus or minus ½ DB across any 6 MC channel), no "suck-outs" or "roll-off" on end of bands . . . accurate 300 ohm impedance match, (VSWR 1.5 to 1 or better) . . . unilobe directivity for maximum ghost and interference rejection. They deliver today's finest TV reception—COLOR or BLACK AND WHITE.

RUGGED CONSTRUCTION — SUNFAST GOLD ANODIZED — COLORTRONS are *built to last* . . . made of high tensile aluminum tubing for rigidity and stability. New locking devices keep the elements aligned—straight as a die. This quality of construction will satisfy a perfectionist! Insulators have a triple moisture barrier to insure top performance, rain or shine. Every COLORTRON is GOLD ANODIZED the WINEGARD way for the best looking, most corrosion-proof and permanent Gold finish known for aluminum.

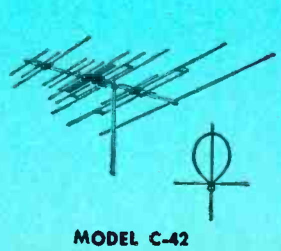
POWERFUL ELECTRONIC ANTENNA — Because the COLORTRON and the NUVISTOR amplifier were designed to match each other perfectly, electronically and mechanically, together they make the most efficient electronic TV antenna yet devised.



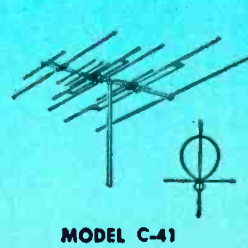
MODEL C-44
GOLD ANODIZED $64.95



MODEL C-43
GOLD ANODIZED $51.90

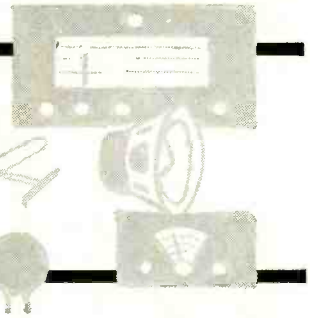


MODEL C-42
GOLD ANODIZED $34.95

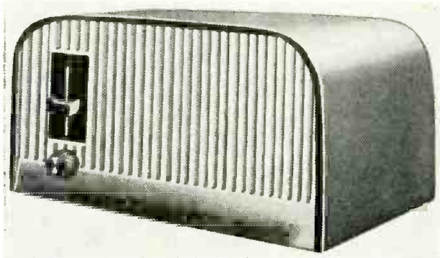


MODEL C-41
GOLD ANODIZED $24.95

NEW PRODUCTS



WIRELESS INTERCOM, *model PA-294.* Plug unit into ac receptacle, remote into another ac receptacle elsewhere in the same house, no



interconnecting wires needed.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, L. I., N. Y.

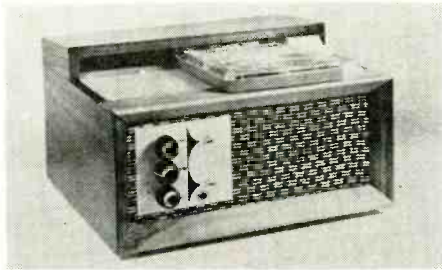
OFFICE INTERCOMS, *series X. Model X120,* 10-station master; *model X220,* 21-station

master; *RX1* remote and *RX3* remote. Units can be set up in any desired arrangement.—**Bogen Communications Div.,** Paramus, N. J.

TRANSISTORIZED PA AMPLIFIER, *Troubador model TR-2.* Simultaneous operation of mikes and music channels. Plug-in super-gain preamp with built-in equalization for tape head and mag phono. Remote control of off/on operation. Electrical isolation, polarity protection, 4-position tone-control; universal mounting. On chassis plug-in ac/dc converter; plug-in emergency stand-by

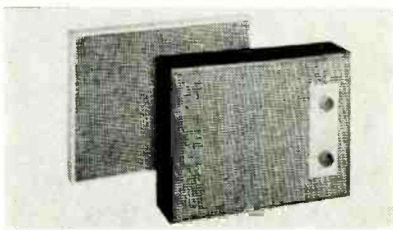
relay. Master volume control. Rated power 35 watts 14 vdc; 30 watts 12 vdc; 8 watts 6 vdc. Response 30 cycles-15 kc ±3 db. Sensitivity: mikes less than 1 mv; music inputs 1 and 2, 300 mv without preamp module; music input 1 less than 1 mv with preamp module. Gain: Mike inputs 84 db, music inputs 34 db without preamp module, 84 db with preamp module. Noise: fundamental —72 db. Inputs: 2 low-impedance mikes, 2 high-impedance music, 1 tape head/mag phono through preamp. Outputs 4, 8, 16 ohms, 25-volt and 70-volt, balanced and unbalanced. Controls: 2 mike, 1 music, 1 master volume, 1 bass, 1 treble, 1 power switch (remote off/on). Power source 14 vdc max.—**Harman-Kardon Inc.,** Ames Court, Plainview, N. Y.

TAPE PLAYER/PAGING SYSTEM, *model ET-10,* for continuous background music and paging. Tape speed 3¾ ips. Flutter less than 0.25% rms. 4-pole induction motor, 1.5-lb dynamically balanced flywheel, Oilite bearings, laminated quarter- and half-track heads, push-pull monaural amplifier. Response 1 db, 30-15,000 cycles; power out-



put 8 watts; Hi-Z mike input. Outputs: 70 volts to line, volume control to external speaker, switch to cut off external speaker. 5 x 7-inch internal speaker. Controls: tape volume, mike volume, tone with on/off switch (10-db treble cut).—**Cine-Sonic Sound Inc.,** 485 8th Ave., New York 1, N. Y.

PA BAFFLES, *Multi-Baffles,* for ceiling and walls. 2 basic designs, each in 6 models. Surface-mounted units, 3½ inches deep, for flush mounting with screws or clips. Recessed model projects 1½ inches from ceiling or wall. Only surface break required is 6-inch hole for speaker. Removable front panels. With or without 8-inch Jensen speakers. Volume controls and transformers, anodized



aluminum front panel with channel switch. 14 x 10½ in.—**Argos Products Co.,** 600 S. Sycamore, Genoa, Ill.

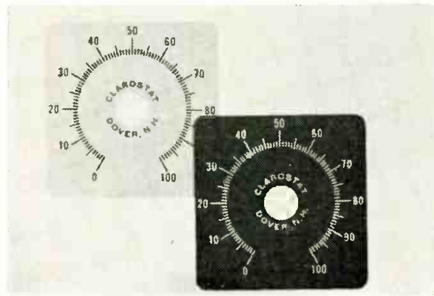
PORTABLE TAPE DICTATING MACHINE, *Stenomaster, Mark XII.* 2 speeds. Tapes that can be played back on any tape recorder. All dictating functions remote-controlled from mike. Sound quality high, making dictation easy to understand. Headphone, or built-in loudspeaker for PA applications. Foot control pedal for transcribing. Tele-

phone pickup available. 3 hours recording time on each tape.—**GBC America Corp.,** 315 W. 43 St., New York 36, N. Y.

TAPE DECK, *model RK-141WX.* Frequency response 50-15,000 cycles ±2 db at 7½ ips; 50-

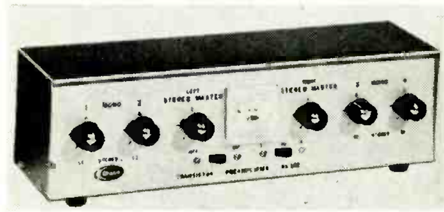
9,000 cycles at 3¾ ips. Wow and flutter 0.15% at 7½ ips. 0.2% at 3¾ ips. Cross-talk and stereo separation, 50 db. Signal-to-noise ratio, 50 db.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, L. I., N. Y.

REVERSIBLE DIAL PLATE for sound system pads. Finished and indexed on both sides from



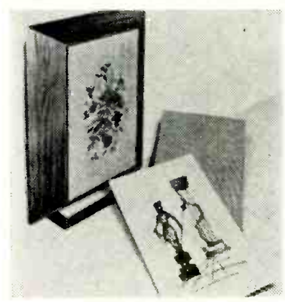
0 to 100 in 1-unit increments. One side is silver on black, other black on gold.—**Clarostat Manufacturing Co. Inc.,** Dover, N. H.

10-TRANSISTOR PREAMP MIXER, *model RA-501.* For tape recording, PA or remote field use. 4 individually controlled inputs, switchable for high- or low-level input. Master gain control,



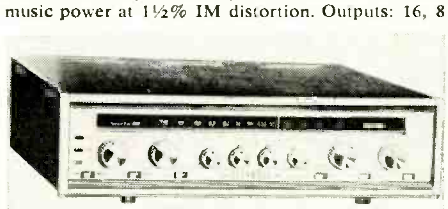
VU meter. Powered by 6 penlight cells, included with unit. Signal-to-noise ratio —65 db.—**Olson Electronics, Inc.,** 260 S. Forge St., Akron 8, Ohio.

4-INCH DECORATOR SPEAKERS, *Styl-o-ette.* Selected-density woofer diaphragm. Ultra-Linear response 8-in woofer, 6½-in mid-range and subsidiary tweeter-radiator. Crossover 500 cycles, response 40–20,000 cycles. Power-handling capacity 30 watts maximum, integrated program material.



Amplifier power requirements 10 watts. Interchangeable grille cloths and frames.—**University Loudspeakers,** 80 S. Kensico Ave., White Plains, N. Y.

STEREO RECEIVER, *model S-8000.* FM Section: IHFM sensitivity 1.8 μv for —30 db. Selectivity 220 kc at —3 db. Frequency response FM mono 20-20,000 cycles ±½ db; FM stereo 20-15,000 cycles ±½ db. Hum and noise level 60 db below 100% mod. *Amplifier section:* Inputs; 2 high-level, 2 phono-preamp, 2 tapehead preamp, 2 tape monitor. Power output: stereo, each channel 32 watts music power at 1½% IM distortion. Outputs: 16, 8



and 4 ohms. 2 recording. Response 20 cycles-20,000 kc, ±½ db. Max hum and noise: volume control min, 86 db below rated output. Radio input 75 db below rated output. Phono input 63 db below rated output, 72 db below 10 mv. Interchannel crosstalk less than 50 db at 1 kc. FM stereo separation 40 db, 150 cycles to 10 kc.—**Sherwood Electronic Labs, Inc.,** 4300 N. California Ave., Chicago 18, Ill.

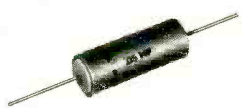
STEREO CARTRIDGE, *Velocitone Mark II,* Compliance 5.5 x 10^{-6}. Channel separation, 30 db.

The HIDDEN 500* wrote these 6 SUCCESS STORIES...

Service Technicians supply the happy endings!

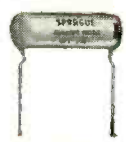
Capacitor success stories are no novelty at Sprague. The "Hidden 500", Sprague's behind-the-scenes staff of 500 experienced researchers, have authored scores of them! And customers add new chapters every day. But none has proved more popular than the 6 best sellers shown here. Developed by the largest research organization in the capacitor industry, these 6 assure happy endings to service technicians' problems.

❶ DIFILM® BLACK BEAUTY® MOLDED TUBULAR CAPACITORS



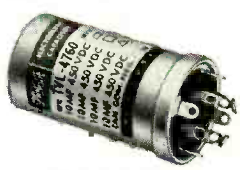
The world's most humidity-resistant molded capacitors. Dual dielectric—polyester film and special capacitor tissue—combines best features of both. Exclusive HCX® solid impregnant produces rock-hard section—nothing to leak. Tough case of non-flammable phenolic—cannot be damaged in handling.

❷ DIFILM® ORANGE DROP® DIPPED TUBULAR CAPACITORS



Especially made for exact, original replacement of radial-lead tubulars. Dual dielectric combines the best features of both polyester film and special capacitor tissue. Exclusive HCX® solid impregnant—no oil to leak, no wax to drip. Double dipped in bright orange epoxy resin to beat heat and humidity.

❸ TWIST-LOK® ELECTROLYTIC CAPACITORS

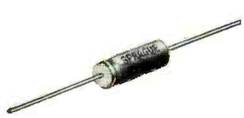


The most dependable capacitors of their type. Built to "take it" under torrid 185°F (85°C) temperatures—in crowded TV chassis, sizzling auto radios, portable and ac-dc table radios, radio-phono combinations, etc. Hermetically sealed in aluminum cases for exceptionally long life. Withstand high surge voltages. Ideal for high ripple selenium rectifier circuits.

❹ ATOM® ELECTROLYTIC CAPACITORS

The smallest dependable electrolytics designed for 85°C operation in voltages to 450 WVDC. Small enough to fit anywhere, work anywhere. Low leakage and long shelf life. Will withstand high temperatures, high ripple currents, high surge voltages. Metal case construction with Kraft insulating sleeve.

❺ LITTL-LYTIC® ELECTROLYTIC CAPACITORS



Ultra-tiny size for use in transistorized equipment. High degree of reliability at reasonable price. All-welded construction—no pressure joints to cause "open" circuits. Withstand temperatures to 85°C (185°F). Hermetically sealed. Extremely low leakage current. Designed for long shelf life—particularly important in sets used only part of the year.

❻ CERA-MITE® CERAMIC CAPACITORS

Tiny, tough, dependable in practically every application. Low self-inductance of silvered flat-plate design gives improved by-pass action in TV r-f circuits. Higher self-resonant frequency than tubular ceramics or micas. Tough moisture-proof coating. Designed for 85°C operation.

The "Hidden 500" are Sprague's 500 experienced researchers who staff the largest research organization in the electronic component industry and who back up the efforts of some 7,000 Sprague employees in 16 plants strategically located throughout the United States.

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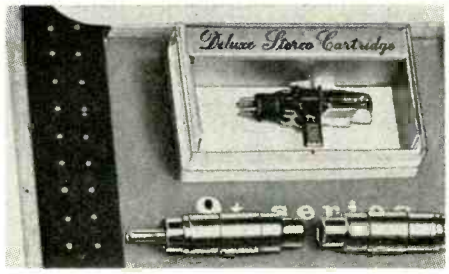
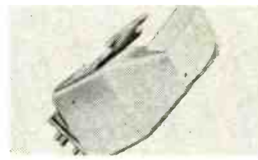
Handy Hanging Wall Catalog C-457 gives complete service part listings. Ask your Sprague Distributor for a copy, or write Sprague Products Company, 81 Marshall Street, North Adams, Massachusetts.

6S-347 R1



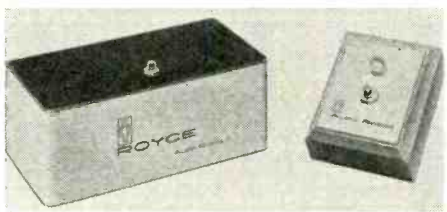
Ceramic cartridge works with hi-fi sets using either velocity or magnetic amplifiers.—**Sonotone Corp.,** Elmsford, N. Y.

STEREO PHONO CARTRIDGE, *Stanton 481AA.* For hi-fi tone arms with tracking force ¼ to 3 grams. Designed as complement to manu-



facturer's model 200 Stanton Unipoise Arm.—**Pickering & Co.,** Sunnyside Blvd., Plainview, N. Y.

HI-FI STEREO REMOTE CONTROL, *Audio Robot.* Operates on/off switch of monophonic or stereo hi-fi component or console system from extension or remote speaker. Remote control in-



dicator light shows when power is on. Up to 5 remote control units usable with one Robot Control.—Dept. P, **Royce Electronic Developments Inc.,** P.O. Box 321, Valley Stream, N. Y.

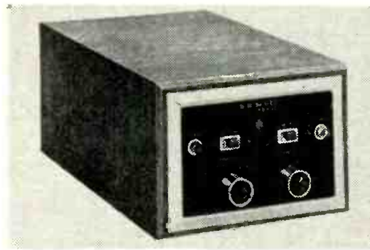
STEREO/MONO PREAMP MIXER, *model RA-502.* For tape recording, hi-fi, theater sound systems and PA. Each channel equipped with switching for high- or low-level inputs, individual

gain control. Master gain control for each stereo channel. Switch adapts to 4 mono inputs; VU meter switches to either stereo channel. Signal-to-noise ratio —65 db. Powered by 6 penlight cells.—**Olson Electronics Inc.,** 260 S. Forge St., Akron 8, Ohio.

FM MULTIPLEX STEREO TUNER, *model ST 97.* Prewired, pre-aligned front end and 4 i.f. stage circuit board. Antenna input 300 ohms balanced. Sensitivity: IHFM usable 3 μv (30 db quieting), 1.5 μv for 20 db quieting; phase locking in

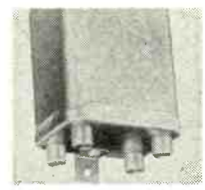
stereo 2.5 μv; full limiting 10 μv. I.F. bandwidth 280 kc at 6-db points; ratio detector 1 mc peak-to-peak separation; audio at FM detector flat to 53 kc, discounting pre-emphasis. IHFM signal-to-noise ratio —55 db. Distortion: IHFM harmonic 0.6%; stereo harmonic 1.5%; IHFM IM 0.1%. Output af response ±1 db 20 cycles–15 kc; IHFM capture ratio 3 db; channel separation 30 db; audio output 0.8 volt. Controls: power, separation, FM tuning, stereo/mono, afc defeat. Power source: 117 volts, 60 cycles, 60 watts drain; extractor post fuse. 17 lb.—**Eico Electronic Instrument Co. Inc.,** 3300 Northern Blvd., Long Island City 1, N. Y.

FM MULTIPLEX ADAPTER, KIT, *LM-35.* Multiplex section prewired. Builder assembles only power supply and controls. Matches all manufac-



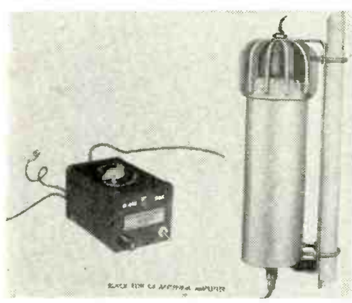
turer's wide-band tuners.—**H. H. Scott Inc.,** 111 Powdermill Rd., Maynard, Mass.

MULTIPLEX FILTER, *model MX-10.* L-C type low-pass filter removes extraneous signals from interaction of rf interference with bias oscillator of tape recorder or recording amplifier. Passes multiplex signal, sharp cut-off at 20 kc. For



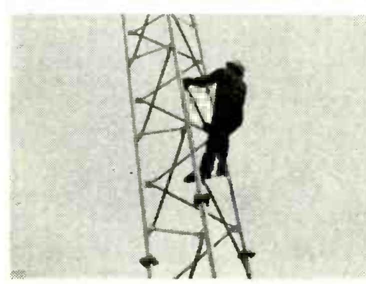
patch-cord connection between output jacks of any stereo FM tuner and high-level or tuner inputs of hi-fi tape recorder. No adjustments or controls.—**Viking of Minneapolis Inc.,** 9600 Aldrich Ave. So., Minneapolis 20, Minn.

ANTENNA AMPLIFIER, *model M-82 Black Box.* Full power restored at antenna when transmitting power is low or minimized by line attenuation. Antenna connected directly to transceiver



when unit is turned off. No internal connections needed to connect control box to transceiver; amplifier carries 30-volt ac 4-tube amplifier cased in aluminum, weatherproofed, easily mounted on any mast to 1½-in. diam; control box has on/off switch, neon type pilot light, 2-amp fuse, isolating filters.—**Antenna Specialists Co.,** 12435 Euclid Ave., Cleveland, Ohio.

HEAVY-DUTY TOWER, *No. 80.* For microwave and heavy-duty communications with towers



up to 800 feet tall. Hot-dipped galvanized, constructed in equilateral triangular pattern 3½ feet. Tower legs of tubular steel 2 to 4 inches. Tailored for individual needs.—**Rohn Manufacturing Co.,** Box 2000, Peoria, Ill.

5-BAND MOBILE ANTENNA, *model HW-5.* For auto use by radio amateurs. Mounts on rear bumper, remotely controlled from driver's seat with car in motion. Solenoid switching for 80, 40, 20, 15, 10 meters; for all mobile transmitters and transceivers. Vswr 1.5 over operating ranges, as low as

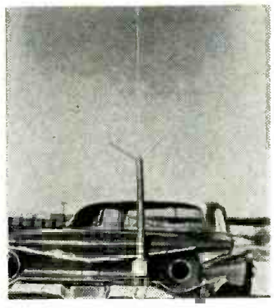
TURNER'S NEW

355C CITIZEN'S BAND MICROPHONE

An all new styling concept from Turner—the company that gave you the famous Turner 350C microphone. Now, with the 355C you get the same Turner ruggedness and dependability in an entirely new microphone design. The convenient hand-ease switch means fast and convenient operation in any mobile situation.

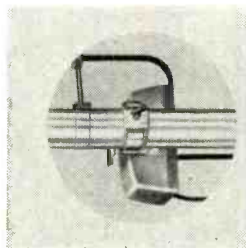
THE TURNER MICROPHONE COMPANY
933 17th Street N.E., Cedar Rapids, Iowa

IN CANADA: Tri-Tel Associates, Ltd., 81 Sheppard Avenue West, Willowdale, Ontario



1.1 under best conditions. 8-foot antenna. Static sheath construction.—**Dynascan Corp., B & K Div.**, 1801 W. Belle Plaine Ave., Chicago 13, Ill.

YAGI ANTENNA COUPLERS, 300-ohm. 12 vhf models *CA-2* through *CA-13*, each individually tuned to single channel. Couples single-channel

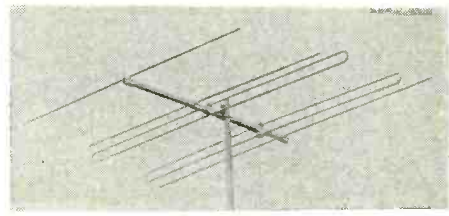


antenna to other vhf types. FM model CA-FM connects FM and TV antennas on same mast, running single 300-ohm downlead. May be used as signal splitter inside house.—**Winegard Co.,** 3000 Kirkwood Ave., Burlington, Iowa.

ANTENNA INPUT COILS for exact replacement. Individually packaged in polyethylene containers, arranged on display board. Shipped

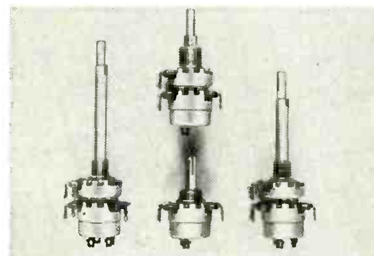
preassembled for immediate display.—**Sarkes Tarzian, Inc.,** Tuner Service Div., East Hillside Dr., Bloomington, Ind.

5-ELEMENT YAGIS. *Y-50 series.* 35 models covering frequency range between 30 and 500 mc.



Gain ranges from 7 to 8 db. 2 or 3 driven elements. —**TACO, Technical Appliance Corp.,** Sherburne, N. Y.

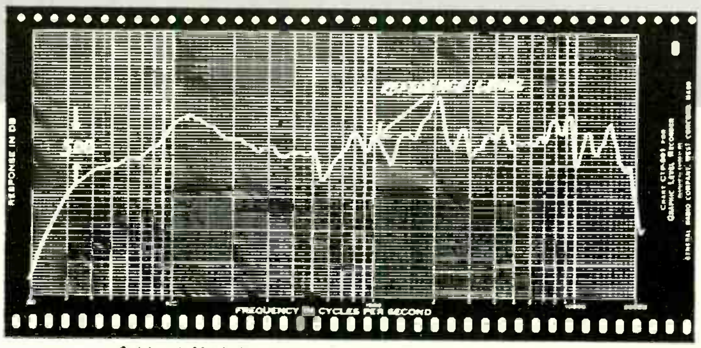
REPLACEMENT CONTROLS for 1961 auto



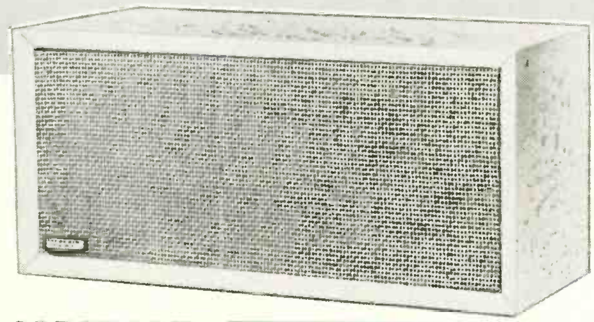
CABINART MARK 3

THE MOST INCREDIBLE BUY IN HIGH FIDELITY HISTORY

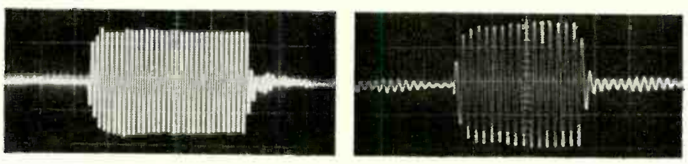
To achieve the magnificent full range tonal response, CABINART Research now presents the FIRST bookshelf Reflex-Horn enclosure around a precision engineered loudspeaker. The MARK 3, priced at $18.00, establishes a new zone of value and quality with the publication of complete Electro-Acoustic data.



Cabinart Mark 3 sound pressure level frequency response.



CABINART MARK 3 **$18.00** Unfinished — Oiled Walnut, $30.00

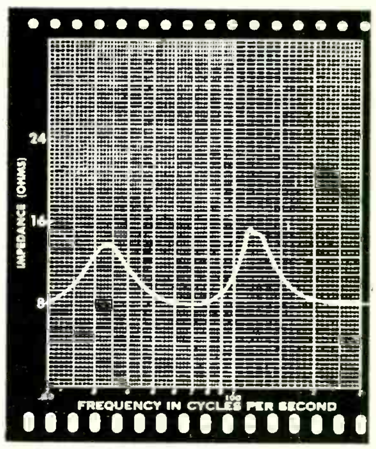

1500 Cycles — Tone Burst Test — 100 Cycles

SPECIFICATIONS: 23″ long, 11″ high, 9½″ deep Loudspeaker: 8″, with rolled annulus • 8 ohm impedance, 10,000 Gauss • 6.8 Dual Diameter Alnico 5 magnet • 3″ whizzer cone for HF dispersion • Free air resonance: 65 cycles **FREQUENCY RESPONSE:** SPL, 50 to 19,000 cycles **SENSITIVITY:** ¼ watt input for 85 DB 10 feet on axis **POWER HANDLING CAPACITY:** 10 Watts

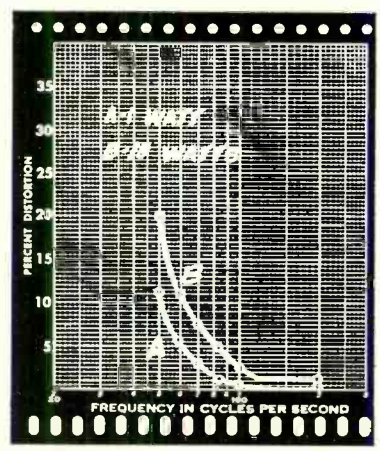
TEST EQUIPMENT COMPLEMENT USED IN CABINART DETERMINATIONS

Bruel & Kjaer Condenser Microphone Model 4134
Bruel & Kjaer Cathode Follower Model 2614
Bruel & Kjaer Microphone Amplifier Model 2604
General Radio Beat Frequency Oscillator Model 1304B
General Radio Graphic Level Recorder Model 1521
Hewlett-Packard Signal Generator Model 200CD
Hewlett-Packard Distortion Analyzer Model 330B
Ballantine Vacuum Tube Voltmeter Model 310A
Tektronix Oscilloscope Model 503
Delco Radio Div. Tone Burst Test Generator Model XP-13295

Data derived from ten production units.



Cabinart Mark 3 impedance characteristic.



Cabinart Mark 3 harmonic distortion levels at 1 and 10 watts input

CABINART GUARANTEES

You must be satisfied for 10 full days or your money back.

ONE FULL YEAR WARRANTY

Written registration card and warranty included.

Sold only direct by CABINART ACOUSTICAL DEV. CORP., Geyer St., Haledon, N. J. and in our Cabinart factory outlet located at 26 West 8th St., New York, N. Y.

Pioneers in hi fi quality since 1948.

CABINART ACOUSTICAL DEV. CORP.
GEYER STREET, HALEDON, N. J.

Cabinart Acoustical Dev. Corp.
32 Geyer St., Haledon, N. J.

Please ship the following to be used in my home for 10 full days. I understand unit(s) may be returned and my money refunded within that time unless fully satisfied.

.............Mark 3 Unfinished $18.00 each

.............Mark 3 Oiled Walnut $30.00 each

(Please make check or money order payable to Cabinart Acoustical.)

Name__________

Address__________

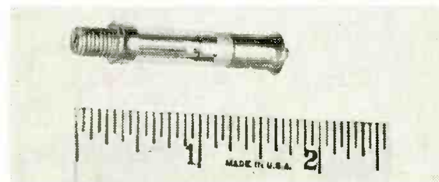
City__________ State__________

radios. 17 units for sets in 1961 Buicks, Chevrolets, Fords, Mercurys, Oldsmobiles, Pontiacs and Ramblers; Model M U-10 for all 1961 Motorola auto receivers, plus sets in Chrysler cars.—**Centralab**, Electronics Div. Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

TRANSVERTER. *Model BX125* 125-watt transistorized power converter. Provides 117-volt 60-cycle ac by plugging into car or boat 12-volt

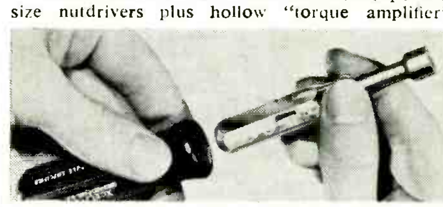
cigarette lighter receptacle. Output 125 watts continuous, 150 watts intermittent.—**Workman Electronic Products Inc.**, PO Box 5397, Sarasota, Fla.

TRIMMER PISTON CAPACITORS. *Super Max-C.* Electrode band embedded in glass cylinder; anti-backlash adjustment mechanism, minimum adjustment life 500 cycles, adjustable torque,



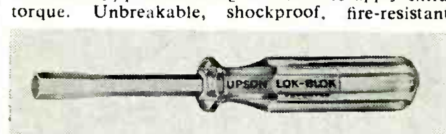
fixed adjustment screw. Sealed construction; Ultra-Linear tuning; no derating from −55°C to +125°C; 1,000 dc working volts; dielectric strength 2,000 vdc; insulation resistance 10^6 megohms; Q factor 500, measured at 1 mc. 10 models cover 1-90 μμf.—**JFD Electronics Corp.**, 6101 16th Ave., Brooklyn, N. Y.

NUTDRIVER SET. 10 color-coded, pocket-size nutdrivers plus hollow "torque amplifier"



handle. 1-in diam. x 3⅛ in long, for larger grip, extended reach, increased driving power. Hex openings 3/32 to ⅜ in.—**Xcelite Inc.**, Orchard Park, N. Y.

NUTDRIVERS. Hollow-shaft, 1-piece construction. Hex-shaped, tempered-steel shaft. Holds nut securely, permits using a wrench to apply extra torque. Unbreakable, shockproof, fire-resistant



handles of tenite butyrate with Lok-Blok insert. 9 sizes: 3/16 through ⅝ inch. Roll-up kit, plastic bench stand, or single drivers.—**Upson Bros. Inc.**, Rochester 14, N. Y.

SABRE SAW. Powered by reciprocating motor. Blade retraction clears cut, prevents splintering or tearing. Heavy-duty 4.8-amp motor; 14,400 strokes per minute. Cuts up to 1-in finished stock, makes own starting hole. Exposed metal parts insulated, no ground required. No lubrication re-

quired. 4 blades and changing wrench. Ideal for making speaker and record player cutouts and when installing built-in intercoms and similar equipment.—**Weller Electric Corp.**, 601 Stones Crossing Rd., Easton, Pa.

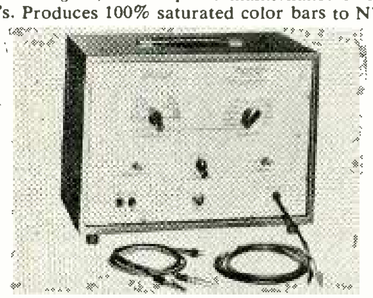
CAPACITOR TESTER, *Cappy Part No. E-2.* Pocket-size unit tests paper, ceramic, electrolytic, motor starting and transistor capacitors for

leakage, shorts and opens. Also checks diodes, resistors, fuses and rf high voltage.—**Watsco Inc.**, 1800 W. 4th Ave., Hialeah, Fla.

COLOR BAR/WHITE DOT GEN, *model E450.* 1 cable connection to antenna inputs, 3 front-panel controls. No external sync signals needed to lock in test patterns. Patterns: color bars, white dots, crosshatch, separate vertical and

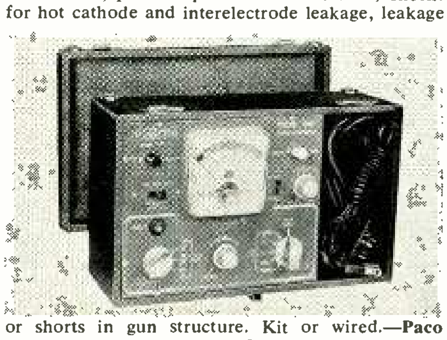
horizontal bars. Rf output available on channel 3 or 4; picture carrier 50 mv max, sound carrier 10% of picture carrier. Output impedance 300 ohms—**Precision Apparatus Co. Inc.**, 70-31 84th St., Glendale 27, N. Y.

COLOR BAR GENERATOR, *model 661 Chrom-Aligner,* for setup and maintenance of color TV's. Produces 100% saturated color bars to NTSC



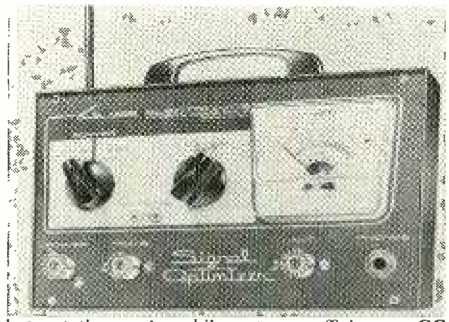
standards, all standard alignment signals, white dot and crosshatch patterns.—**Hickok Electrical Instrument Co.**, 10514 Dupont Ave., Cleveland 8, Ohio.

CRT TESTER/REJUVENATOR, *model T63.* Beam-current type, tests and rejuvenates all picture tubes, including color, each gun separately, at correct heater voltage from 1.5 to 12 volts, continuously variable. Checks for screen brightness under high or low line-voltage conditions; simulates need for booster; predicts probable life of tube; checks for hot cathode and interelectrode leakage, leakage



or shorts in gun structure. Kit or wired.—**Paco Electronics Inc.**, 70-31 84th St., Glendale 27, N. Y.

SIGNAL OPTIMIZER/CB TESTER, *Globe model 65-518.* For complete check of CB installations. Tests antenna power in watts, modulation, field strength, antenna output, harmonics, SWR,



base station and mobile antenna efficiency.—**GC Electronics Co.**, Dept. G-7, 400 S. Wyman St., Rockford, Ill.

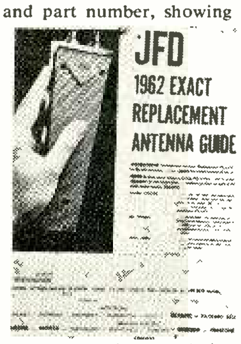
All specifications are from manufacturers' data

NEW BUSINESS GETTERS

NEW 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.

REPLACEMENT FLIP-CHART for portable TV antennas from 29 manufacturers. Indexed by OEM set and part number, showing supplier's re-



placement. 80 units illustrated in 8½ x 11-in chart. Available to registered dealers; revisions mailed periodically.—**JFD Electronics Corp.**, 6101 16th Ave., Brooklyn 4, N. Y.

DESIGN CONSIDERATIONS IN SELECTING PHOTOCONDUCTIVE CELLS. 28-page 8½ x 11-inch booklet explains photocell principles, materials, use in test equipment. Design characteristics discussed are: spectral response, electrical ratings, sensitivity, temperature effects, linearity, speed of response, life, reliability. Gives specs on four types, listing 47 applications, 15 schematics.—**Technical Information & Product Service, Receiving Tube Dept., General Electric Co.**, Owensboro, Ky.

PROFESSIONAL TEST EQUIPMENT for radio-TV technicians. 12-page *Catalog AP20* describes cathode rejuvenator testers, tube testers, TV analysts, circuit analyzers. New units include color analyst, transistor radio analyst, plus combination tube, volt-ohm-millimeter, cathode rejuvenator tester.—**B & K Div.**, Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago 13, Ill.

MOBILE CERAMIC MIKE SPECS, *model 511,* described in 2-page, single-sheet *Data Bulletin.* Life-size photo plus details of output, ceramic element, response, switch, cable, housing material and finish, special vertical/horizontal mounting bracket. —**Astatic Corp.**, Conneaut, Ohio.

RADIO/TV SERVICE DATA. From supplier's manuals, radio diagrams **50¢**, TV **75¢**. Material from other publishers **$1.00.** Old radio data from the 20's. — **Supreme Publications,** 1760 Balsam Rd., Highland Park, Ill.

OIL-TIGHT INDICATOR LIGHTS offered in 8-page brochure, *Form L-200C.* Describes vibration-resistant construction, retained gaskets and O-rings, built-in resistors, lens styles and colors. Life-size photos, drawings, schematics illustrate lamp and indicator-light assembly — R. E. Greene, **Dialight Corp.**, 60 Stewart Ave., Brooklyn 37, N. Y.

ELECTRONICS COURSES AND KITS offered in 44-page *Catalog 189L.* 30 correspondence courses in electronics, radio, TV, telephony, covering fundamentals, instrumentation, servos, automation, calculus, applied and industrial electronics. Training kits, optional with courses, include lab manuals, circuit boards, special experiments, professional vtvm.—**International Correspondence Schools,** School of Electronics, Scranton 15, Pa., or **ICS Canadian Ltd.**, 7475 Sherbrooke St. W., Montreal 28, Quebec, Canada.

SILICON POWER TRANSISTORS listed in condensed foldup catalog. Charts give data on miniature, medium, intermediate and high power types, plus industrial units. Illustrated page shows case types and dimension diagrams.—**Silicon Transistor Corp.**, 150 Glen Cove Rd., Carle Place, L. I., N. Y.

TV KITS, WIRED CHASSIS, *Professional Series,* described and illustrated in 12-page catalog. Includes table and floor model cabinets, deluxe and custom front panels, custom installation, with all technical data. Photos show top and bottom views, vertical and horizontal control panel mountings. 23- and 27-inch cabinets, component parts.—Educational Dept., **Transvision Electronics, Inc.**, Grey Oaks Ave., Yonkers, N. Y.

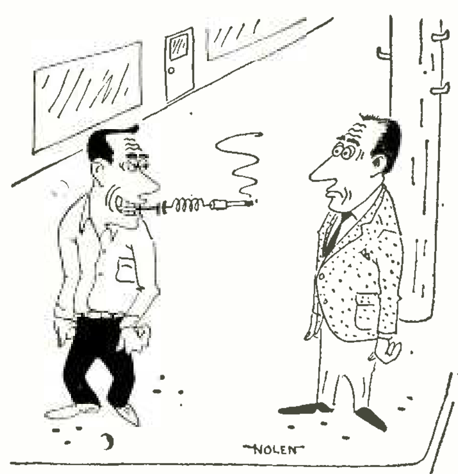
IRON-CORE COMPONENTS CATALOGS. *Vol I:* 52 pages of transformers, inductors, Magamps. Vol II: 20 pages of electric wave filters, high-Q coils and inductors. Custom-built components in both catalogs. Cross-index, capsule digest of various lines, explanation of MIL specs. — **United Transformer Corp.**, 150 Varick St., New York 13, N. Y.

TRANSISTOR INTERCHANGEABILITY LIST. 16-page brochure has data on 1167 JEDEC-registered transistor types and manufacturer's closest replacements. Outline drawings, construction and general use categories for each transistor.—**General Electric Co.**, Bldg. 7, Electronics Park, Syracuse, N. Y.

MINIMIZING RADIATION IN DIAGNOSTIC PROCEDURES. 10-page booklet for radiologists and technicians outlines 7 steps to reduce radiation in diagnosis. Covers all types of medical and dental X-ray equipment. Compiled by RSNA and NEMA. **25¢. National Electric Manufacturer's Assoc.**, 155 E. 44 St., New York 17, N. Y.

INDUSTRIAL CATALOG. 32-page illustrated Catalog 6E2 features 1,700 solderless terminals and connectors, Shakeproof products, electronic hardware, instrument knobs and dials, cases, terminal strips, standard and printed circuit tube sockets, jack covers, planetary drives. — **Waldom Electronics, Inc.**, 4625 W. 53 St., Chicago 32, Ill.

STEREO HI-FI GUIDE. 92-page catalog contains complete product and price data on components and audio equipment, plus suggested stereo systems. — **Tulane Stereo Hi-Fi Co.**, 1909 Tulane Ave., New Orleans, La.



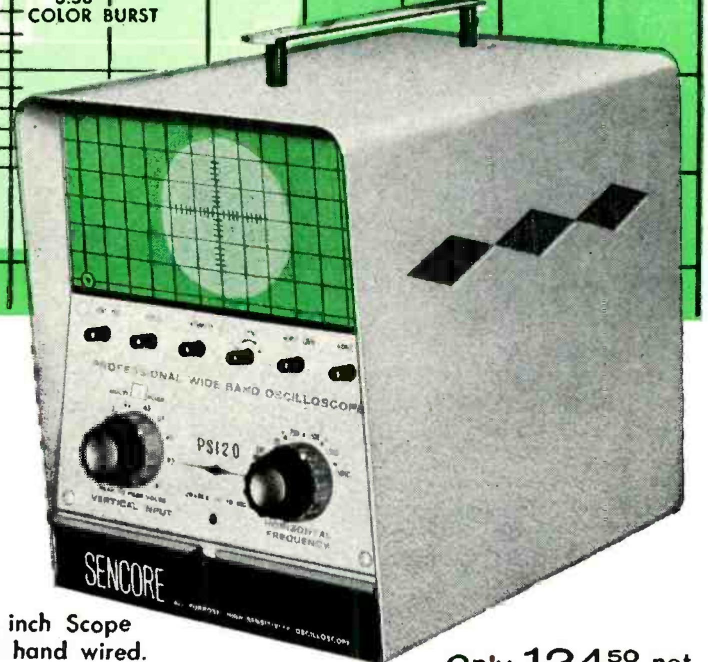
"What's wrong? Haven't you ever seen a filter-tip cigarette before?"

NEW, MODERN, PORTABLE . . . FOR THE MAN ON THE GO . . .

as easy to use as a voltmeter

3.58 COLOR BURST

- A new 3 inch Extended View Portable Scope with New Features and Performance Unmatched by even the most Costly 5 inch Oscilloscopes



NEW

SENCORE PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

Lowest priced Wide Band 3 inch Scope anywhere. All hand wired.

Only 124⁵⁰ net

Here it is, the scope that technicians, engineers and servicemen from coast to coast have been demanding. A portable wide band scope that can be used on the job anywhere, yet has the highest laboratory specifications for shop or lab. Cumbersome color TV sets, remote audio and organ installations and computers are just a few of the jobs that make owning a scope of this type so essential. Why consider a narrow band scope, when for only a few dollars more, this professional wide band sensitive scope equips you for any job.

• The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

• Electrical specifications and operational ease will surpass your fondest expectations. Imagine a wide band scope that accurately reproduces any waveform from 20 cycles to 12 megacycles. And the PS120 is as sensitive as narrow band scopes . . all the way. Vertical amplifier sensitivity is .035 volts RMS. The PS120 has no narrow band positions which cause other scopes to register erroneous waveforms unexpectably. Another Sencore first is the Automatic Range Indication on Vertical Input Control which enables the direct reading of peak-to-peak voltages. Simply adjust to one inch height and read P-to-P volts present. Standby position on power switch, another first, adds hours of life to CRT and other tubes. A sensitive wide band oscilloscope like the PS120 has become an absolute necessity for trouble shooting Color TV and other modern circuits and no other scope is as fast or easy to use.

SPECIFICATIONS

WIDE FREQUENCY RESPONSE:
Vertical Amplifier—flat within ½ DB from 20 cycles to 5.5 MC, down—3 DB at 7.5 MC, usable up to 12 MC.
Horizontal Amplifier—flat within —3 DB from 45 cycles to 330 KC, flat within —6 DB from 20 cycles to 500 KC.

HIGH DEFLECTION SENSITIVITY:

	RMS	P/P
Vertical Amplifier—Vert. input cable	.035V/IN.	0.1V/IN.
Aux. vert. jack	.035V/IN.	0.1V/IN.
Through Lo-Cap probe	.35V/IN.	1.0V/IN.
Horizontal Amplifier—	.51V/IN.	1.44V/IN.

HIGH INPUT RESISTANCE AND LOW CAPACITY:

Vert. input cable	2.7 Meg. shunted by approx. 99 MMF
Aux. vert. input jack	2.7 Meg. shunted by approx. 25 MMF
Through low cap. probe	27 Meg. shunted by 9 MMF
Horiz. input jack	330 K to 4 Meg.

HORIZONTAL SWEEP OSCILLATOR:

Frequency range—	4 ranges, 15 cycles—150 KC
Sync Range—	15 cycles to 8 MC–usable to 12 MC

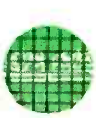
MAXIMUM AC INPUT VOLTAGE:

Vertical input cable— Aux. vert. jack— Lo-Cap probe—	1000 VPP (in presence of 600 VDC)
Horiz. input jack—	approx. 15 VPP (in presence of 400 VDC)

POWER REQUIREMENTS:

Voltage—	105-125 volts, 50-60 cycle
Power consumption—	On pos. 82 watts Stby. pos. 10 watts

SIZE: 7" wide x 9" high x 11¼" deep—weight 12 lbs.



The PS120 is a must for color TV servicing. For example, with its extended vertical amplifier frequency response, 3.58 MC signals can be seen individually.

SENCORE
ADDISON 2, ILLINOIS

HOTTEST VALUE EVER OFFERED!

$200 HEARING AID (as shown)—YOUR PRICE . . . $2

We Scooped the Market on 15000 of these HEARING AIDS from one of the Leading Manufacturers (name withheld) who switched to the Transistor Type.

Each HEARING AID INSTRUMENT is a Complete AUDIO AMPLIFIER and includes—a CRYSTAL MICROPHONE, 3 SUB-MINIATURE TUBES and a Superb Beige Phenolic CABINET.

Indeed a TOP ITEM for the Experimenter—can be modified and converted to: RADIOS—INTERCOMS—TRANSMITTERS—SECRET LISTENING DEVICES — MICROPHONE for Tape Recorders — PRE-AMP & MICROPHONE COMBINATION for Public Address Systems—ETC.

5" x 2½" x 1"—Shipping Weight 1 lb.

Complete as illustrated—Including a detailed informative SCHEMATIC DIAGRAM (less Earphone and Battery) $2

Sold without limit or reserve! Order as many as you want! Rush your order!

ANDREA CUSTOM-BUILT TV CHASSIS
23"—110° Incl Westinghouse CRT & FRONT PANEL, Compl. ready to play $227.50

TECH-MASTER CONSTELLATION CHASSIS
#6115—Successor to the famous 630 TV Complete ready to play (less CRT) .. 159.50

EMERSON 19" TRU-SLIM PORTABLE TV
#1825—Dual Antenna, Front Speaker, Ilum Dial, Complete in sealed carton 139.95

LATEST GARRARD RECORD CHANGER
"Autoslim" Complete with Shure M-7D Stereo Cartridge with Diamond Stylus 36.67

GLOBAL 6-TRANSISTOR POCKET RADIO
Excellent performance, wonderful tone Complete Ready to play, in Gift Box .. 9.97

★ Descriptive literature on request

"ONE DOLLAR" buys

As much as $15 worth—Everything Brand New and sold to you with a money back guarantee.

10% OFF & FREE GIFT—ON PURCHASE OF $10 OR OVER (ON DOLLAR BUYS)

- ☐ $15.00 RADIO PARTS "JACKPOT" handy assortment $1
- ☐ 1—6" x 9" OVAL PM SPEAKER (one to a customer) $1
- ☐ 1—5" PM SPEAKER alnico #5 magnet $1
- ☐ 1—4" PM SPEAKER alnico #5 magnet $1
- ☐ 1—4" TWEETER SPEAKER for HI-FI 1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 50L6 type $1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 6K6 or 6V6 type $1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 3Q4, 3Q5, 3S4 $1
- ☐ 3—I.F. COIL TRANSFORMERS 456kc, most popular type $1
- ☐ 2—G.E. #RTL-143 I.F. COIL TRNSFRMRS 456kc w/flange $1
- ☐ 3—I.F. COIL TRANSFORMERS 10.7mc for FM $1
- ☐ 3—I.F. COIL TRANSFORMERS 262kc for Auto Radios $1
- ☐ 4—OVAL LOOP ANTENNAS assorted popular sizes $1
- ☐ 3—LOOPSTICK ANTENNAS hi-gain, ferrite, adjustable $1
- ☐ 3—½ MEG VOLUME CONTROLS with switch, 3" shaft $1
- ☐ 5—½ MEG VOLUME CONTROLS less switch $1
- ☐ 5—ASST. 4 WATT WIREWOUND CONTROLS $1
- ☐ 10 — ASSORTED VOLUME CONTROLS less switch $1
- ☐ 5—ASSORTED VOLUME CONTROLS with switch $1
- ☐ 10—SURE-GRIP ALLIGATOR CLIPS 2" plated $1
- ☐ 10—SETS PHONO PLUGS & PIN JACKS RCA type $1
- ☐ 20—ASST. PILOT LIGHTS #44, 46, 47, 51, etc. $1
- ☐ 20—PILOT LIGHT SOCKETS bayonet type, wired $1
- ☐ 50—ASSORTED TERMINAL STRIPS 1, 2, 3, 4 lugs $1
- ☐ 100'—FINEST NYLON DIAL CORD best size, .028 gauge $1
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- ☐ 15—ASSORTED ROTARY SWITCHES regular $15 value $1
- ☐ 25—ASSORTED PRINTED CIRCUIT SOCKETS best types $1
- ☐ 30—INSTRUMENT POINTER KNOBS popular screw type $1

- ☐ 100—ASSORTED ½ WATT RESISTORS some in 5% $1
- ☐ 70 — ASSORTED 1 WATT RESISTORS some in 5% $1
- ☐ 35 — ASSORTED 2 WATT RESISTORS some in 5% $1
- ☐ 40—ASST. PRECISION RESISTORS in 1 percenters $1
- ☐ 20 — ASS'TED WIREWOUND RESISTORS 5, 10, 20 watt $1
- ☐ 10 — ASST. RADIO ELECTROLYTIC CONDENSERS $1
- ☐ 5—ASST. TV ELECTROLYTIC CONDENSERS $1
- ☐ 2 — ELECTROLYTIC CONDENSERS 40/40-450v $1
- ☐ 4 — ELECTROLYTIC CONDENSERS 20/20—450v $1
- ☐ 300—ASST. ½ W RESISTORS AB, IRC, Short leads, excellent $1
- ☐ 10—6' ELECTRIC LINE CORDS with plug $1
- ☐ 4—50' SPOOLS HOOK-UP WIRE 4 different colors $1
- ☐ 50—STRIPS ASSORTED SPAGHETTI handy sizes $1
- ☐ 100 — ASSORTED RUBBER GROMMETS best sizes $1
- ☐ 200'—BUSS WIRE #20 tinned for hookups, special circuits, etc. $1
- ☐ 250—ASST. SOLDERING LUGS best types and sizes $1
- ☐ 1—LB SPOOL ROSIN-CORE SOLDER 40/60 $1
- ☐ 1000—ASST. HARDWARE KIT screws, nuts, washers, rivets, etc. $1
- ☐ 250—ASST. SELF TAPPING SCREWS #6, #8, etc. $1
- ☐ 150—ASST. 6/32 SCREWS & 150 6/32 HEX NUTS $1
- ☐ 150—ASST. 8/32 SCREWS & 150—8/32 HEX NUTS $1
- ☐ 150—6/32 HEX NUTS & 150—8/32 HEX NUTS $1
- ☐ 8—ASST. LUCITE CASES hinged cover, handy for parts $1
- ☐ 4—TOGGLE SWITCHES SPST, SPDT, DPST, DPDT $1
- ☐ 6—ASST. SLIDE SWITCHES SPST, DPDT, etc. $1
- ☐ 100—ASST. RUBBER FEET FOR CABINETS best sizes $1
- ☐ 50—100K ½ WATT RESISTORS 10% $1
- ☐ 50—220K ½ WATT RESISTORS 10% $1
- ☐ 50—470K ½ WATT RESISTORS 10% $1
- ☐ 3—ASST. SIZES RADIO CHASSIS PANS drilled & plated $1

- ☐ $15.00 TELEVISION PARTS "JACKPOT" best buy ever $1
- ☐ 50—ASSORTED TV COILS I.F. video, sound ratio, etc. $1
- ☐ 1—$10 INDOOR TV ANTENNA hi-gain, 3 section, tiltproof $1
- ☐ 5—TV CHEATER CORDS with both plugs $1
- ☐ 3—ELECTROLYTIC CONDENSERS 50/30-150v $1
- ☐ 65'—MINIATURE ZIP CORD 2 conductor, 101 uses $1
- ☐ 100'—TWIN TV LEAD-IN WIRE 300 ohm, heavy duty $1
- ☐ 50' — FLAT 4-CONDUCTOR WIRE many purposes $1
- ☐ 40—ASSORTED TV KNOBS ESCUTCHEONS etc. $20 value $1
- ☐ 15—ASSORTED STANDARD TUNER VHF STRIPS $1
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- ☐ 1—70° FLYBACK TRANSFORMER Incl. Schematic Diagram $1
- ☐ 100—ASST. CERAMIC CONDENSERS some in 5% $1
- ☐ 1—TV VERTICAL OUTPUT TRANSFORMER 16 to 1 ratio $1
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- ☐ 10—ASST. DIODE CRYSTALS 5—1N60 and 5—1N64 1
- ☐ 2—SILICON RECTIFIERS 750ma, 400 PIV $1
- ☐ 3—SILICON RECTIFIERS Top Hat 500ma-400 PIV $1

MARKET SCOOP COLUMN

- ☐ 500' CHOICE HOOKUP WIRE asst colors cut in handy lengths some stripped & tinned $1
- ☐ 2—WIRE STRIPPERS/CUTTERS adjusts for insulation sizes $1
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- ☐ 1—SQ. YARD GRILLE CLOTH most popular brown & gold design $1
- ☐ 6—TRANS. RADIO BATTERIES 9 volt, same as Eveready #216 $1
- ☐ 10—ASSORTED TUBES Radio, Television and Industrial $1
- ☐ 10—RCA #12L8 TUBES $1
- ☐ 10—RCA #954 TUBES $1
- ☐ 10—ROGERS #2X2 TUBES $1
- ☐ 3—SYLVANIA 35W4 TUBES $1
- ☐ 10—AMPERITE #3-38 TUBES most popular Ballast Tube $1
- ☐ 5—RCA #1U4 TUBES also serves as a 1T4 Tube $1
- ☐ 6—I.F. COIL TRANSFORMERS 456 kc, latest 3/4" x 3/4" type $1
- ☐ 1—90° DEFLECTION YOKE including schematic diagram $1
- ☐ 1—90° FLYBACK TRANSFORMER including schematic diagram $1
- ☐ 1—HEARING AID AMPLIFIER incl 3 Tubes, Mike, Etc (as is) $1
- ☐ 100—ASSORTED SOCKETS all type 7 pin, 8 pin, 9 pin $1
- ☐ 100—ASSORTED FUSES 3AG and other popular sizes $1
- ☐ 100—ASSORTED TUBULAR CONDENSERS .001 to .47 up to 600v $1
- ☐ 100—GOODALL CONDENSERS .0033-400v 85° top quality $1
- ☐ 30—GOODALL CONDENSERS .19-600v 85° top quality $1
- ☐ 20—STANDARD CONDENSERS .047-600v 85° top quality $1
- ☐ 10—C-D TUBULAR CONDENSERS 50mfd—150 volts lists at $1 $1
- ☐ 10—SPRAGUE CONDENSERS 100/100/100—75 volts $1
- ☐ 10—SPRAGUE CONDENSERS 450/100/100—16 volts $1
- ☐ 10—RADIO ¼ MEG CONTROLS less switch, long shafts $1
- ☐ 3—TV DUAL CONTROLS ½ meg & 1500 ohms, with switch $1
- ☐ 1—4 SPEED PHONE ARM with sapphire flipover Cartridge $2

HANDY WAY TO ORDER—Simply pencil mark items wanted (X in square is sufficient), enclose with money order or check. You will receive a new copy of these offers for re-orders.

ON SMALL ORDERS—Include stamps for postage, excess refunded. **LARGER ORDERS** shipped express charges collect.

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N. Y. TELEPHONE COrtland 7-2359

TECHNICIANS' NEWS

Code of Ethics Preferred

Pittsburgh, Pa.—The Better Business Bureau here prefers setting up a code of ethics for the TV-radio repair business rather than licensing such technicians, according to J. K. Orr, assistant general manager of the local BBB. The code would be set up with the aid of the local service technicians association. The bureau is already working out such a system.

Wisconsin News

Color Course

Bloomer, Wis.—Fourth part of the Sams color service course was the major portion of TESA-Indianhead's meeting. Details of the forthcoming state convention were also discussed.

Election Returns

Jefferson-Dodge County—New officers are Ken Wilkes, president; Carl Schuett, vice president; George Seja, secretary, and R. Wagner, treasurer.

TESA, Sheboygan—Wilmer Weinhold, president; Elroy Van Sluys, vice president; Fred Leonard, secretary-treasurer, and John Bruder, NATESA director.

Election in Missouri

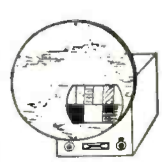
St. Louis—Selecting officers was the business of a recent meeting. Morton Singer was elected president; Wm. Frasure, chairman of the board; Bill Thomas, vice president; Connie Bill, secretary; Jos. Dittrich, treasurer; Otto Horak, sergeant-at-arms. Board members are Gus Prionas, Dennis Towell, Earl Bess and Ben Goedeker. NATESA director is Vincent Lutz.

Customer Complaint

A self-styled "tube tester" regularly advertised in a North End neighborhood paper, and who has admitted to the BBB that he has no technical education or experience in electronics but who purchased a mail-order tube tester and offers to test tubes in the home, sometimes for $3.00 and sometimes on a *free* basis, left a customer's set in far worse condition than when he found it.

The customer claims he replaced some eight tubes, did not leave the customer's old tubes, and fiddled with all the internal adjustments for something over two hours.

The customer admits she made the



basic mistake of biting on the cut-rate ad for night-time service, but places the real blame on the neighborhood weekly which displays the ad. She states that the "serviceman" should have his "license" revoked.—*TSA Service News, Seattle, Wash.*

Techs Lend a Hand

Saginaw, Mich.—Latest project of the local TESA is picking up, free of charge, any radio, phonograph or TV which people might want to donate to a worth-while cause. After they are picked up, members donate their time and repair the sets. The association provides the necessary parts.

Of a total of 130 items donated in a recent drive, 75 were repaired and presented to various hospitals and charitable institutions. The rest were given to schools that teach electronics.

"Payment in Full"

How often have you received a check with the notation (on the check, on a statement attached to it or in an accompanying letter) that the check is "payment in full" when it isn't? Mishandling such checks can be expensive.

Here are the rules on "payment in full" with suggestions on how you can avoid loss when you get such an endorsement, and use the endorsement on your own checks.

It's well settled law that when a claim is unliquidated, or a claim is liquidated in amount and an honest dispute exists concerning the indebtedness, acceptance of any payment as "payment in full" binds the creditor.

You aren't helped either by crossing out the limiting endorsement or advising the debtor that the payment is credited "on account."

Take care. You don't protect yourself by holding on to the check—that's just as bad as depositing it. You have to object firmly and immediately.

If you don't you'll be deemed to have accepted the check in discharge of the whole debt.

Doctor, lawyer, Indian chief and everyone else, including salesmen, brokers, employees owed bonuses or vacation pay, and sellers of goods all are bound by the rule.

The rules don't apply in the following situations:

Wages: Most states have statutes requiring that employees be promptly and fully paid. No tender and acceptance of a lesser sum will discharge an obligation to an employee in this situation.

Taxes: You can't discharge income-tax liability through payment of a smaller sum except, of course, through regular procedures.

When you get a check marked "full payment," do these things *promptly*:

Return the check by *registered mail, return receipt requested,* with a covering letter stating that the amount is insufficient;

Attach to your office copy of the letter a description or photostat of the check together with a statement showing the date, time and place of mailing, signed by the person who actually did the mailing, and

Do whatever is necessary to collect.—*NATESA SCOPE*

Color Workshop

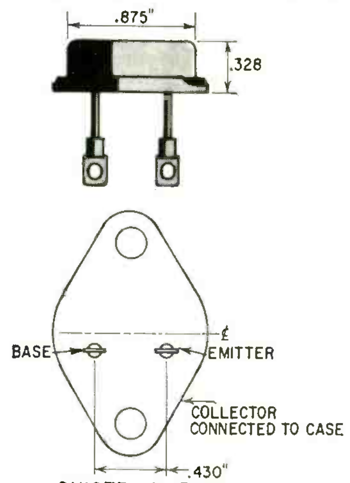
Albany, N.Y.—Members of TSA attended a fascinating meeting conducted by Bob Fish, RCA distributor's service manager. He showed complete color set-up procedure and followed up with a complete rf, i.f. and video alignment. Scope traces were visible to all technicians attending as Bob set up a closed-circuit TV camera to monitor the scope screen. The techs watched two carefully located 19-inch monitors follow the action. END

NEW TUBES and SEMI-CONDUCTORS

VARIETY IS THE KEYNOTE THIS MONTH—a series of power transistors, a new nuvistor tube, a p-n-p-n switch and a duodiode in a novar envelope for TV sweep circuits.

2N1073, -A, -B

A lineup of p-n-p diffused base power transistors designed for applications requiring fast switching speeds,



2N1073,-A,-B

low saturation voltages and high current capability.

Absolute maximum ratings for these Delco transistors are:

	2N1073	1073-A	1073-B
V_{CBO} (collector diode voltage)	40	80	120
V_{EBO}* (emitter diode voltage)	0.75	0.75	0.75
I_C (collector current, amps)	10	10	10
I_B (base current, amps)	1	1	1

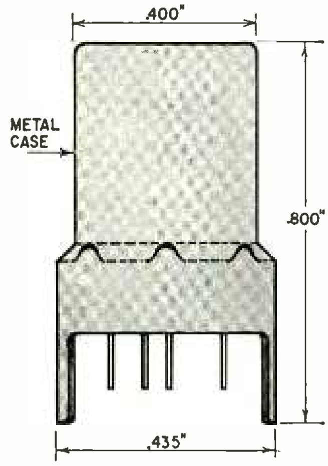
*This rating may be exceeded as long as the maximum base current or maximum dissipation of the device is not exceeded.

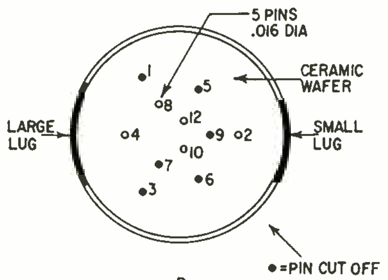
Electrical characteristics are:

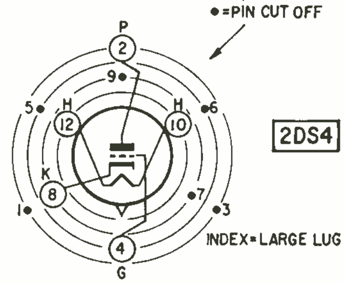
h_{FE} (current gain, min)	20
(current gain, max)	60
f_{hfe} (common-emitter current amplification cutoff frequency: typical kc)	30
f_t (internal cutoff freq when $h_{fe} = 1$: typical mc)	1.8

2DS4

The newest of the nuvistors, the RCA 2DS4 is a high-mu triode for use as a grounded-cathode neutralized rf amplifier in vhf tuners of TV and FM







receivers using series-string heater circuits. The tube has a 2.1-volt 450-ma heater and an average warmup time of 8 seconds.

Typical operating ratings are:

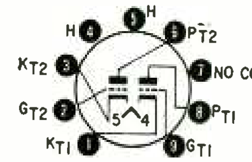
V_P	70
V_G supply	0
R_G (ohms)	47,000
μ	68
R_P (approx ohms)	5,440
gm (μmhos)	12,500
I_P (ma)	7

Maximum grid circuit resistance:

For fixed-bias operation (megohm)	0.5
For cathode-bias operation (megohms)	2.2

6GF7, 10GF7, 13GF7

A series of novar dual-triodes with dissimilar units for vertical amplifier and vertical oscillator circuits in TV receivers with 110° picture tubes.



6GF7, 10GF7, 13GF7

Maximum ratings of these RCA tubes are:

	6GF7	10GF7	13GF7
V_{htr}	6.3	9.7	13
I_{htr} (ma)	985	600	450
Warmup time (seconds)	—	11	11

Section 1 when used as a vertical oscillator stage:

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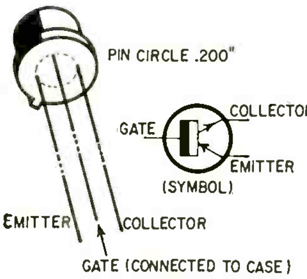
V_P	330
V_G (peak neg pulse)	400
I_K (peak ma)	77
average ma)	22
P_P (watts)	1.5

Section 2 when used as a vertical output stage:

V_P	330
V_P (peak pos pulse)	1,500
V_G (peak neg pulse)	250
I_K (peak ma)	175
(average ma)	50
P_P (watts)	11

2N2260

A p-n-p-n germanium alloy-junction Dynaquad having bi-stable characteristics. This unit has sustaining currents between 0 and 5 ma and is designed to operate with collector currents between 7.5 and 20 ma. The unit is controlled at the gate for both turn-on



2N2260

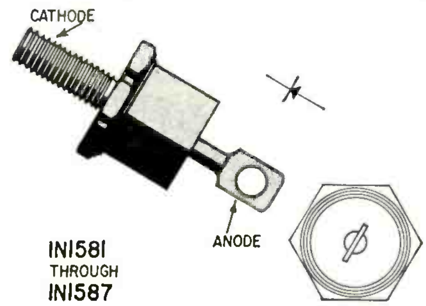
and turn-off within the stated current limits.

Maximum ratings for the Tung-Sol 2N2260 are:

BV_{CGO} (collector-to-gate voltage)	30
BV_{EGO} (emitter-to-gate voltage)	30
BV_{CES} (collector-to-emitter voltage)	30
I_C (collector current, ma)	200
P_O (collector dissipation, mw)	150

1N1581 through 1N1587

A series of diffused-junction silicon power rectifiers designed for use where high ambient temperature, small size and high efficiency are vital. Besides direct use in power rectifier circuits, they



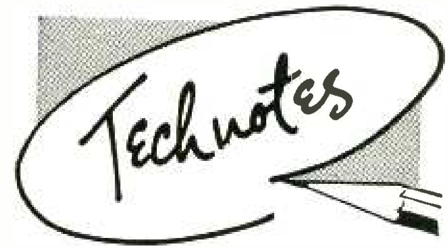
1N1581 THROUGH 1N1587

are useful in magnetic amplifier and dc blocking circuits.

Maximum ratings for these Bendix diodes are:

	1N1581	1582	1583	1584
PRV (dc)	50	100	200	300
RMS (ac)	35	70	140	210
I_{surge} (amps)	15	15	15	15
	1N1585	1586	1587	
PRV (dc)	400	500	600	
RMS (ac)	280	350	420	
I_{surge} (amps)	15	15	15	

END



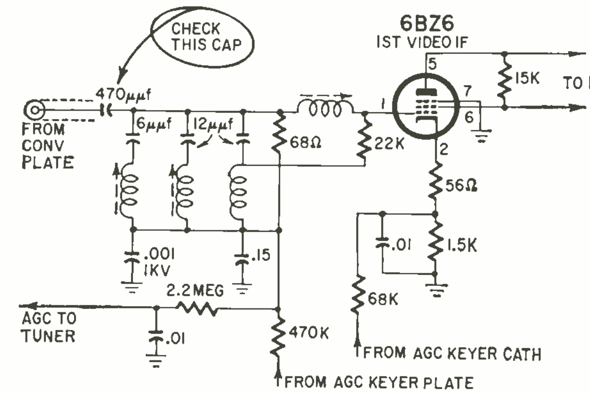
Reversed Polarity

Here is something to watch for in these days of automobiles with different battery polarities.

A 1958 Oldsmobile with a custom Delco radio came in with a complaint of a dead radio. A blown A-lead fuse was replaced but the radio still did not work. An in-car check of aerial, speaker and tubes proved nothing. Upon removal and testing on bench, with negative lead connected to case, the radio worked OK. The customer agreed to leave the set until we found the apparently intermittent trouble. After a week of testing we found nothing, and when the radio was replaced in the car it still was dead. Measuring at car's A-lead we found 12 volts, but the polarity was wrong for this type of car. After quizzing the owner, we learned the voltage regulator had been replaced about the time the radio quit. The wrong type had been used and the garage had turned the battery around for some reason. The generator had reversed its polarity to suit and the rest of the car equipment was not affected. Installing the proper regulator and reversing the battery again cleared up the radio trouble.—*V. L. Johnson*

Zenith Chassis 19A20

Complaint: No agc action. Agc can be set for good reception of strong or weak signals, but not for both. Voltage on the agc line varies normally as agc is operated, appar-



ently indicating trouble in the agc keyer circuit.

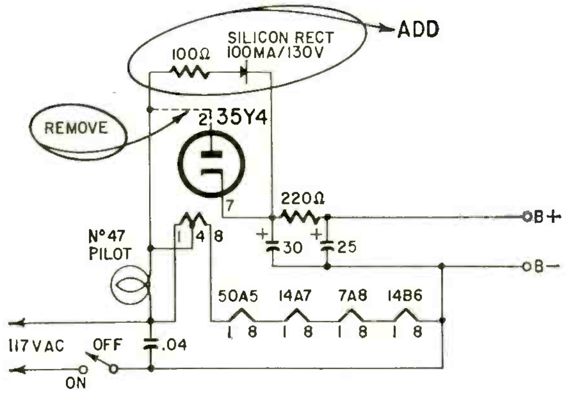
Cure: If voltage on the agc tube plate varies with signal strength, but voltage on the agc line does not vary, check the 470-μμf disc ceramic between the converter plate and first i.f. grid for leakage. This capacitor is located on the i.f. coil close to the first i.f. tube. If it is leaky, the agc line will become more positive when the first i.f. tube is pulled. (Because of the delayed tuner agc circuit in this set, the agc line is normally about 22 volts positive. The cathode of the first i.f. stage is at about 24 volts, and the second i.f. is connected in series for dc with the first.)—*W. J. Stiles*

Philco 49-505

This set uses loctal tubes. They are nearly impossible to obtain in our rural community so I don't like to see these sets come in for repairs.

The 50A5 power output tube was bad so I changed the socket to an octal type and plugged in a 50L6-GT. This put the set into operation, but it was weak on all stations. When I checked the B-plus, it measured only 42 volts. Further checking confirmed that the 35Y4 rectifier was weak. Getting a new tube would have taken a few days. Changing the socket was a 1-hour job at best.

Suddenly a happy thought—why not use a silicon rectifier? The tube was left in the socket to take care of the heater string and pilot-light voltage. The lead represented



by the dotted line from pin 4 to pin 2 was removed. The silicon rectifier was connected in series with a 100-ohm 1-watt resistor from pin 1 to pin 7. The 100-ohm resistor acted as a surge current limiter and also lowered the B-plus to its original value (there's less of a voltage drop through a silicon rectifier).—*James A. Fred*

Intermittent CRT Heater

Picture and raster brightness varied from normal to nothing, usually fading as the set warmed up. With the picture very faint, the set was turned off. The picture-tube heater was checked with an ohmmeter after disconnecting the tube socket. It read 25 ohms instead of the normal few ohms. Resoldering the picture-tube heater pins cured this intermittent trouble. Crimping these pins would probably be a better procedure.—*Harold Blackstone*

Hum Modulation in AM Radio

A fairly common fault in ac–dc radios is hum which cannot be attributed to conventional causes. The type of hum referred to is (mostly) evident only on strong stations.

Part of the radio signal enters the receiver through the power line. The nonlinearity of the rectifier then mixes this signal with the 60-cycle line frequency and produces sidebands.

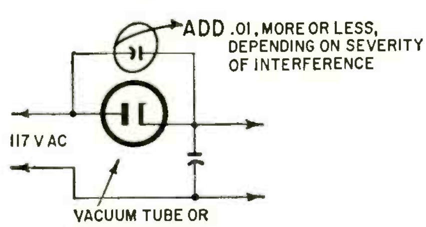


Fig.1

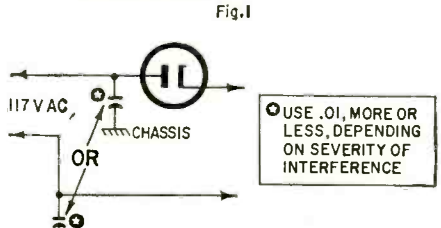


Fig.2

The diagrams show two simple ways of eliminating the problem. In the first and usually best method (Fig. 1), the capacitor shorts out the nonlinearity of the rectifier for radio frequencies. In the second method (Fig. 2), the signal on the line is prevented from reaching the rectifier. For the latter, the side of the line the capacitor must be connected to is determined experimentally.—*Stanley E. Bammel.* END

Improving Aquadag Contact

Occasionally the Aquadag coating on a CRT chips away where the grounding spring makes contact, causing arcing and picture interference. A simple repair is to place a small wad of aluminum foil between the Aquadag coating and grounding spring. This will greatly increase the contact area on the coating and restore good contact with a minimum of effort.—*Albert J. Krukowski*

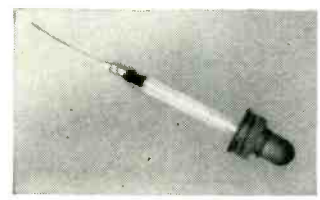
Quick Connects

Quick-separating connectors are handy, but can be expensive. Auto supply stores often have the type of connector shown at a price that makes its use permissible. The ¼-inch plug connector is trademarked Lynn No. 3401 or No. 3701 or AMP No. 30202. The socket connector is Lynn No. 3402. Generally displayed in boxes of 30 connectors, their list price is $1. If a crimping tool is not available, use diagonal cutters, making two crimps. The newly made connection can also be protected

by an accordion type of spark-plug protector.—*I. C. Chapel*

Special Dropper

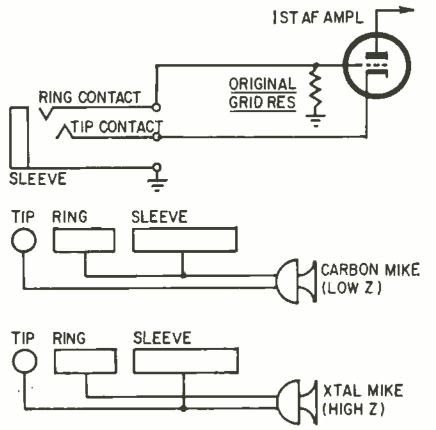
Many chemicals affect the rubber bulb used with needle applicators. By enlarging the hole inside the needle cap it is possible to insert a glass eye-dropper tip and attach it with a cement that is not soluble by the chemical used in



the dropper. Glyptal has held this one together for many years before epoxy-resin cements were available. Several applications of cement may be necessary for an air-tight joint. The glass body makes the quantity of fluid used visible, eliminating guesswork in some applications.—*Elmer C. Carlson*

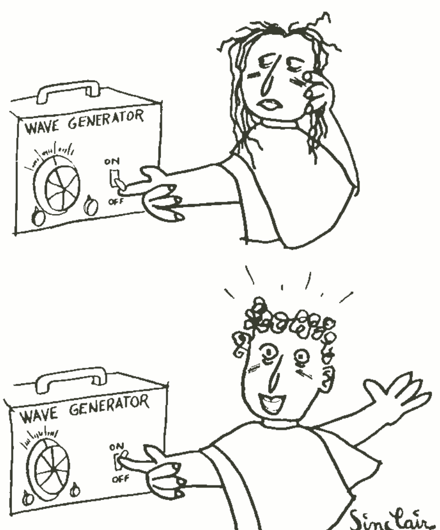
A Universal Microphone Jack

Here is a simple but effective modification for almost any piece of communications gear—such as Citizens-band equipment and ham transmitters—that uses a crystal, ceramic, dynamic or carbon microphone. By replacing the existing microphone connector with one of the three-conductor types such as the



Mallory 702B or the Switchcraft 12B, high- or low-impedance microphones can be used as desired. Use Switchcraft 260 phone plugs for the microphones.

The modification outlined was made on a popular Citizens-band transceiver with the result that a good-quality crystal mike can be used at the base station, and a rugged Army surplus mike when operating mobile or portable. Percentage of modulation seems to be the same in either case.—*Irwin Math*



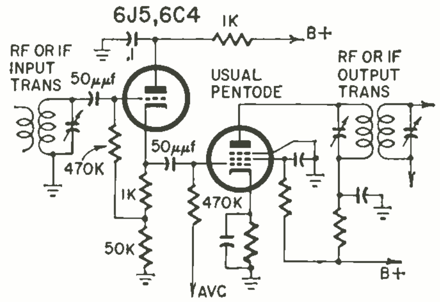
NOTEWORTHY CIRCUITS

Stable I.F. Amplifier Circuit

This circuit was developed to obtain maximum gain from narrow-band rf and i.f. amplifiers. In the conventional amplifier, gain is often deliberately reduced to eliminate instability caused by feedback between the output and input tuned circuits through interelectrode and stray wiring capacitances. Stray capacitance should be minimized by careful design and construction.

The diagram shows how I use a cathode follower to prevent the energy fed through the tube's plate-to-grid capacitance from reaching the tuned input circuit and causing oscillation or regeneration. Also, it prevents the applied avc from having a detuning effect on the input transformer.

The circuit is not critical and can be used wherever instability cannot be eliminated without reducing circuit gain. The cathode follower may be a 6J5, 6C4 or the triode section of a triode-pentode such as the 6CM8 or 6CU8. Lay out the circuit to keep input and output leads short and to minimize coupling between the input and output circuits. Avoid overly compact or min-

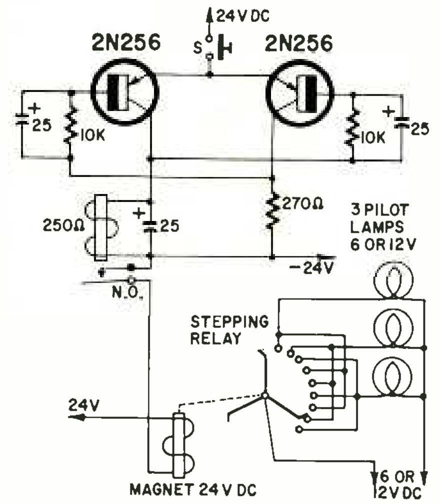


iaturized construction. Use ample decoupling as shown to eliminate interaction between stages.—*Charles Erwin Cohn.* END

Electronic Shell Game

The electronic flasher circuit on page 43 of the September 1961 issue can be used as an industrial scanner by replacing one of the lamps with a relay and the other by a resistor (or another relay). The relay drives a stepping relay, scanning as many points as there are on the stepper.

The circuit is shown with a 24-volt supply and a small aircraft type 250-ohm relay substituted for one of the flasher lamps. With a 24-volt supply, the relay operates at about two steps per second. Lowering the supply voltage increases the stepping speed.

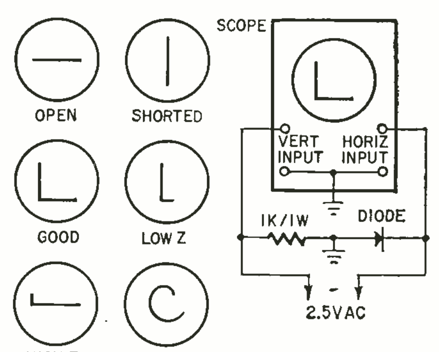


Another use for the circuit is the old "shell" game. When the pushbutton switch is closed, the relay can be stepped for an indefinite time and then stopped. With the lamps wired as shown and hidden from view, the players guess which shell covers the lighted lamp. The game becomes more difficult when the lamps are wired in some odd sequence.—*Tom Jaski*

Simple Diode Tester

Here is a quick and easy method of checking diodes with a scope. All you need is one resistor, test leads and a source of around 2.5 volts ac. You can check diodes for open and short circuits, high and low impedance, and ability to rectify. You can use this method to match diodes for critical applications.

The technique is simple and accurate. The ac voltage may be obtained from a filament transformer or a tube checker. The load current is low so the size of the transformer is unimportant. The diagram shows the setup. The scope is set for external sweep.



Typical waveforms are shown. You can calibrate with a diode known to be good but, generally, the scope's horizontal and vertical input attenuators should be set for identical deflection ranges—usually about one-fourth of maximum.
—*M. Lerman* END

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RADIO AND ELECTRONIC LABORATORY HANDBOOK (seventh edition of Radio Laboratory Handbook), by M. G. Scroggie. *Iliffe Books Ltd., Dorset House, Stamford St., London, England. 5½ x 8½ in. 537 pp. 55 shillings.*

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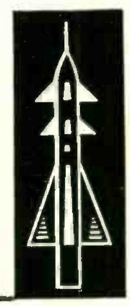

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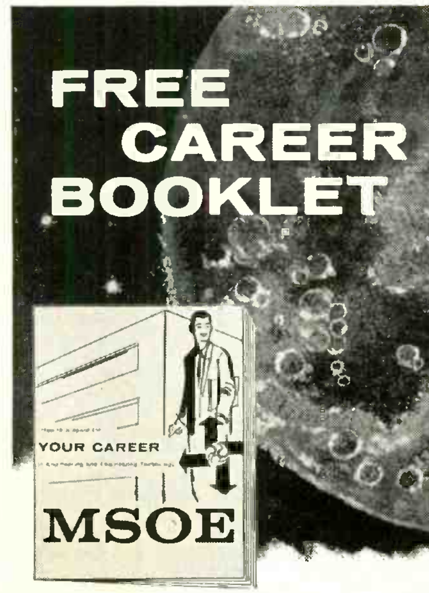

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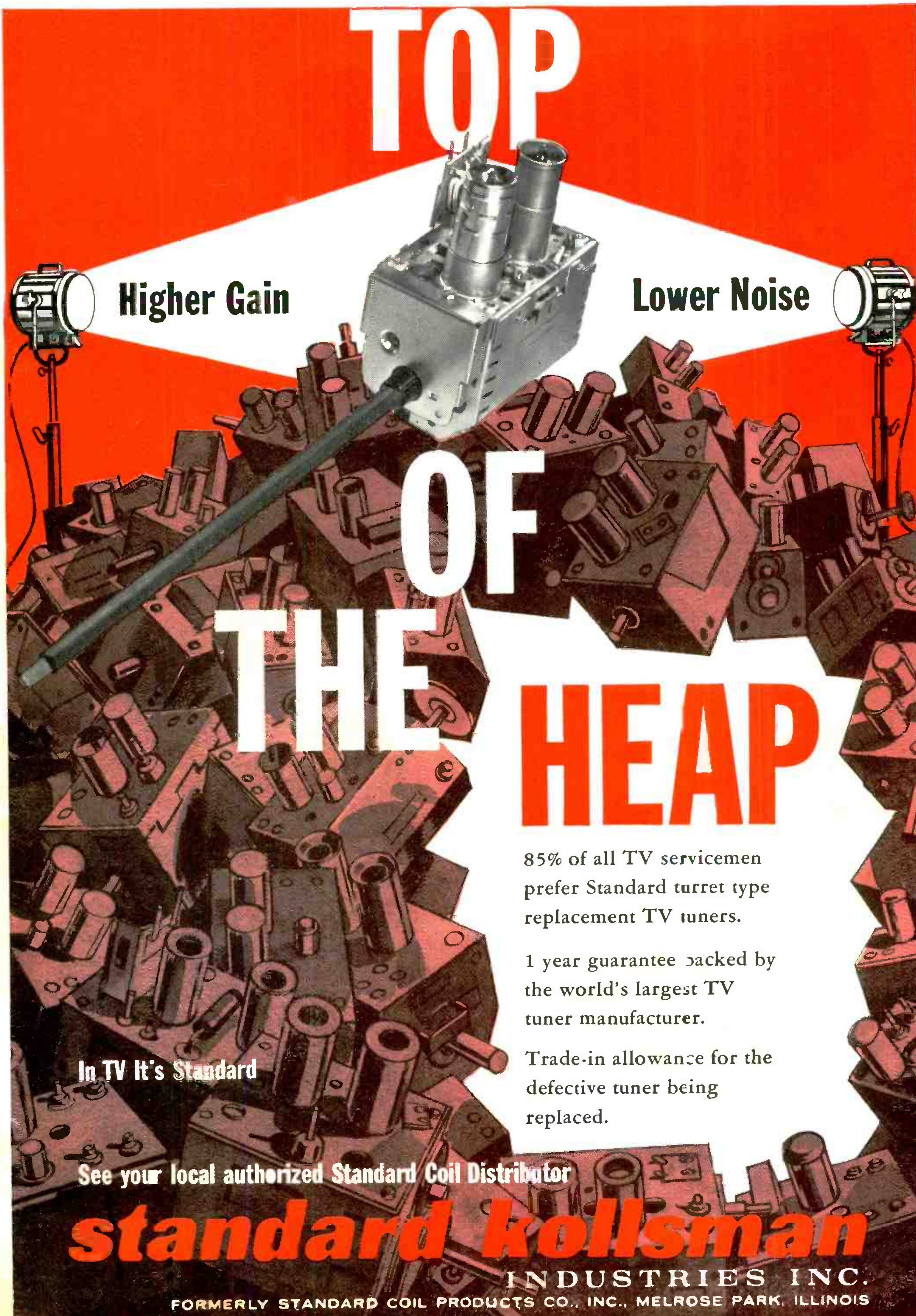

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