APRIL 1960
IND

Radio-Electronics

Static Electronic Controls in Industry

HUGO GERNSBACK, Editor

Archimedes' Screw Antenna

See page 49

Using Audio Transformers

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Transistorized Photoflash Gun

50c

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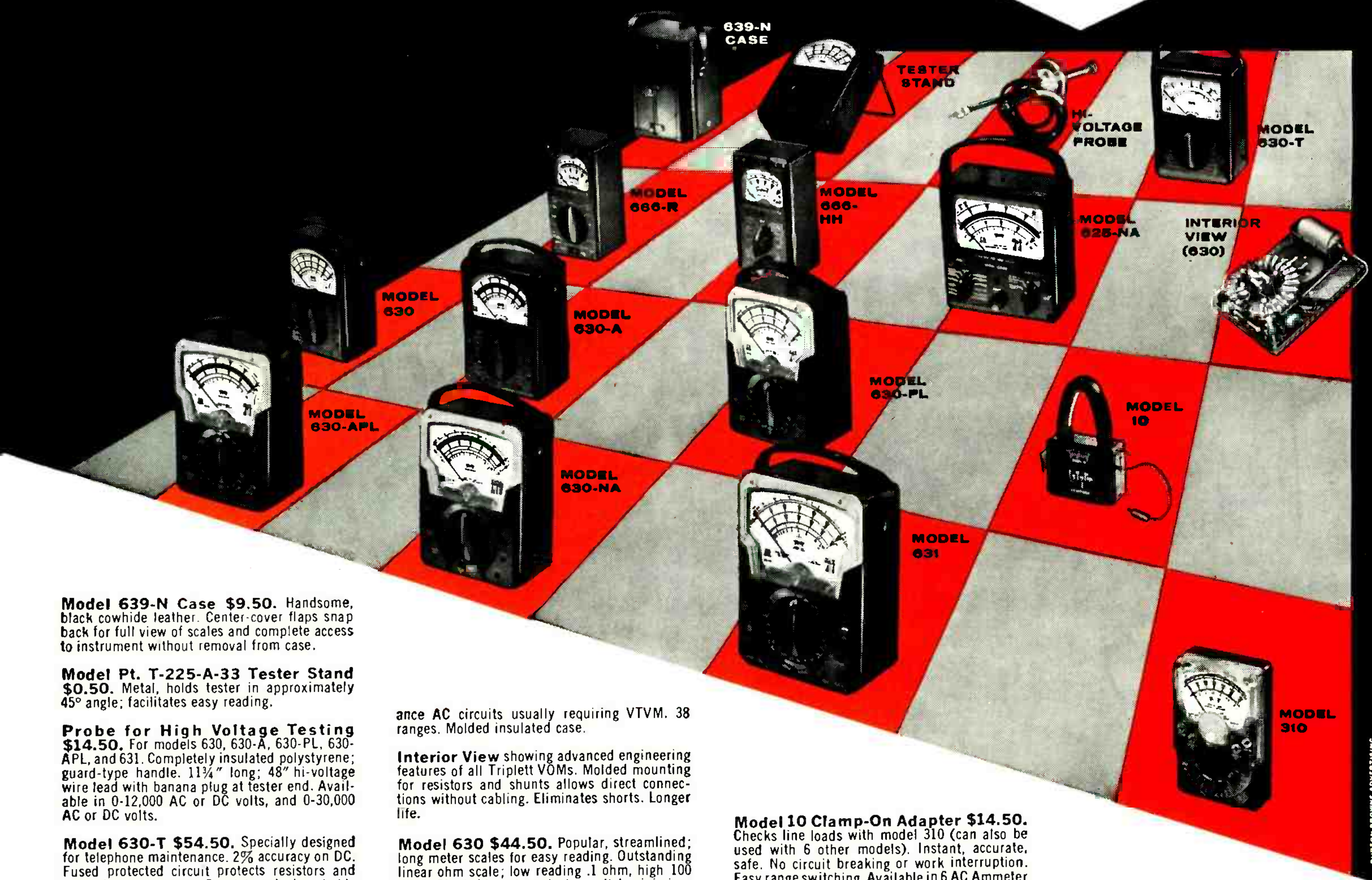

Model 639-N Case $9.50. Handsome, black cowhide leather. Center-cover flaps snap back for full view of scales and complete access to instrument without removal from case.

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

Probe for High Voltage Testing $14.50. For models 630, 630-A, 630-PL, 630-APL, and 631. Completely insulated polystyrene; guard-type handle. 11¾" long; 48" hi-voltage wire lead with banana plug at tester end. Available in 0-12,000 AC or DC volts, and 0-30,000 AC or DC volts.

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

Model 666-R Pocket VOM $29.50. Hand size, ideal for electrical maintenance. With recessed range knob it fits easily into case. AC rectifier pre-calibrated unit for easy replacement. Banana jacks at panel top prevent leads falling over meter dial. Single king-size selector switch minimizes incorrect settings, burnouts. 20 ranges. Molded case streamlined, fully insulated.

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

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

Interior View showing advanced engineering features of all Triplett VOMs. Molded mounting for resistors and shunts allows direct connections without cabling. Eliminates shorts. Longer life.

Model 630 $44.50. Popular, streamlined; long meter scales for easy reading. Outstanding linear ohm scale; low reading .1 ohm, high 100 megs. Single king-size selector-switch minimizes incorrect settings, burnouts. High sensitivity: 20,000 ohms per volt DC; 5,000 AC. Molded, fully insulated case.

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

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

Model 10 Clamp-On Adapter $14.50. Checks line loads with model 310 (can also be used with 6 other models). Instant, accurate, safe. No circuit breaking or work interruption. Easy range switching. Available in 6 AC Ammeter ranges: 0-6-12-30-60-120-300. Clips around single wire to read AC. Amperes direct. Use with adapter 101 to instantly divide 2-conductor cords. Molded case fully insulated, black plastic with engraved white markings.

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

Model 630-NA $74.50. Super DeLuxe with 70 ranges—nearly double conventional types. Frequency compensated from 35 cps to 20 kc. Temperature compensated. Accurate within 1½% full scale reading on DC. Large open front meter easy to read. Unbreakable window. Mirrored scale. Meter protection against overloads. Molded fully insulated case.

Model 631 Combination VOM and VTVM $64.50. Two fundamental units at the price of a single tester. The No. 1 instrument for all electronic men. Battery operation assures VTVM stability and long life. Sensitivity PLUS. 1.2 volt (VTVM) range is equal to more than nine million ohms per volt. Large easy to read meter with unbreakable face. Single king-size selector switch minimizes incorrect settings, burnouts. Molded case fully insulated.

Model 310 $34.50. The only complete miniature VOM with 20,000 ohms per volt and selector range switch. Self-shielded against strong magnetic field. Rugged, high torque, barring instrument. Unbreakable plastic meter window. Converts to common probe—frees one hand—by fitting interchangeable test prod into top. Standard sensitivity 20,000 ohms per volt DC, and 5,000 ohms per volt AC. Accuracy 3% DC. Molded fully insulated case.

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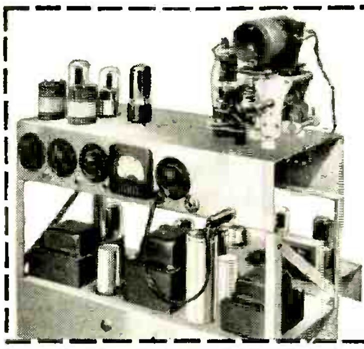

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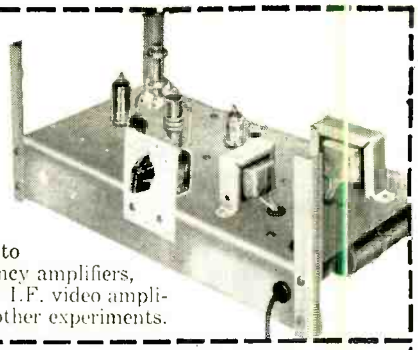
As part of N.R.I. Communications Course you build this low power Transmitter; use it to learn methods required of commercial broadcasting operators, train for FCC license.

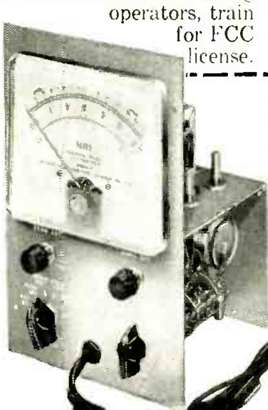
YOU BUILD Signal Generator



N.R.I. sends kits of parts to build this Signal Generator. You get practical experience, conduct tests to compensate Radio frequency amplifiers, practice aligning a typical I.F. video amplifier in TV circuit, many other experiments.

YOU BUILD Vacuum Tube Voltmeter

Use it to get practical experience, earn extra cash fixing neighbors' sets in spare time, gain knowledge to help you work in Radio, Television, Color TV. With N.R.I. training you work on circuits common to both Radio and TV. Equipment you build "brings to life" things you learn in N.R.I.'s easy-to-understand lessons. 64 page Catalog FREE, shows all equipment you get.



YOU BUILD AC-DC Superhet Receiver

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Chief Engineer

"I am Chief Engineer of Station KGCU in Mandan, N. D. I also have my own spare time business servicing high frequency two-way communications systems." R. BARNETT, Bismarck, North Dakota.

Paid for Instruments

"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix car Radios for garages. I paid for instruments out of earnings." G. F. SEAMAN, New York, N. Y.

Has Own TV Business

"We have an appliance store with our Radio and TV servicing, and get TV repairs. During my Army service, NRI training helped get me a top rated job." W. M. WEIDNER, Fairfax, South Dakota.

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APRIL, 1960

Radio-Electronics

Formerly RADIO-CRAFT ■ Incorporating SHORT WAVE CRAFT ■ TELEVISION NEWS ■ RADIO & TELEVISION*

ON THE COVER

(story on page 49)

What looks like the work of Alice in Wonderland's mad haberdasher is really a modified helical antenna, designed at ITT Laboratories, Nutley, N. J., and modeled as an example of what the smart Martian might be wearing. It was adapted for use in a classified radio communication program underway at the research center. The comely young lady is Marie Grey, draftsman at the Laboratories.

Color original courtesy ITT Laboratories

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News Briefs

Medical FM Net

Radio Corp. of America has applied to the FCC for FM frequency assignments for a medical network. Two types of programs have been planned. One will be heard in the doctor's outer office and will consist solely of background music. The second program will be heard only in the inner office and will have 36 minutes a day of medical news and about 10 minutes of advertising. The program, it was said, will give physicians easier access to medical news and information.

New Prefixes

The National Bureau of Standards and the International Committee on Weights and Measures have adopted four new prefixes. These prefixes, in common use in Europe, are: *tera*, meaning trillion; *giga*, meaning billion; *nano*, billionth, and *pico*, trillionth. Sample uses of the prefixes are: 1 terawatt or 1,000,000,000,000 watts; 5 gigavolts or 5,000,000,000; 3 nanoamperes or .000,000,003 ampere; 7 picofarads or 7 micro-microfarads or .000,000,000,007 farads. These prefixes now become part of the list of prefixes in more common use which include micro, mega, kilo and milli.

Cleveland Ham Wins Edison Award

Walter Ermer, Sr., has been awarded the eighth annual Edison Radio Amateur Award for public service. General Electric Co., who sponsors the award, selected Ermer, W8AEU, as the ham with the most outstanding public service record for last year. He organized and directed a 300-man voluntary emergency radio communications corps which served his home city, Cleveland, Ohio, on 23 occasions last year—including flood and storm alerts and searches for lost children. He will receive a trophy and $500. The photograph shows Ermer and Police Lieut. Michael Roth, K8KNJ.

Long Telephone Cable

A new pair of telephone cables now connects West Palm Beach, Fla., and San Juan, Puerto Rico. The system, 1,250 land miles long, was built by American Telephone & Telegraph Corp. and Radio Corp. of Puerto Rico, a subsidiary of International Telephone & Telegraph Corp. (ITT). The system has 59 amplifiers. Each amplifier contains 3 tubes and 60 other components. The units, spaced about 44 miles apart, amplify voice currents about 1,000,000 times. About 1,500 volts are required at each end to operate the system. The cables can carry 48 two-way phone calls at one time.

New products for portable TV?

Two components, which rumor says are soon to appear, may make portable TV better and should revolutionize the picture-tube and battery business.

The first is a picture tube with a solid-state emitter. The cathode and heater of standard types are eliminated, and a little block of a semiconductor material fills the gap. When 25 ma at 6.3 volts is fed through it, enough electrons are supplied to put a picture on the screen. High voltage for the 8-inch version runs 7,000 volts. The peak-to-peak video driving signal is 20 volts. A 118° deflection angle makes for a very short tube indeed. G-E and Sonotone are said to be dickering for this Japanese-built prize.

Another item portable TV manufacturers want is a battery being developed by a leader in this field. The silver–mercury cell, said to be in late stages of production and expected on the market in about 6 months, combines the best features of mercury and nickel–cadmium types. It has the capacity of a mercury cell and the rechargeability of nickel–cadmium.

A simple comparison shows its ability. A rechargeable nickel–cadmium battery rated at 1,000 ma hours is the same size as a mercury battery that has a 2,400-ma-hour rating. The same size in a silver–mercury battery is rated at 2,000 ma hours and can be recharged as often as a nickel–cadmium cell. In Philco's portable TV (they are a prime bidder for the new battery), it would last twice as long as the one now used—8 hours without recharging instead of the present 4-hour limit.

Stereo Committee Out

The FCC rejected a request by the National Stereophonic Radio Committee to sponsor its reorganization. The Committee, set up by the electronics industry to test and evaluate stereo radio systems, has been forced to disband.

South Africa Wants TV

The TV Society of South Africa has been formed to fight the Government's anti-TV policy. The Government feels that TV would be detrimental to children and "the less developed races." The society intends to get one-half million signatures on a petition for TV and submit it to the government. The *London Observer* reports that "tests have been made by the South African Broadcasting Corp. that would enable TV to be speedily introduced if the (South African) Cabinet were to sanction it."

Radio-Wave Duct

Experiments on a frequency of 220 mc confirmed the existence of a radio-wave duct between the West African coast and Brazil. From ground level to 5,000 feet, the air temperature gradually drops. At about 5,000 feet there is a sharp rise in temperature. About 500 feet above this level, the temperature drops sharply again. This creates two re-let DeVry train your **Handy Hands**

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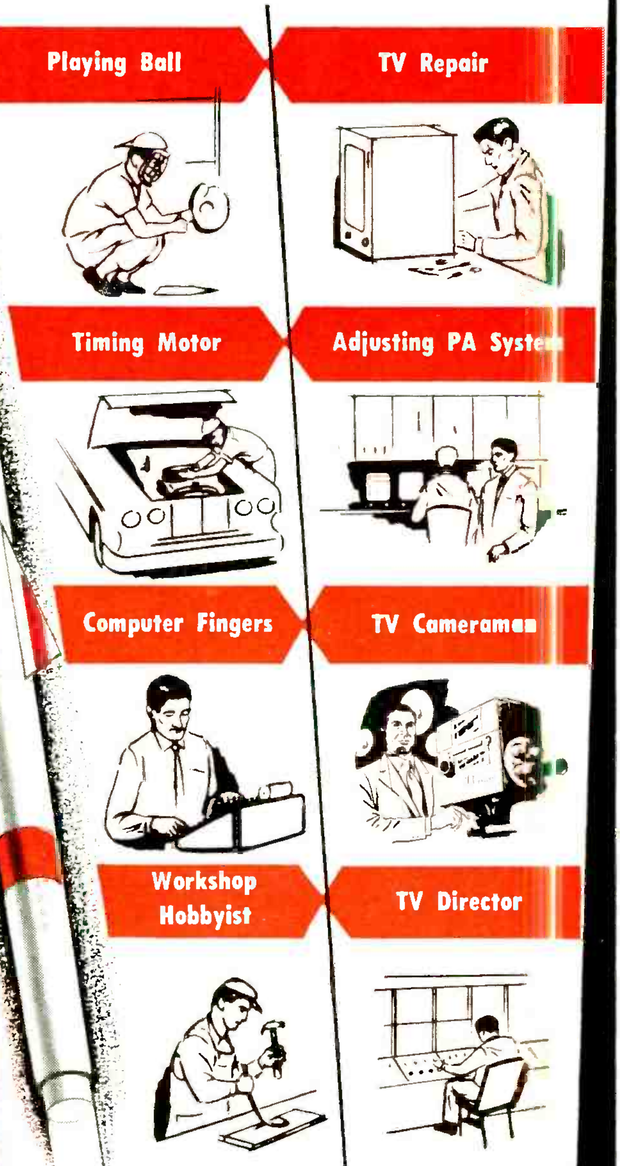

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2073 Canadian residents: Write DeVry Tech of Canada, Ltd., 626 Roselawn Ave., Toronto 12, Ontario flecting surfaces for radio transmission. This duct carried a 100-watt signal from a Navy airplane over Brazil to another plane 1,430 miles away. It is believed that there might be three other ducts, one each in the North Atlantic, North Pacific and South Pacific areas.

TV Production Up

Manufacturers produced 6,349,380 TV sets in 1959 as compared with 5,748,676 sets in 1958, according to figures released by the Electronics Industries Association. Also up were radio production and TV sales. There were 15,622,357 radios produced in 1959, as against 11,817,243 in 1958. Stereo phonographs outsold monaural phonographs; stereo, 2,744,720; monaural, 1,653,137.

Channel Allocation

The FCC is considering five plans for TV channel allocation, according to a statement by Commission Chairman John C. Doerfer, before The Senate Interstate Commerce Committee. They are: a 50-channel vhf system keeping the present 12 vhf channels; a continuous 50-channel vhf system keeping channels 7 through 13 and removing channels 2 through 6 from use; a continuous 25-channel vhf system keeping channels 7 through 13; a 70-channel all-uhf system; the present 82-channel vhf-uhf system. The commission has presented Congress with the draft of a bill that will enable it to set minimum standards for TV set reception. They claim the bill is important to the success of any plan they adopt for channel allocation.

Police-Car Bugs

Some New York City police cars have "bugs" in them. The "bugs" are small tape recorders that go on when the car's transmitter is turned on. The department is using them in an attempt to find out which of the patrolmen in the cars sing or yodel or use improper language on the air.

Japanese Make Transistor TV

Transistor TV set from Japan may provide competition for Philco, Emerson and others with an 8-inch screen. Weighing 23 pounds, and 6¼ x 8 x 8¾ inches overall it operates from a 12-volt rechargeable battery or house ac power supply. Price has been tentatively set at near $200, but is expected by the producers, Sony Corp., to drop at least 10% after about a year. It has 23 transistors, 14 diodes and a whip type antenna.

Rapid Air Photos

CBS Laboratories have announced the development of a system that can take an aerial photo and relay it to a ground station in about 2 seconds. The system, called Photoscan, produces a picture made up of

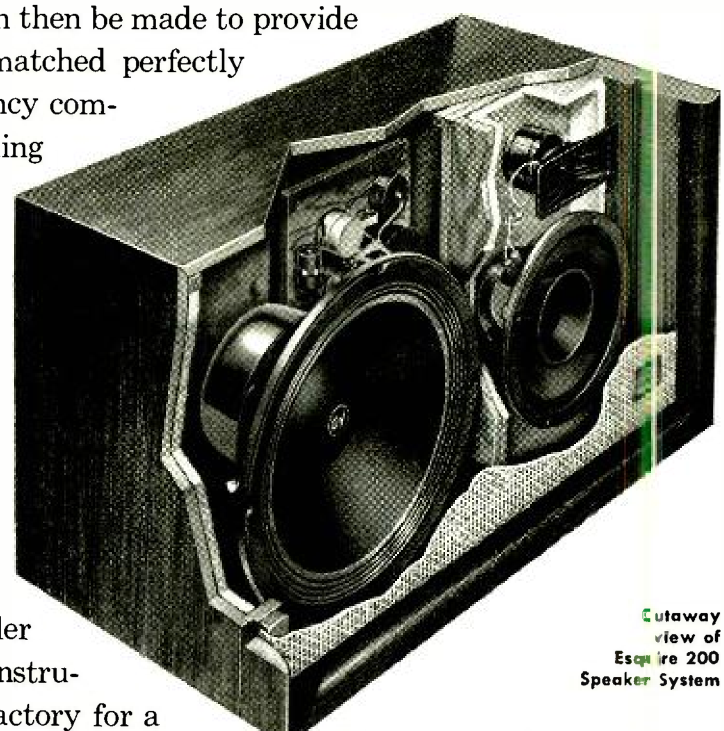
It is an axiom in high fidelity that no single speaker is capable of ideally reproducing the entire musical range of a symphony orchestra. At least two speakers, each specifically designed to reproduce a part of the sound spectrum, are needed to do a really adequate job.

ELECTRO-VOICE ULTRA-COMPACT SYSTEMS OFFER MORE THAN JUST BASS RESPONSE

Ultra-compact systems are no exception to this rule. This is why two year's research went into the development of Electro-Voice's new ultra-compact line. In its tradition of providing the finest, Electro-Voice would not introduce a system in which only the bass speaker and enclosure had been engineered to the special requirements of the compact system. Each component within that enclosure had to be designed to make certain it was a perfect match to the other elements in the system. Laboratory measurements and exhaustive listening tests had to be coordinated and differences resolved. The result of these efforts can now be heard from the new Leyton, Esquire 200, Regal 300, or Royal 400. These speaker systems produce bass of astounding definition and solidity, clear undistorted treble, and remarkable brilliance in their upper ranges.

One of the key factors in producing this purity of sound was the judicious choice of crossover points, restricting each of the specially designed speakers to cover only the range over which its performance is most perfect. In all models, for example, the crossover from woofer to mid-range occurs at 200 cycles per second. With this degree of specialization, all forms of distortion are held to the lowest levels possible. Operating below 200 cycles, the bass speaker is not required to reproduce any of the mid-range spectrum and can act as a true piston. The specially designed mid-range speaker can then be made to provide exceptionally flat response, with its level matched perfectly to that of the woofer. The very-high-frequency compression driver faces only the necessity of adding "sparkle", and dispersing high-frequency sound throughout the room. The result is a clarity and definition of sound that can best be described as transparent — enabling you to feel the deepest bass, marvel at the effortless clarity in the mid-range, and delight in the brilliant definition of the upper harmonics.

Whether you intend to purchase a new high-fidelity speaker system now or later, we urge you to visit your Electro-Voice dealer for a demonstration of these remarkable instruments. You may also write directly to the factory for a complete description of these new units. Ask for High-Fidelity Catalog No. 137.



Cutaway view of Esquire 200 Speaker System

Mahogany, Limed Oak, or Walnut... $123.00
Unfinished Birch................ $111.00

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NEWS BRIEFS *(Continued)*

about 120,000,000 elements as compared with the 250,000 elements of a TV picture. A camera takes a picture, the film is automatically and rapidly developed, and then moves before a special tube. This Line Scan Tube shines a small spot of light on the photo. A photomultiplier tube behind the film converts the varying amounts of light that pass through the film into a varying electrical current. This current modulates a radio signal to the ground station.

Calendar of Events

Nuclear Congress, April 3–8, New York Coliseum, New York, N.Y.
Spring Technical Conference on Electronic Data Processing, Apr. 12–13, Hotel Alms, Cincinnati, Ohio.
Conference on Automatic Techniques, April 18–19, Sheraton Cleveland Hotel, Cleveland, Ohio.
Symposium on Active Networks and Feedback Systems, April 19–21, Auditorium of Engineering Societies Bldg., New York, N.Y.
Southwest IRE Regional Conference and Electronics Show, April 20–22, Shamrock-Hilton Hotel, Houston, Tex.
PACE Annual Meeting, April 29–May 1, Nevele Hotel & Country Club, Ellenville, N. Y.
Semiannual Convention of Society of Motion Picture and TV Engineers, May 1–7, Ambassador Hotel, Los Angeles, Calif.
National Aeronautical Electronics Conference, May 2–4, Biltmore & Miami Hotels, Dayton, Ohio.
URSI-IRE Spring Meeting, May 2–5, Sheraton Hotel, Washington, D. C.
Western Joint Computer Conference, May 3–5, Jack Tar Hotel, San Francisco, Calif.
National Symposium on Microwave Theory and Techniques, May 9–11, Hotel Del Coronado, San Diego, Calif.
Electronic Components Symposium, May 10–12, Hotel Washington, Washington, D. C.
Electronic Parts Distributors Show, May 16–18, Conrad Hilton Hotel, Chicago, Ill. Closed show for manufacturers, representatives, distributors. RADIO-ELECTRONICS and GERNSBACK LIBRARY will exhibit in Room 504 and Booth 588.
EIA Annual Convention, May 18–20, Pick Congress Hotel, Chicago, Ill.
IRE Regional Technical Conference & Trade Show, May 23–25, Olympic Hotel, Seattle, Washington.
Armed Forces Communications & Electronics Association Convention, May 25–27, Sheraton Park Hotel, Washington, D. C.

Details on all events supplied by sponsoring organizations.

No Station Changes

There were no changes of any kind in the TV station picture since our March report. This is the second such lull since RADIO-ELECTRONICS started recording the activity. Both occurred, incidentally, this winter.

Signal Reflected from Sun

Solar contact has been made by the Radioscience Laboratory of Stanford University. The 40,000-watt transmitter used by the group of experimenters was turned on and

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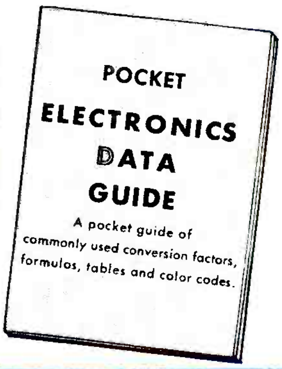

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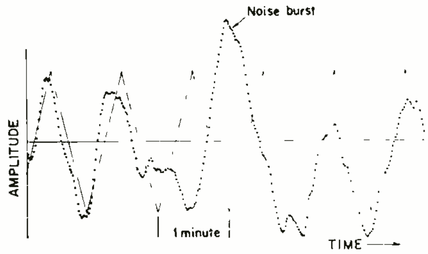

off in 30-second pulses for 15 minutes, then kept silent while waiting for the echo, due to arrive in 17 minutes from the time the first pulse was sent. The frequency used, 25.6 mc, was chosen to minimize absorption by the sun's corona.

The contacts were recorded on tape at daybreak on the mornings of April 7, 10 and 12, 1959. Months were required to separate the echoes from solar background noise, which was 50,000 times stronger.

The graph shows the solar echo by dotted line, the way the perfect echo should look by the solid line.

Ultra-Fast Computers

Dr. Peter J. Isaacs of Sperry Gyroscope Co. at the Long Island, (N. Y.) Electronic Manufacturers Council predicted that computers will be built that can handle 10,000,000 calculations a second as compared with today's 250,000 rate. He also said that if these high-speed units were put to work on weather prediction problems, computer forecasts would be available before the expected weather instead of after it.

High-Frequency Diodes

General Electric Co. has announced that its research scientists have made tunnel diodes work at frequencies above 4,000 megacycles. The diodes are made of gallium arsenide instead of silicon or germanium. Tunnel diodes, the newest solid-state device in the transistor family, have already been put on the market to original equipment manufacturers, and G-E has announced an 83% price reduction, dropping the cost to manufacturers to between $10 and $15 a diode.

Sunspot Peak Definitely Past

The sunspot maximum period, which stretched out long after its theoretical peak early in 1958, showed a clear decline in the last 3 months of 1959, sunspot activity in December being lower than at any time since early 1956. Activity remained high so long after the expected peak that for many months observers believed that the peak might be still to come. Looking back over the period since March, 1958, however, a decline can be seen. The decline was so slow that the average sunspot number for 1959 is above

(Continued on page 18)

"When we heard the Citations our immediate reaction was that one listened through the amplifier system clear back to the original performance, and that the finer nuances of tone shading stood out clearly and distinctly for the first time."

C. G. McProud, Editor, AUDIO Magazine

We know you will be interested in these additional comments from Mr. McProud's report:

Performance: "The quality of reproduction reminds us of the solidity of Western Electric theatre amplifiers of some years ago . . . The bass is clean and firm and for the first time we noted that the low-frequency end appeared to be present even at low volumes without the need for the usual bass boost."

Specifications: "Our own measurements gave IM figures of 0.35 per cent at 60 watts; .08 per cent at 20 watts, and less than .05% (which is essentially unmeasurable) from 10 watts down."

Construction: "It is obvious that considerable thought has gone into the preparation of the Citation as a kit (and) when the amplifier is completed, the user may be assured of having a unit he can be proud of . . . The kit is a joy to construct."

For a copy of Mr. McProud's complete report and a Citation catalog, write Dept. RE-4, Citation Kit Division, Harman-Kardon, Westbury, N. Y. The Citation I is a complete Stereophonic Preamplifier Control Center. Price, $159.95; Factory Wired, $249.95. The Citation II is a 120 Watt Stereophonic Power Amplifier. Price, $159.95; Factory Wired, $229.95. Prices slightly higher in the West.

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HK-30

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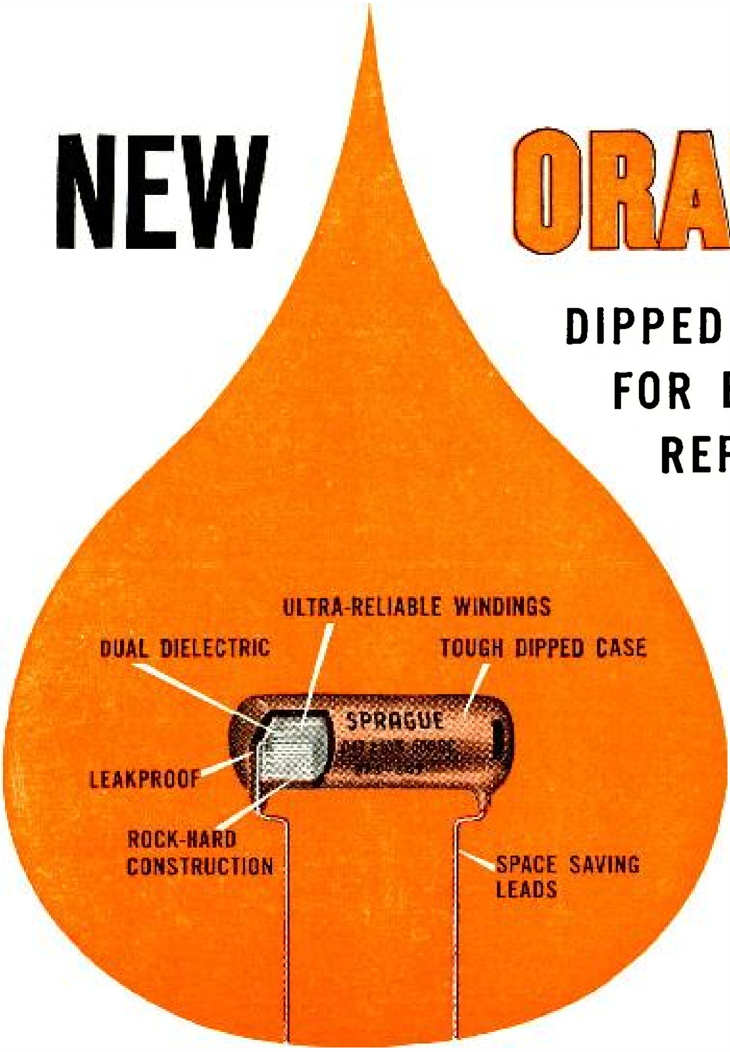

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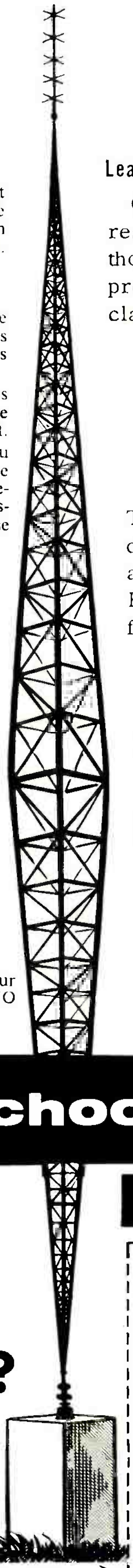

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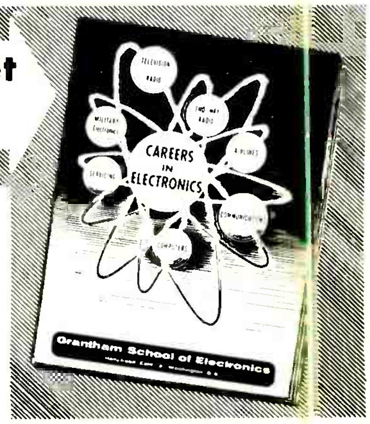

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Mario Bidese, 342 Alexander Avenue, Greensburg, Pa.	1st	12
Richard M. Wilhoit, 2104 Santa Paula, Las Vegas, Nev.	1st	12
Larry R. Perrine, 7 Normandy Place, Champaign, Ill.	1st	15
Emerson F. Lawson, 111 Excelsior Ave., Union, S.C.	1st	12
Marion Woolsey, 3246 Warwick, Kansas City, Mo.	1st	12
Harold W. Johnson, 5070 Hermosa Ave., Los Angeles, Calif.	1st	15
Arthur W. Hardy, 66 Dresser Ave., Great Barrington, Mass.	1st	12
Ralph Frederick Beisner, 2126 Grand, Joplin, Mo.	1st	12
N. B. Mills, II, 110 So. Race St., Statesville, N.C.	1st	12
Dean A. Darling, 403 S. Chase Ave., Columbus 4, Ohio	1st	12
Paul D. Bernard, 408 First Ave., N.E., Watertown, S.D.	1st	18
Gerald L. Chopp, 518 Aubudon Road, Kohler, Wisc.	1st	12

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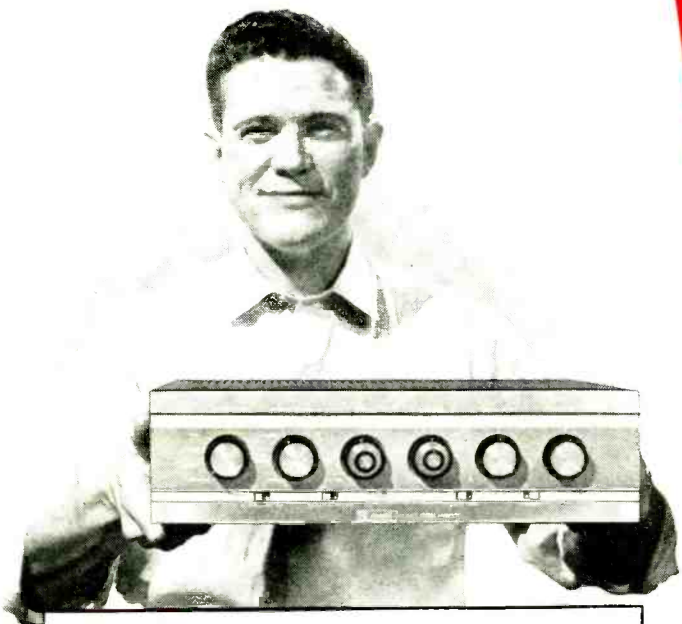

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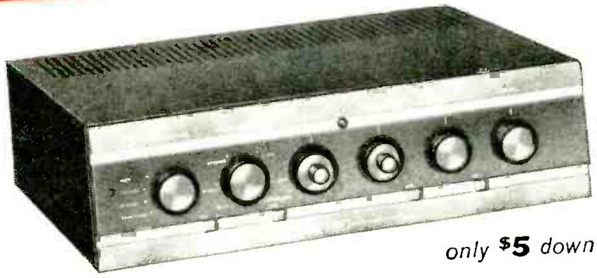

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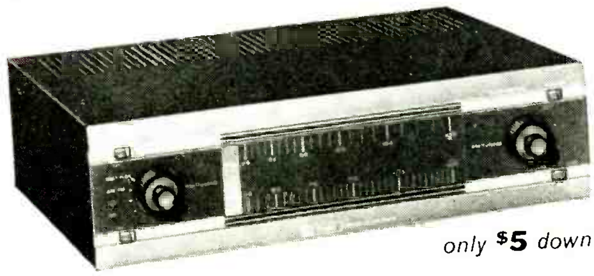

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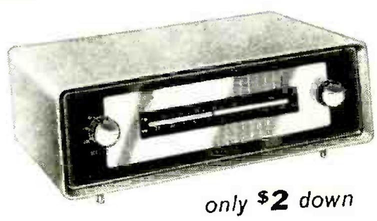

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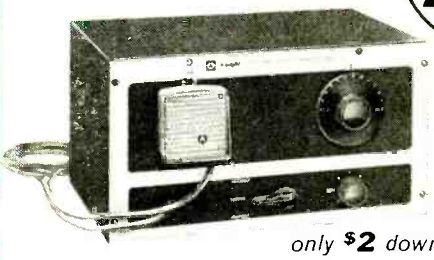

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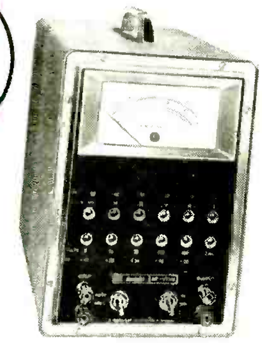

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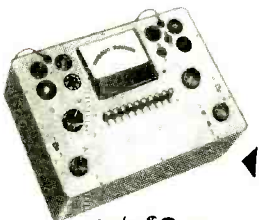

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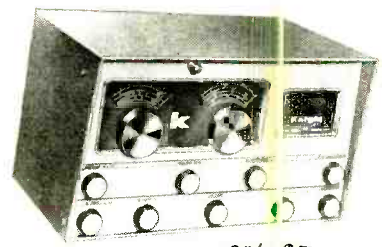

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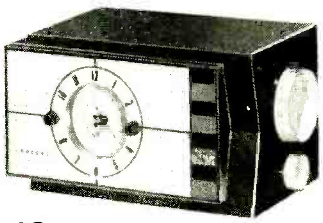

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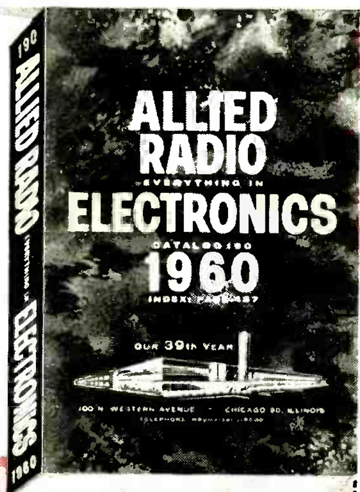

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160, higher than at the maximum of any earlier sunspot cycle.

If the present rate of decline continues, the sunspot number for 1960 is expected to be around 115, with a corresponding lowering of the maximum frequencies usable for long-distance radio communications.

Mars Technical Net

The First Army schedule for April is: April 6, "Filter Design and Applications," James L. Prather; April 13, "New Semiconductors for High Frequency Circuits," W. A. McCarthy; April 20, "Modern Trends in Electronic Instrumentation," Walter A. Knoop; April 27, "TACAN and Similar Aircraft Navigation Systems," William Loebel.

The net is on the air Wednesday at 9 pm EST on 4030 kc, upper sideband.

Arrangements are being made to set up a Second Army Technical Net in the Washington, D. C., area.

Toll TV Trial

Zenith Radio Corp. has announced it will file application for a trial run on pay-TV soon. The FCC has already set up standards for such a test, including 3-year duration, testing in only one city (which must already have four good TV signals available to viewers) and no sales of decoding equipment to the general public during the test period.

Zenith has indicated that it's prepared to meet these stiff tryout requirements, and says it'll pick one of five cities presently under consideration.

Language Experts Lacking

According to Dr. Kenneth E. Harper of U. C. L. A., there is a shortage of electronic translating-machine personnel in this country. Dr. Harper says the Soviet Union has 450 machine-translating experts compared to our 120. He also says that the Russians are working with machines that can translate 20 pairs of languages. American experts use computers to translate Russian and German to English.

Telemetered Teeth

Transmitters in teeth may enable Dr. Allen Brewer of the School of Aviation Medicine, Brooks Air Force Base, San Antonio, Tex., to learn why some people grind their teeth for several hours each night. Dr. Brewer installed tiny radio transmitters in the dentures of two people to signal whenever the person brings his teeth together or grinds them. The signals are amplified and recorded so they can be studied.

The Air Force dentist expects to install smaller transmitters in natural living teeth. He believes they may eventually reveal the cause of peridontial disease. END

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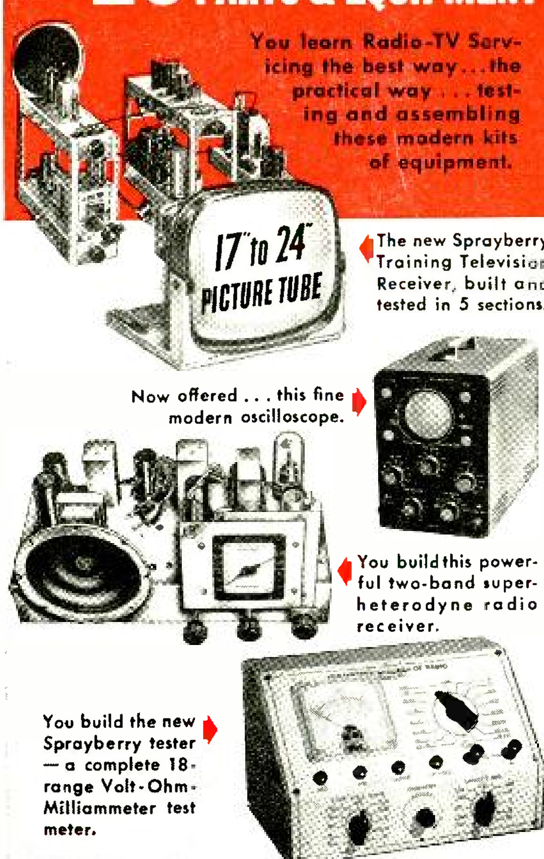

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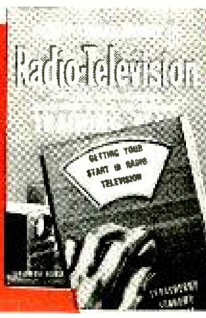

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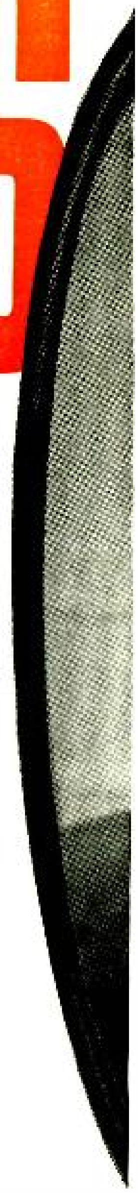

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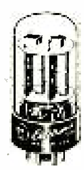

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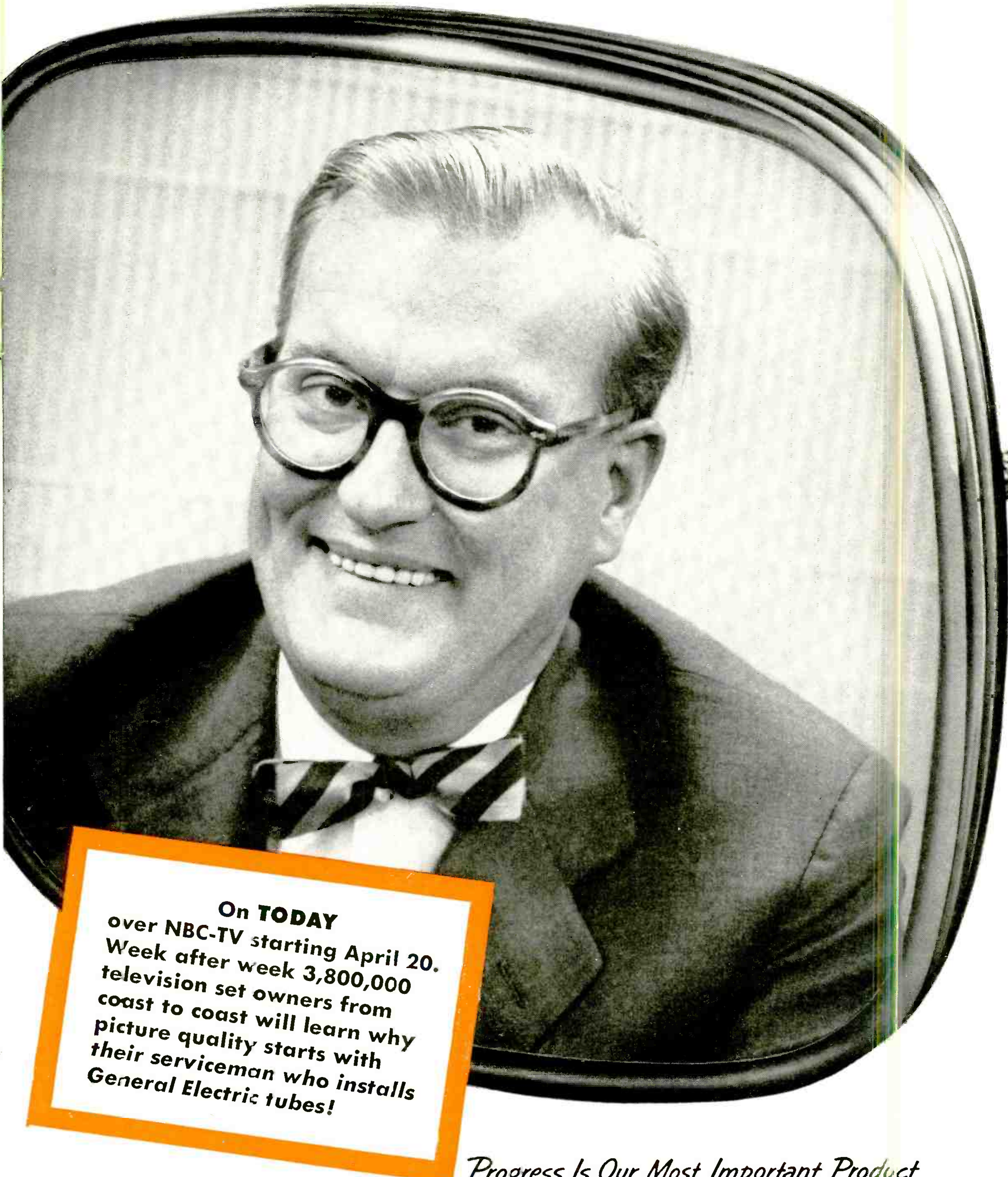

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Correspondence

VOLTAGE REGULATOR

Dear Editor:

The article "All-Transistor Voltage Regulator for Your Car" on page 107 of the February issue of RADIO-ELECTRONICS is very interesting, but a couple of points need clarification. First, on page 114, it says "the old regulator is not removed . . . because the reverse-current relay and the current regulator coil are also in the same box." This implies that the current regulator still functions, which is not the case. Since the field circuit of the generator is completely disconnected from the old rgulator, the current regulator loses control. This leaves the generator without current limitation. This might cause generator overloading in some instances and should be carefully watched. It might be necessary to put a resistance in series with the field to assure that the output current does not get out of hand when the battery charge is low. Second, the reverse-current relay can be eliminatd by connecting a suitable low-voltage silicon diode between the battery and the generator armature so that current flows from generator to battery in the forward direction. This diode must have a current rating sufficient for the generator output.

To guide the experimenter, it might be mentioned that, among American cars, Ford generators have the field grounded, while Auto-Lite and Delco-Remy generators have it connected to the armature terminal.

Another point that should be emphasized is that the new regulator box should be located in the coolest possible place for maximum reliability. Since large currents do not flow in the leads, it would be permissible to make them rather long to accomplish this. Mounting inside the passenger compartment might be desirable in some cases, of course avoiding locations near the heater.

I think that this project should give good results with the proper precautions.

CHARLES ERWIN COHN

Chicago, Ill.

HALL-EFFECT ERRATA

Dear Editor:

The article on the Hall Effect, "Something New in Semiconductors," by R. W. Crawford and N. P. Milligan, p. 105, January, contains so many serious errors that it must be rebutted.

1. Hall was not a physicist at Harvard—he was a graduate student at Johns Hopkins.

2. In paragraph 2 the authors state that the magnitude of the Hall voltage depends on carrier mobility for a given current and magnetic field. This is *not* so. The higher the mobility the greater the power available from the Hall generator.

3. In paragraph 3 the authors state that no practical devices using the Hall effect had been available until recently. Actually, one company produced *and marketed* a magnetic field Hall-effect probe over 5 years ago.

4. The authors failed to restrict their discussion sufficiently. By using the generic term "Hall-effect device," their statements become too inclusive to be correct. An example appears in paragraph 5. Here figures are given which are roughly correct for *low-impedance* Hall generators, but not correct for the high-impedance Hall-effect multiplier.

Too, there are other applications of the Hall-effect, for example, the magnetohydrodynamic generator mentioned on

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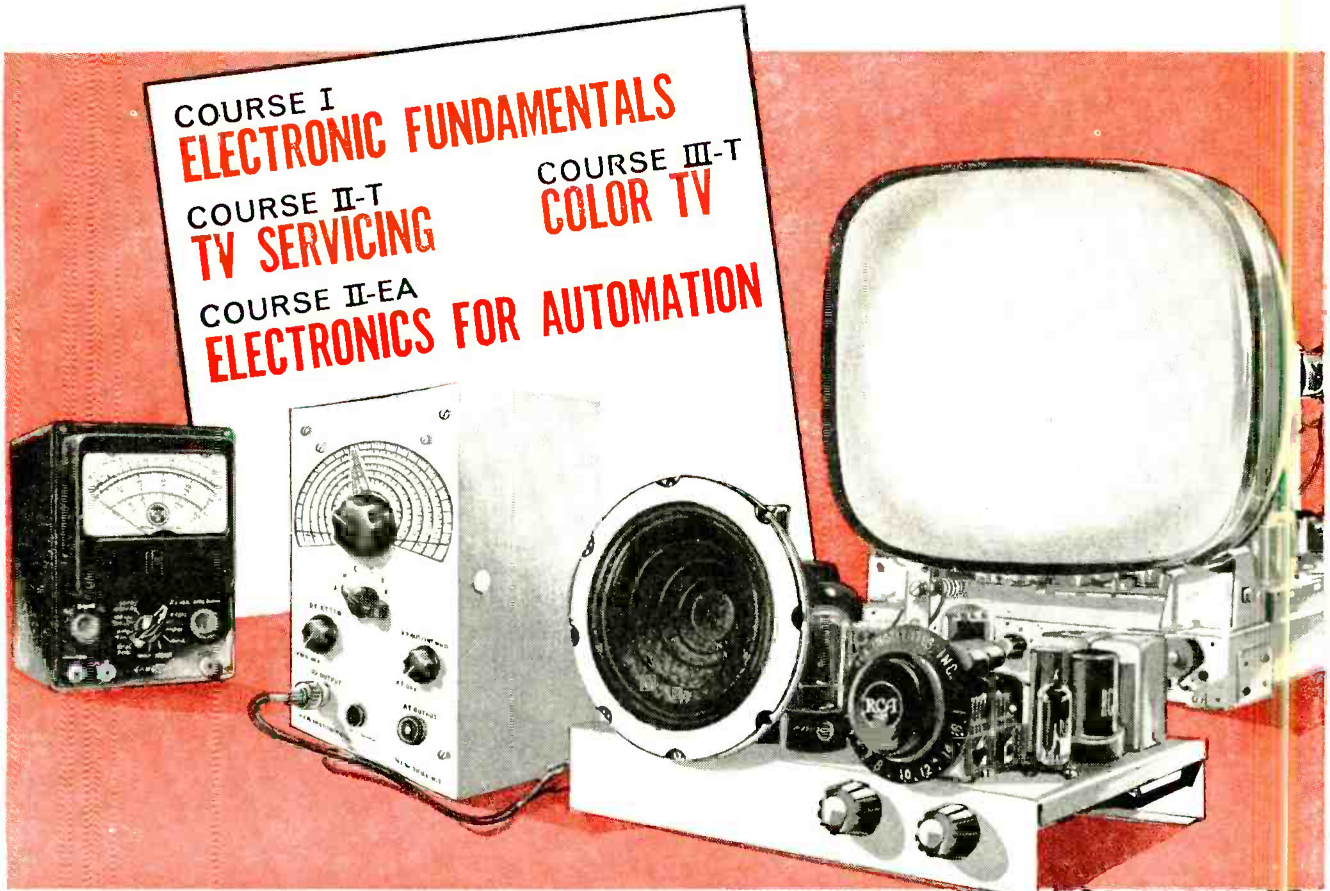

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page 8 of the same issue of RADIO-ELECTRONICS. This device is said to produce 900 watts of power—hardly a low-level device.

T. R. LAWSON, JR.
Westinghouse Electric Corp.
Pittsburgh, Pa.

Dear Editor:

In reply to Mr. Lawson's letter—

1. When Edwin Hall discovered his effect, he was working for his PhD at Johns Hopkins. He received his degree there in 1880, and thereupon joined the faculty at Harvard where he stayed until 1921.

2. The magnitude of the Hall voltage for a given geometry is a function of the Hall coefficient, which in turn is a function of carrier mobility and the resistivity of the material.

3. Our reference to the commercial availability of Hall-effect generators referred only to those utilizing indium arsenide or indium antimonide. To the best of our knowledge these units have been produced commercially only by Westinghouse and Ohio Semi-conductors in the United States and by Siemens in Germany. It is our understanding that only the Siemens and and Ohio Semiconductors are on the market.

4. Mr. Lawson's criticism of our use of the generic term Hall-effect device is valid. It was our intention that our usage of the term be limited to the low-impedance devices described in the article. The appearance of a new device on the market often creates confusion until terms are standardized. We have seen the terms "Hall-effect device," and "Hall-effect generator," "Hall generator" and "Hall plate" used synonymously. We frankly do not know which term will be adopted by the industry.

We did not mean to imply that the Hall-effect devices described in the article constituted the sole use of the Hall effect. Devices of the type described are, however, low-level devices.

We are aware of Mr. Lawson's work on the junction Hall generator but did not include it in our article since we were restricting ourselves to the commercially available types.

R. WAYNE CRAWFORD
NEAL P. MILLIGAN
Ohio Semiconductors
Columbus 14, Ohio

LICENSING AND STANDARDS

Dear Editor:

James A. Fred's letter in the September issue expressed fear that legislation will prevent individuals from servicing part-time. The legislation wanted by the service industry would require that this man pass an examination in order to practice. The other aim of the legislation is to control the ethics of the "sharp" full-time operator who bait-advertises low service rates, yet effectively receives pay far above that of the shop that advertises realistic service charges. This legislation would

protect the public from the unqualified beginner since it would set up a training and apprenticeship period, and from the gouger since his license could be revoked.

He speaks of a highly qualified and experienced individual who practices part-time. Why should a qualified person like that not be in the business full-time? He has probably learned that servicing gives such a poor return for the work involved that he must work at a better paying job. Now that he has security, he can work at his first love, electronics servicing. Might not licensing bring up the standards of the service industry so that he can find better remuneration as a shop owner and operator?

He mentions a friend of his who repaired a "toughie" that two regular repair shops turned down. This friend likes servicing so much that he is willing to give his time away to practice the art. His regular job assured him his mortgage was paid and his kids were fed. Might not the rise in standards that licensing might bring allow the men in the full-time service field to have security for the family by working 8 hours a day? Then they too could afford to tackle a "toughie" just for the joy and satisfaction of completing the job. We find great satisfaction in completing a tough repair job, and we often take a loss on the time spent on it.

We could hire out to the missile factories and find security in a standard wage and extra benefits. But we believe so greatly in the electronics service industry that we hope to raise its standards and bring it professional recognition that will give us all the benefits you get from the manufacturing industry. On top of that, we will be our own bosses.

FRANK T. KUROWSKI
Self-Employed
New Hartford, N. Y.

THANK-YOU NOTE

Dear Editor:

We, the officers of the Pennsylvania Federation, in behalf of the member chapters and delegates, wish to extend thanks to you and your publication RADIO-ELECTRONICS for the publicity afforded them during the past year.

Your column Technicians News is a generous contribution to organized service. Its value is great, as it enlightens association members in various locations on the thinking and activities of groups in other geographic sections, particularly with associations that are not yet aligned with a state or national organization.

Praiseworthy, too, are your recent efforts in compiling and printing the names and addresses of the known service organizations in the United States.

LEON J. HELK, SEC'Y.
Pennsylvania Federation
Television–Radio Service Associations

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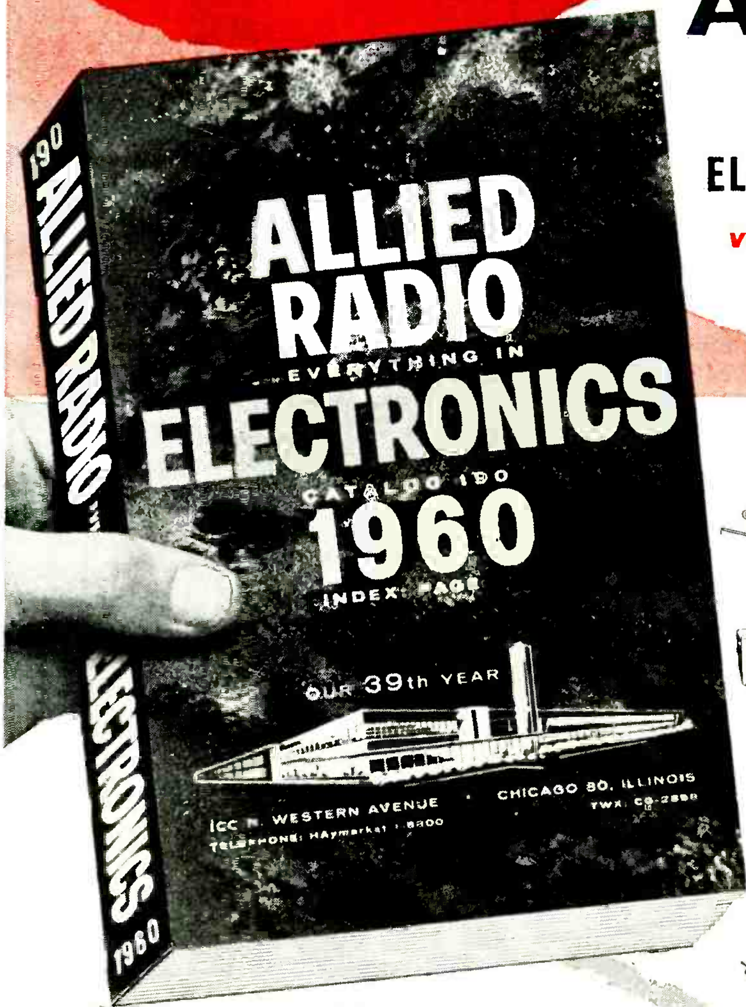

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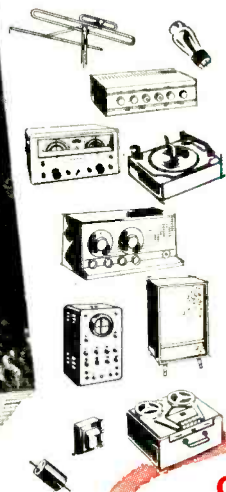

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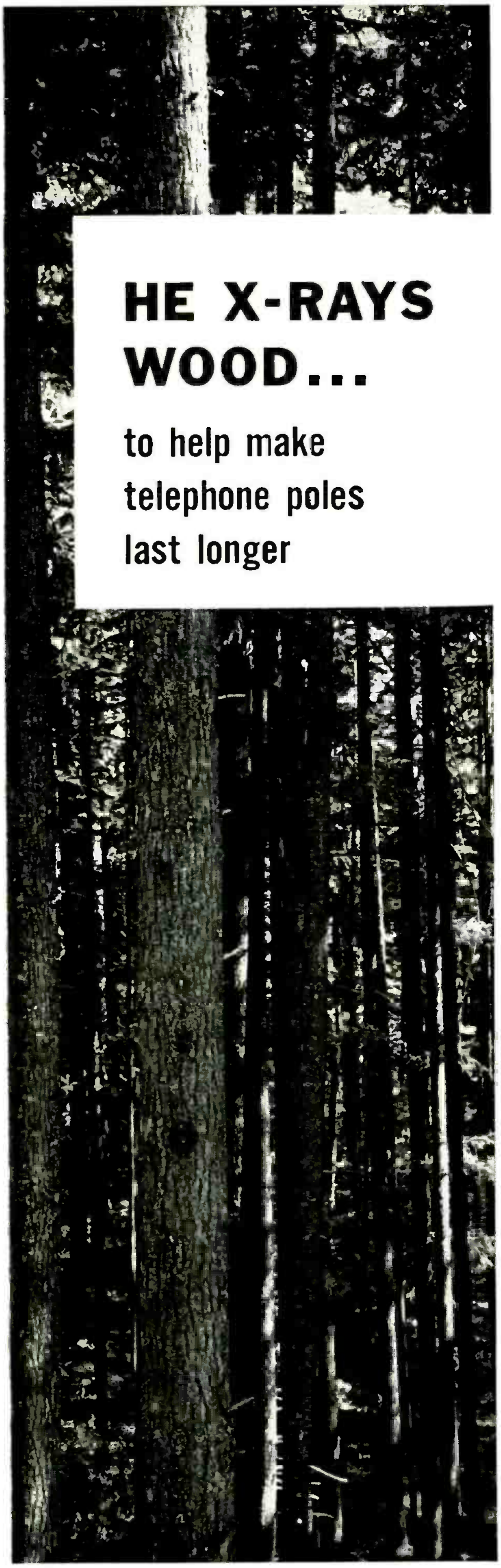

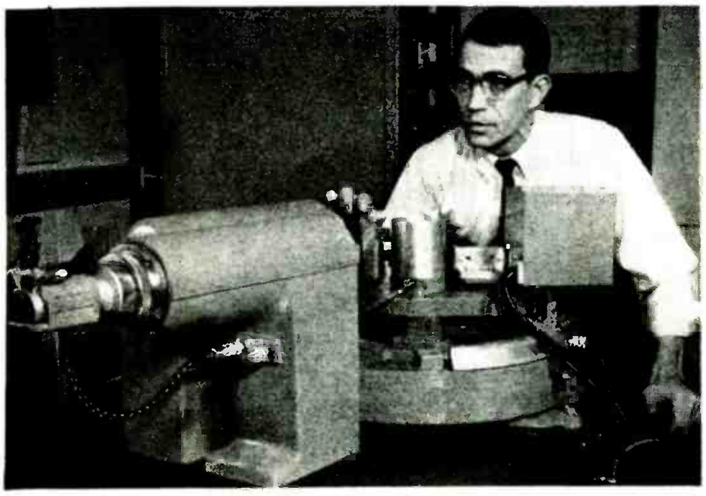

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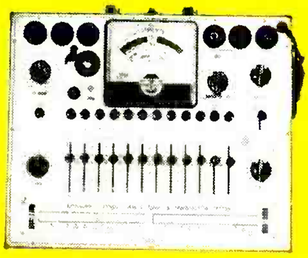

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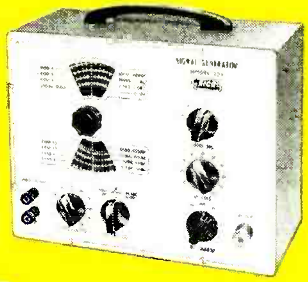

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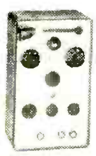

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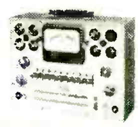

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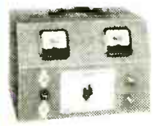

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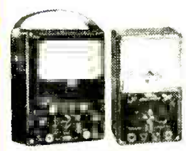

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Radio-Electronics
Hugo Gernsback, Editor

SUPERCEPTION

. . . The Next Development in Radio and Television . . .

FUTURE radio and television receivers will bear no resemblance to those now familiar to us. None of the original inventors and protagonists of broadcasting and television foresaw the tension, the strife and the dissension these noble and useful inventions could cause in the average household.

Unfortunately, today both radios and TV receivers have often become monstrous nuisances which all too often create unhappiness for unwilling eyes and ears. Usurping hearing and sight of others is barbaric, creating widespread and all too much lasting dissatisfaction among its victims.

Children and youths regularly trespass upon the time and nerves of their elders by forcing them to listen and thus participate in *their* program selections—unless the elders leave the room.

Husbands and wives continuously clash over the choice of programs—the former want sports events or other male entertainment, while the latter insist on drama or other female fare.

Yes, a family may conceivably have two separate radios and three TV sets, each in a different room—everyone has seen such split households—but we must all agree that this is an asinine and not very progressive solution to the problem, even if sufficient rooms are available. It won't prevail in the future.

In the present hectic and stressful civilization, when our nerves are under continuous assault from a wide variety of noises, the extra-high-decibel onslaught of radios and TV's injures our nervous systems far more than anyone cares to admit. And, unfortunately, the noise situation is steadily worsening, hence the increasing nervous collapse of a large percentage of our population.

The recent addition of hi-fi and stereo has done nothing to ameliorate the sonic impact on our audio centers. Our authorities, who get an increasing number of complaints, wonder where it will all end.

If this sounds as if we were roundly condemning and denouncing all electronic entertainment instruments and devices, let us assure you at once that nothing is further from our thoughts. Indeed, we who were in at the birth of all of them have spent our entire life and efforts in publicizing and propagandizing electronic sound and sight.

What we *do* object to is *the crude form* of our present-day electronic entertainment gear. Future historians will wonder how we possibly could have tolerated it so long!

Let us now visit our family of five of the not-too-distant future. It is 7 in the evening. The entire family is together once more, all assembled in the living room after dinner. All are listening to either their TV's, their radio or their hi-fi Stereo. *But the casual stranger entering the room hears not a sound, sees no picture on a screen!*

All is serene and quiet. The lights are low and the room has a pleasant cozy atmosphere. Father and mother are sitting on the couch, relaxed. *Their eyes are closed,* but by the alert expressions on their faces, you know that they are wide awake.

The two girls, 8 and 12, are sitting in comfortable over-stuffed chairs, one listening to her radio, eyes wide open, and the other entertained by her TV, her eyes closed but fluttering while she follows the latest courtroom drama. Junior, age 16, sits at the table doing his homework, by the room's sole dimmed table lamp. He listens to the latest hi-fi stereo explorer's account recorded on board a huge space-liner in transit from the moon to the earth. The only audible noise in the room is Junior's rustling homework papers.

The entire family wears individual, modern-style headgear that runs over the forehead and back around the head. It is made of light aluminummagnesium with a soft plastic inside pad where it touches the forehead and hair in back. It can be adjusted for any size head. Its total weight is less than 5 ounces. Over the ears are tiny adjusting knobs for off, on, change of channel, intensity and volume control. The headband nowhere measures more than ¼ inch thick. *All the electronic components are contained within this thickness, along which they are distributed.* There is neither a visible antenna nor a connecting cord. Entirely transistorized, the long-life batteries are in the headband, too. Hence one can walk about the house without ever missing any part of a program.

The headgear is called a *superceptor.* It is at once a combination radio set, television receiver and hi-fi stereo. You can go to sleep with your superceptor, too. Special models are built for learn-while-you-sleep purposes; others will awaken you to music at the preset time.

Fantastic? Not any more than radio or television was in 1900.

The superceptor is just a few stages more sophisticated than today's receivers. At the present state of electronics, it becomes discernible that we will soon break through into the *inner consciousness* of man. We do not need ears or eyes to hear or see—anyone who dreams while asleep knows that. By going *directly* to our brain's hearing and sight centers, we can bypass the optic and audio nerves that lead to them. But how do we accomplish that? Here is one approach—there may be several others.

Last January, a trio of scientists at the University of California at Los Angeles reported in the *Proceedings of the Society for Experimental Biology and Medicine* that electromagnetic fields created by electromagnets could stimulate the brain without contacting the skull. Drs. Alexander Kolin and Norman Q. Brill and graduate student Paul Broberg reasoned that brain tissue is conductive; thus they thought that electric currents could be induced in the brain just as electric currents are induced in transformer coils. Such brain conductivity had been noted by Norwegian technicians working in a hydroelectric station. They "saw" bluish-white flickerings whenever they were near the large choke coils of the plant. The phenomenon is called *phosphenes.* The UCLA researchers were able to duplicate the phosphenes by creating a low-frequency current in a magnet and placing their heads in its field.

Such super-perception—we term it *superception*—has a long distance to go before we can perceive television images in our sight or optic brain centers, but we feel certain that it will be accomplished in the future. Tiny, solid-state electronic scanners, replacing the present cathode ray tube, may do the trick.

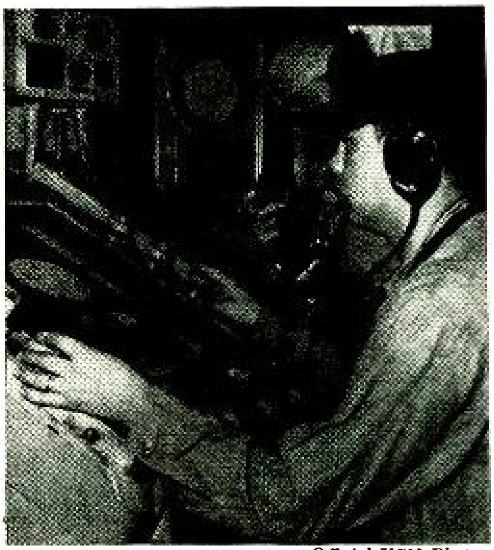
As for the much simpler audio superception, we have commented on this at length.* *It is already here.*

Will superception TV supplant screen television? Probably not. Large wall-screen projection will always remain for simultaneous viewing of specialized programs for the entire family and for their invited company's electronic fare.

—*H.G.*

*See "Future Audio Goals," October, 1959, RADIO-ELECTRONICS, page 33. See also "Microelectronics," page 33, February, 1960, RADIO-ELECTRONICS.

HSS-2 helicopter drops its sonar detection gear to search for hidden submarines.



Official USN Photos

A push of a button, and anti-submarine weapon ALPHA will be fired.

afford to lose the few fleeting detections we get. We need positive holding devices to stay with anything we get long enough to identify it completely, and, if necessary, destroy it.

Attack

Our kill capability is presently the least of our worries. In general, if we can find and classify a submarine, we can destroy it if we have to. Of course, the enemy can also kill us so, while it is the least, it is still a considerable worry. Since it is much easier for a submarine to destroy Chicago, Detroit, New York plus a dozen other cities and strategic military bases, the submariner would prefer to do that than approach a hunter killer group.

We have several methods of trying to outshoot the submarine. The best is to keep our surface and subsurface vessels out of lethal range and send out an aircraft to attack. Next best is the destroyer with its hedgehogs (multiple ahead-thrown bombs), weapon ALFA (a rocket-propelled depth charge, and no relation to the task group of the same name) or antisubmarine torpedoes. All these require the surface attacker to drive right into the hostile submarine's sights. Most urgently we need range so we can kill a hostile craft well beyond its lethal range. We also need speed and depth with our torpedoes, lest tomorrow's submarine simply run away from our weapon. We need homing weapons with better acquisition ranges to improve the probability of a hit and reduce the time required of the fire-control solution, time we probably won't have. Since atomic depth charges are limited in number and extremely expensive, we must do most of our dirty work with conventional torpedoes. Political considerations may deny the use of atomic weapons. Furthermore, a hole smaller than a fist in the pressure hull of a submarine is adequate for a kill.

What we have and need

Ideally, I would want a single super vehicle that could locate, pinpoint and (if necessary) destroy instantly every hostile submarine any potential enemy could deploy against the United States. There is no such vehicle. The operations of Task Group ALFA have proved again and again that, to do the job, I must employ the best capabilities of many types of vehicles in coordination. For speed, accuracy, range and staying power, I must call upon specialists in three mediums: air, surface and subsurface.

The basic antisubmarine aircraft is the carrier-based Gruman S2F Tracker. It is an electronic package equipped with engines, wheels and just enough space among its electronic equipment for four crew members to squeeze in. Into its fuselage are packed a complete radar, electronic countermeasures (ECM) equipment, a magnetic anomaly detector (MAD), sonobuoy receivers, uhf and mhf communications transceivers with associated homing equipment, navigational radio receivers and a tape recorder. Stowed behind the engines in the nacelles are expendable sonobuoys. There are rails on the wings for rockets, bombs, smoke markers or explosive sound signals. In its bomb bay it can carry either conventional or atomic depth bombs or homing torpedoes. A MAD boom extends from its tail, a radome from its belly and an ECM dome from over its cockpit. It fairly bristles with antennas.

Complete as this compact electronic package may seem, it is inadequate to combat modern submarines. Designated an all-weather aircraft, it requires too much of its crew's attention just to stay safely airborne at low altitude in foul weather. It needs an automatic navigation and control system to free its crew from the mundane task of saving their own skins, and allow them to concentrate on antisubmarine warfare. It needs a radar long-ranged and discriminating enough to pick out a periscope the size of a baseball bat from the clutter of sea return miles away.

Today the S2F is perhaps too fully equipped. Its pilot has trouble using all the information available to him. It needs a presentation system that will give the plane commander data from all his equipment in the best form to allow him to analyze and act. It needs an automatic data link with the command post in the aircraft carrier and with other units with whom he must coordinate. It needs an active as well as a passive ECM capability, both of which must be more discriminating and quicker, and cover a wider band. It needs lightweight terminal equipment for monitoring directional sonobuoys, with simple, accurate display. It also needs miniature directional sonobuoys to monitor. All this must be packed into a small airframe, light enough to fly, rugged enough to be hurled off a catapult and snatched back aboard the carrier in a jolting stop that the Navy calls an arrested landing. It must be simple enough for rapid maintenance by semi-skilled technicians, cheap enough for you and me, the taxpayers, to afford. The crew would also like room for a coffee pot.

The Tracker's big brother in the airborne end of the ASW business is the land-based Lockheed P2V Neptune. It carries essentially the same equipment as the S2F, but more of it. Its radar is larger, more powerful and more discriminating, and the P2V has more communications equipment. Nearly twice the size of the S2F, with accommodations for duplicate crews, the P2V has the people and space for plotting information and controlling other forces, given the electronic eyes, ears and memory to do it.

Like the S2F, the P2V needs automatic navigation and control systems to make it truly all-weather and to keep track of the forces deployed over the wide area it can control. Its sonobuoys and associated receivers are no better than the Tracker's—there are just more of them. Its ECM is just as restricted and clumsy. Its APS 20 radar is far superior to the S2F's, but is still so frustrated in its search for the elusive periscope that any appreciable wave height gives the peeking submarine an easy immunity.

Facing the same limitations is my third airborne vehicle, the Douglas AD-5W, the Guppy. It is a carrier-based single-engine skyhook. Its function is to provide wide-area surveillance around the task group with its APS 20 radar, and to provide an automatic relay for radar and communications over the wide area ALFA must investigate for submarines. It is essentially an elevated antenna for control stations in surface ships, showing its radar picture on the ship's scopes through automatic relay equipment, and receiving and automatically retransmitting uhf communications between surface forces, greatly extending the uhf line-of-sight. These two automatic features approach the solution to our needs. If we could add automatic navigation and control features, the crew could concentrate on working for me, and quit having to worry about staying alive.

A unique craft in ALFA's stable of airborne sub hunters is the Sikorsky HSS-1 helicopter. It carries a minimum of navigational equipment, a uhf transceiver and a sonar transducer that can be lowered into the water from a hover. The newest modification of the HSS gives it virtually an automatic all-weather capability. What it needs now is an equivalent advance in sonar performance. That is a major project. The helicopter is a critical vehicle for acoustic equipment. The sonar operator must listen for faint submarine indications against a high background level of helicoper self-noise, from both engine and rotor blades. It is also critical in its weight-carrying capacity. If the copter is to lift enough gasoline to carry out any respectable mission, a better sonar will demand transistor, printed-circuit type simplification.

Antisubmarine warfare's biggest surface vehicle is Task Group ALFA's flagship, the aircraft carrier. It is a high-speed mobile air base, logistics center and command post from which all the operations of the group are coordinated and controlled. Its radars, communications equipment, electronic navigational gear and electronic countermeasures devices are legion. Although improved versions of all of these would be welcome, the great need is to improve the carrier's capability as a control center. This means automatic collection, screening and presentation of information, varying from the turn count on a fleeting "sinker" to the prevalence of fish in the Gulf Stream. Added to the need for enough valid information is the ability to do something about it—directing, controlling and coordinating the forces available for contact investigation. While this is primarily a communication problem, accurate navigation is a vital corollary. I must know where my forces are—air, surface and subsurface—what they are doing, what they see, hear and feel, to decide where they should go and what they should do.

The mainstays of the antisubmarine carrier group are the destroyers, the oldest, most overworked and most reliable vessels in the fleet. Like the carrier, they have numerous radars, communications and ECM equipment, all of which could profit from improvement. The area for priority effort, however, is underwater search: sonar. This is the most significant contribution to the task group's ability to find submarines. We need a detectable sound response from every piece of the ocean where a submarine could lurk. Areas which we cannot enter electronically, we must enter physically with the hydrophone. We need a variable depth sonar to overcome the difficulties caused by temperature discontinuities at all possible target depths.

Like the carrier, the destroyer needs automatic plotting and control facilities. The destroyer skipper often finds himself pursuing a contact in company with another destroyer or two, a P2V, three helicopters, two S2F's and an antisubmarine submarine. Just keeping track of his teammates is a major task. Directing all of them in effective coordination demands electronic help. During the 1960's, analog computers will give way to digital computers. Digital language will be used within the destroyer and between ships for data transmission. Information from ECM, radar, sonar and other detection systems will also be digitalized. It is quite conceivable that detection information from one vehicle may be sent in digital language to another's fire control system so the second may attack a target detected by the first.

Modern submarine improvements have drastically reduced the reaction time available to an opposing surface ship. To get the jump on today's submarine and stand him off long enough to get in the first lethal shot, the destroyer needs more effective electromagnetic and acoustic jamming and deception systems. ECM and radio direction-finding equipment must be developed to insure coverage of all submarine frequencies quickly enough to produce a lethal fire-control solution on a single submarine slip of the tongue. High-definition sonar is needed for shallow-water investigation and to help sort out a submarine from fish, wrecks, pinnacles or underwater disturbances in a manner just as positive, but a little more comfortable, than intercepting a torpedo or missile amidships.

For the future

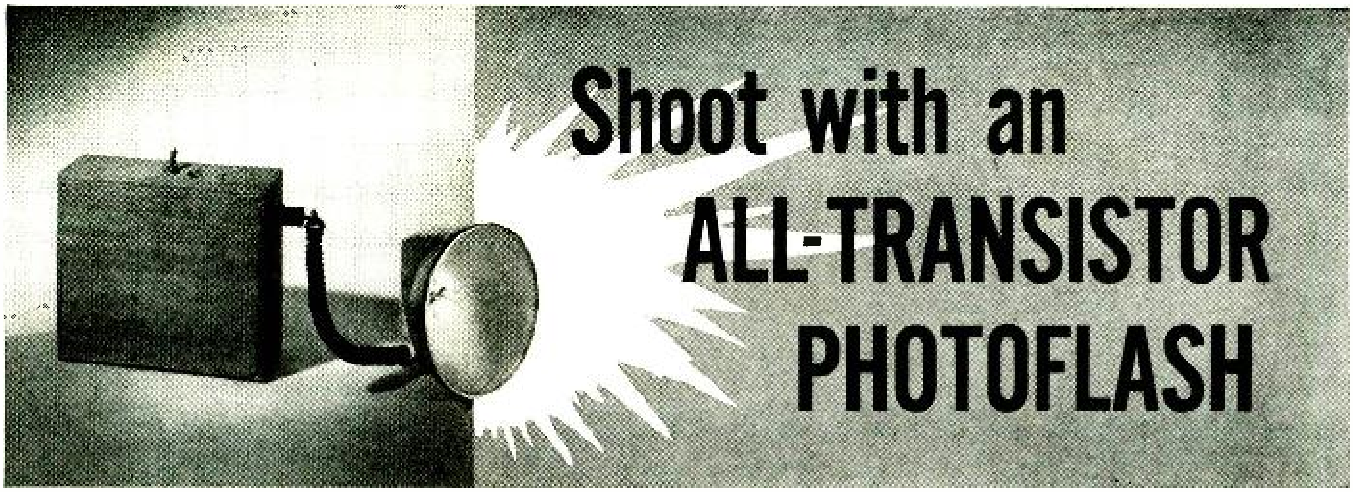
Detection systems will grow larger and more complex as their power requirements are increased and their frequencies lowered. As the destroyer electronics systems increase in size, in numbers of individual units and in complexity, maximum attention must be given to developing equipment both highly reliable and easy to maintain. That means a move toward such simplifiers as solid-state components, printed circuitry, modular construction and automatic warning of circuit malfunction.

Finally, to make the whole system effective, a precise navigation system must be developed for the destroyers. Many obstacles must be overcome before a small, precise shipboard navigation system can be developed. In the meantime, it may be necessary to develop a highly accurate relative position-fixing system, using a beacon or similar device, on a ship within the formation as a common reference point.

The antisubmarine submarines working underwater are up against the same sort of problems as destroyers. They, too, depend on active and passive sonar, radar, radio and ECM intercept, and a fire-control system unique but pointed toward the same solution. Unlike the other vehicles, however, they have an additional and very uncomfortable problem. They look, sound and act just like the guys we all are after, a built-in invitation for a disastrous mistake we cannot afford to make. Neither can we afford to forfeit their services. Submarines are my most effective underwater ears.

First of all, we need a foolproof method of underwater identification, a submarine IFF that allows absolutely no mistakes. As soon as we are sure of who's on first, we must then give him a secure hot line to his surface and airborne teammates, so that he can stay silent at his best listening depth while they go after the target he is zeroed in on. And to make sure that my submarine finds the target before the target hears him, I need a submarine sonar that can give me both bearing *and* range passively. The minute a submarine has to put energy into the water actively, he has lost the initiative (and maybe his retirement benefits if it comes down to a shooting match).

Calling off the capabilities and limitations of each of my vehicles individually may be misleading. Task Group ALFA is not just a collection of individuals. A year's operations have proved the validity of the integrated antisubmarine weapons system concept—each unit and each type contributing its capabilities to compensate for the inherent limitations of others, and using the strengths of its teammates to plug the gaps in its own capabilities. Today this coordination within the task group is done with people and doctrine. All our needs have a common denominator—*automatic* navigation, *automatic* communication, *automatic* data exchange, *automatic* functions to free people for decision making, command and coordination. Unless the technical details can be taken care of by automation, computers and electronic analysis, people and doctrine alone will not be able to cope with the ever-increasing antisubmarine problem. Tomorrow's submarines will tax the capabilities of people to the utmost in just making decisions and pushing the right buttons. Every time people have to stop to figure out a problem that pressing the right button could solve automatically, the submarine has another jump on us that we cannot afford to give it. END



Shoot with an ALL-TRANSISTOR PHOTOFLASH

By RICHARD W. AHRONS

THE three-transistor electronic photoflash described here eliminates two major difficulties common to the many commercial units that use size-D flashlight cells for power. These problems are excessive battery drain during standby operation, and variation of light output with output voltage, decreasing as battery voltage drops with battery life. Both are overcome by the unique automatic control feature of this transistor unit.

Electronic photoflash operation is based on charging a large capacitor to about 450 volts over a period of 5–20 seconds and then discharging it through a photoflash lamp, creating the flash. The discharge usually has a 1/500–1/2,000-second duration. The output control built into the transistor unit maintains a constant output voltage, while output of commercial units may vary considerably with battery life.

Size-D flashlight cells are used in many portable photoflash units because of their low cost. Then, too, you can get them almost everywhere. Their life in a 53-watt-second photoflash unit is about 80 flashes, a convenient number for the amateur photographer.

The dc-to-dc conversion is handled by rectifying the boosted transformer output of a transistor oscillator—commercial units use mechanical vibrators. If the dc-to-dc converter continues to operate after the capacitor is fully charged, a large amount of battery power is wasted. This is prevented by the automatic control feature of my unit, which turns off the oscillator when the photoflash capacitor reaches the proper voltage.

Here is an abbreviated list of performance characteristics of the photoflash unit:

- Charging time*—15 seconds
- Battery current drain* during charging—30 ampere-seconds
- Battery current drain during standby operation—15–25 ma
- Automatic control at output
- Constant light output
- Ready light

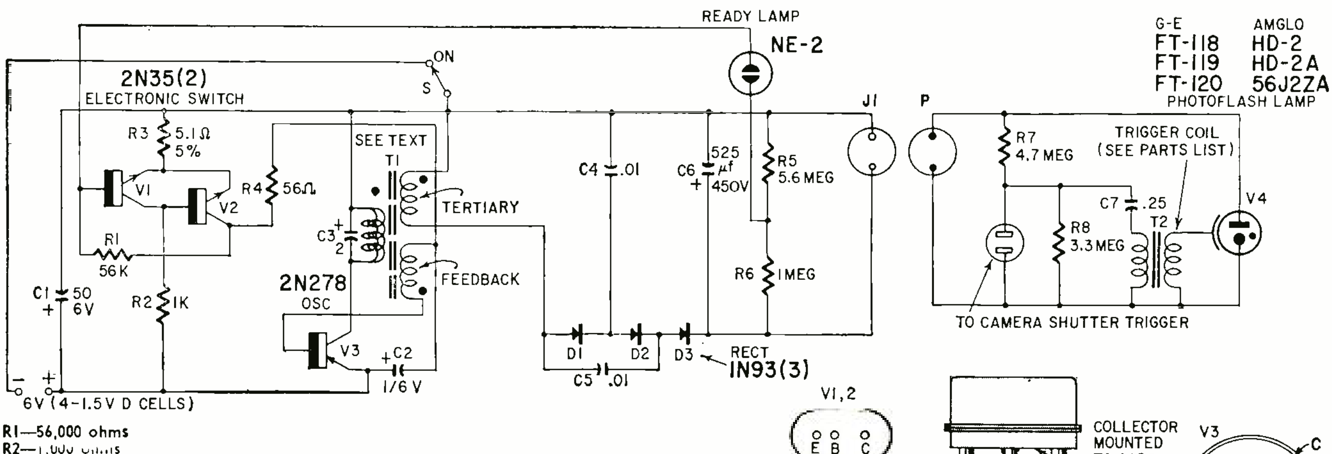
**Charging time and battery drain during charging was measured for charging the capacitor from 100 to 410 volts with fresh cells.*

Transistor life is much longer than that of an electromechanical vibrator. Size and weight advantages are also obtained.

How it works

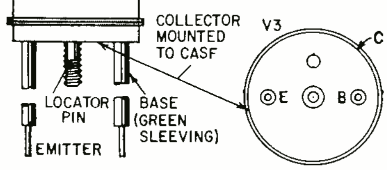
When the unit is turned on, capacitor C6 (see diagram) charges to about 450 volts and the neon ready lamp goes on. This triggers a switching circuit which turns off the transistor oscillator. If the photoflash lamp is not flashed before the capacitor voltage decays to about 95% of its top value (when the neon lamp went on), the transistor oscillator goes back into operation and brings the charge back up to a useful level.

The circuit of the transistor photoflash is shown in the diagram. Oscillator transistor V3 is kept oscillating

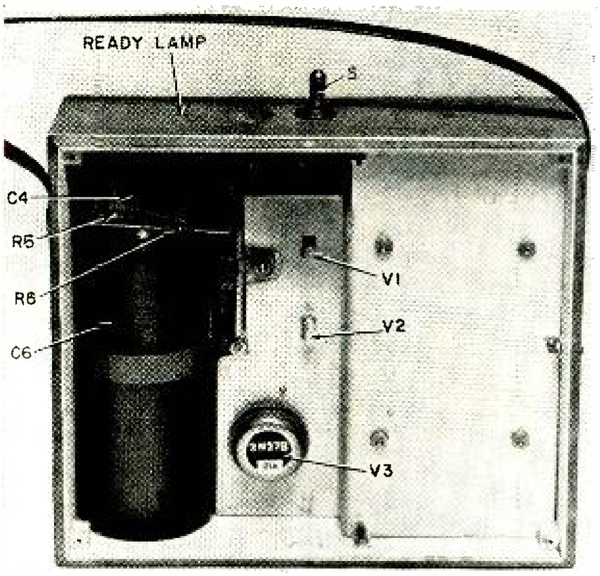


R1—56,000 ohms
R2—1,000 ohms
R3—5.1 ohms, 5%
R4—56 ohms
R5—5.6 megohms
R6—1 megohm
R7—4.7 megohms
R8—3.3 megohms
All resistors ½-watt 10% unless noted
C1—50 μf, 6 volts, electrolytic
C2—1 μf, 6 volts, electrolytic
C3—2 μf, paper
C4, 5—.01 μf, disc ceramic
C6—525 μf, 450 volts, photoflash capacitor
C7—0.25 μf
All capacitors 600 volts unless noted

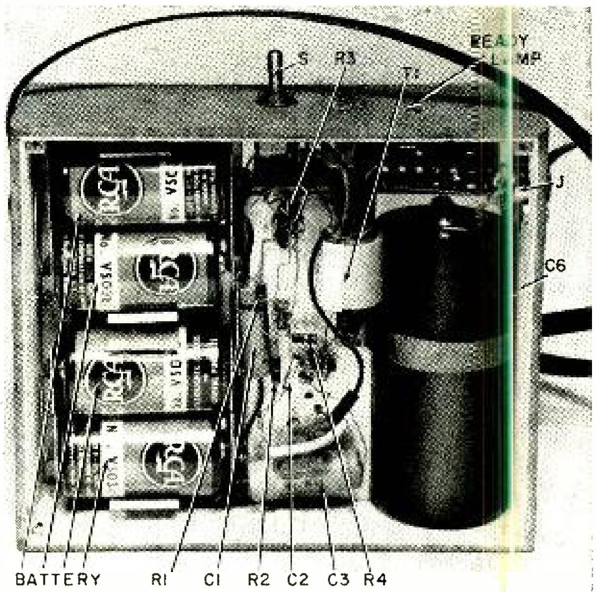
D1, 2, 3—1N93
J—2-contact, polarized jack
P—2-contact polarized plug (to match J)
S—spst toggle
T1—see text
T2—trigger coil, Stancor P6426
V1, 2—2N35
V3—2N278
V4—Photoflash Lamp (see text)
NE-2 neon lamp and socket assembly
Flashlight batteries, size D (4)
Case, to suit
Miscellaneous hardware



Complete power supply with the remote flash unit and trigger circuit.



Transistors are readily accessible should replacement become necessary.



Batteries are on the reverse side, with most of the smaller components.

by feedback through the transformer to its base. Base bias is provided through resistor R4, transistor V2 and resistor R3. Capacitor C3 and the inductance of transformer T1's primary set the oscillator frequency at about 10 kc. Diodes D1, D2 and D3 and capacitors C4 and C5 form a voltage tripler.

Automatic voltage control

When the voltage across capacitor C6 reaches 450, the neon lamp, which also acts as a ready light, goes on and the unit is ready to fire. Current through this lamp appears as base bias at transistor V1, normally cut off. This permits V1 to conduct, increasing the voltage drop across R2 and lowering V2's base bias.

The lowered base bias cuts off V2, which removes base bias from V3. This cuts off V3, stopping the oscillation. As the voltage across capacitor C6 drops because of leakage, current through the neon lamp also drops. As this current decreases, the voltage drop across R5 decreases and V2's base bias rises. When this bias has increased sufficiently, V2 conducts once again and applies base bias to V1, starting the oscillator. This cycle will repeat itself as long as the batteries last.

Points to remember

The values of R1 and R2 are critical but depend upon the particular transistors used. Try adjusting R2 over a range of values, using several values for R1. These resistors should be selected so that the oscillator resumes operation when the charge on capacitor C1 drops to about 95% of peak.

Transformer T1 is homemade. The ferrite core comes from a flyback transformer. The core cross-section is about ⅜ inch square. The primary winding consists of 12 turns of No. 33 enameled magnet wire, bifilar layer-wound, connected in parallel. The secondary (feedback) is 18 turns of No. 24 enameled magnet wire, layer-wound on top of the primary. The tertiary is made up of 660 turns of No. 30 enameled Formvar magnet wire, layer-wound in 10 layers with 3-mil Kraft paper separating each layer.

Using the photoflash

When the unit is completed and after all connections have been checked, insert the transistors and batteries. Turn the unit on. In about 15 seconds, the neon lamp will light. As soon as it does, you are ready to go. After each flash the light will go out and you will have to wait about 15 seconds before using the unit to take another photo.

Several photoflash lamps can be used with this circuit. General Electric makes three, the FT-118, FT-119 and FT-120. All are electrically identical and differ only in basing. The FT-118 is the simplest mounting of the group. Using a Weber Brass Co. (3344 Payne Ave., Cleveland, Ohio) reflector, the lamp is inserted in the rear of the reflector and a slight crimp on the rear edge of the collar holds it in place. The FT-120 has a four-pin radio tube base and the FT-119 is baseless It has two leads and must be specially mounted to avoid breaking them.

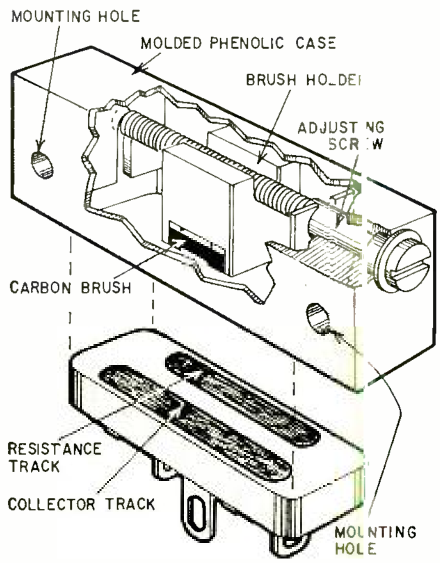
Amglo also has a group of photoflash lamps you can use. They are the HD-2, HD-2A and 56J2ZA. They come separately or with a reflector. The trigger circuit for both groups of photoflash tubes (see diagram) is built into the flash holder. END

ADJUSTABLE FIXED RESISTOR

Compact adjustable resistors for continuous stepless control are now being made for equipment manufacturers in values from 100 ohms to 2.4 megohms—¼-watt rating. These sealed precisely adjustable units are noninductive, watertight rheostats or potentiometers with a small slotted screw for screwdriver setting. They may be ordered with lugs (as shown) or wire pins for mounting.

The screw turns up to 25 full revolutions, moving a carbon contact brush across the molded resistance track, changing the amount of track in the circuit. Tolerance is either 10% or 20%. These units can be used at temperatures from −55° through 120°C and are manufactured by Allen-Bradley Co.

Resistors of similar construction and operation are made by other firms.



center of a simple solenoid coil of wire. The coil does double duty—it furnishes the strong magnetic field to align (polarize) the protons, and the precessing magnetic moments of the protons induce the signal voltage in it. This is exactly analagous to an ac generator.

In the satellite magnetometer, 7 amperes dc is passed through the coil for 2.2 seconds. A relay then switches the current off and connects the coil to a high-gain band-pass amplifier which modulates the telemetry transmitter.

The Vanguard satellite magnetometer has four essential parts:

- A liquid abundant in hydrogen
- A coil of wire
- A switching circuit, called the programmer
- A band-pass amplifier

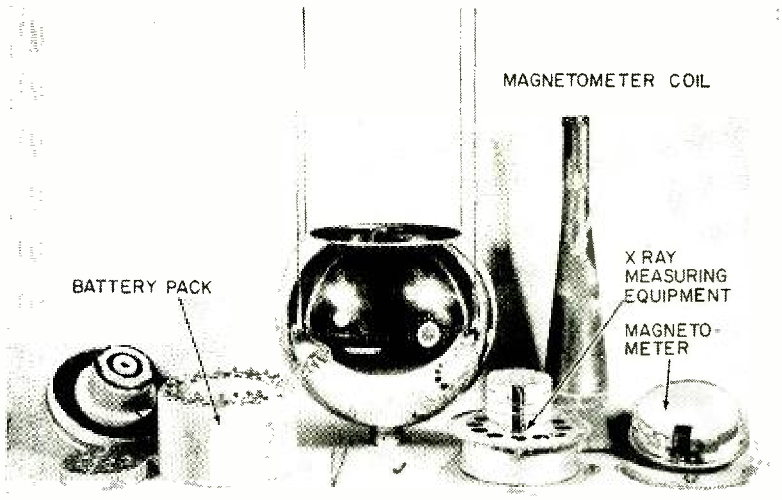


Fig. 5—Major components in the satellite.

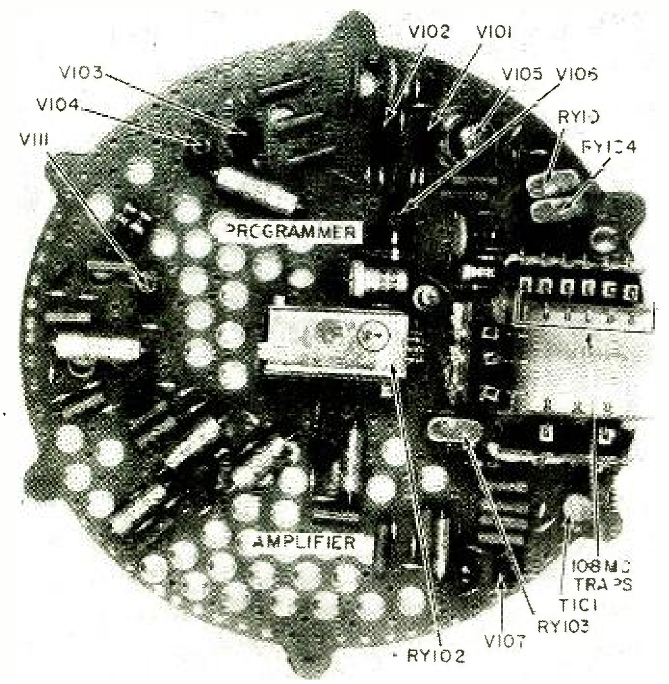


Fig. 3 — Magnetometer module used in the Vanguard III.

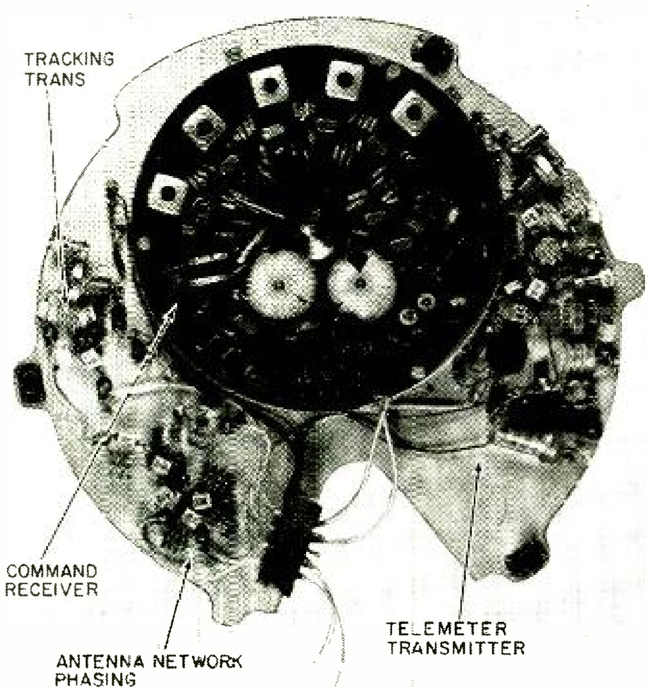


Fig. 4—The command receiver, tracking transmitter and telemeter transmitter that went into the Vanguard III.

The liquid chosen for the satellite ride was normal hexane, commonly known as naptha. It was picked chiefly because of its low freezing temperature.

The coil was made of 600 turns of No. 15 HF (heavy Formvar) aluminum wire on a 1-inch diameter phenolic cylinder 4 inches long. The coil form serves as a bottle to contain the hexane, with phenolic end plates cemented to the ends of the coil with Armstrong A-2 adhesive. An O ring sealed brass screw plug in one end allows filling with hexane. This coil is exposed to the outside atmosphere, or the lack of it, when in flight. The entire outside of the coil is covered with an etched Faraday shield for rf shielding.

Measurements on command

To conserve battery power, the magnetometer makes a measurement only on command from the ground. The programmer must respond to a momentary contact closure in a command receiver within the satellite, go through one polarize–measure cycle and turn off to await another command.

When the command relay's contacts close, terminals 5 and 6 on the magnetometer are shorted (Fig. 1). RY101, the on–off switching relay is energized through R117. The contacts of RY101 do two things: they turn on the magnetometer circuits on command, and they keep C103 and C127 charged, via R103, while the magnetometer is off. When the command receiver relay drops out, after 0.1-second closure, RY101 is held energized by V105's collector current, and the magnetometer is held on.

Immediately upon turn-on, the multivibrator (V101, V102) is triggered on because of the charge on C103 and C127. In a steady state, the multivibrator would be stable with V101 cut off and V102 operating near saturation. In the triggered state, V102 is cut off, resulting in a negative pulse of 2.2 seconds' duration at V102's collector. The negative pulse is directly coupled to V106's base, operating as an emitter follower with relay RY102's coil in the emitter circuit.

RY102 is the high-current switching relay, so current is applied to the magnetometer coil and the protons are "polarized." The negative pulse at V102's collector is also differentiated and the trailing edge is used to trigger a second one-shot multivibrator (V103, V104), resulting in another negative pulse 2.2 seconds long. This pulse delays the turning off of the circuits while the precessing protons induce a signal into the magnetometer coil. This is the measuring time.

The trailing edge of the second pulse (differentiated also) is coupled to V105's base, driving this transistor toward cutoff, and allowing RY101 to drop out and turn the magnetometer off.

Relay RY103 is energized via RY102's contacts. RY103 disconnects the amplifier from the magnetometer coil during polarize time. Diode D104 slows RY103's contact reclosing time so the amplifier is reconnected to the coil only after transients caused by turning off the polarizing current have damped out.

A circuit consisting of R151, R122, C109 and D103 is connected across the coil to help damp out transients and limit the inductive current surge in the coil when RY102 opens.

Another relay, RY104, is energized all the time the magnetometer is on. It turns on the telemetry transmitter. This saves battery power during orbit. If the command receiver should fail to open after a command, the magnetometer would stay turned on because RY101 is held energized. If this condition should last beyond the time when the magnetometer would normally turn off, the space experiment would be permanently finished, since the turn-off pulse would be ineffective, even if the command relay did eventually drop out.

To safeguard the equipment, C101 is allowed to discharge through R101 to generate another trigger pulse to the first multivibrator, resulting in another polarize-measure cycle, when the command relay opens.

Transmission of data

The amplifier boosts the signal level sufficiently to modulate the telemeter transmitter. The signal level induced in the magnetometer coil by the precessing magnetic moments of the hydrogen nuclei is in the order of 2 μv, so it is very important that the amplifier have a good noise figure. A combination of careful matching of the coil to the input base, choosing a low-noise transistor and operation of the first stage at high gain improves the amplifier's signal-to-noise ratio.

The amplifier's frequency response is determined largely by coupling capacitors in the last three stages, and by bypass capacitors C114, C118 and C121. Unbypassed resistors in the emitter circuits help stabilize the amplifier gain for temperature changes. The amplifier output voltage is clipped by D105 and D106, to prevent overmodulation of the telemeter transmitter. The modulation transformer, V111's collector load, is located in the transmitter module.

With a battery supply of 14.6 volts, the output voltage into a 600-ohm load will be 4.4 peak to peak. A typical amplifier response curve is shown in Fig. 2. The upper frequency limits are determined by the earth's magnetic field at Washington, D. C., and Cape Canaveral, Fla., where ground tests were made. The lowest precession frequency encountered in space by Vanguard III to date is 300 cycles, and the highest 1,600 cycles.

Fig. 3 shows a completed magnetometer module. Terminals for external connections are in the rectangular area, and each terminal has a tuned trap (108 mc) to keep rf out of the magnetometer circuits. The relay in the center of the circuit card is the high-current-carrying relay (RY102) and is placed in the center because it is the heaviest component. The printed-circuit board is perforated so the Eccofoam potting compound can cover both sides.

Fig. 4 is a picture of a command receiver, tracking transmitter and telemeter transmitter. The transmitters were developed at Naval Research Laboratory for use with the Varian magnetometer. The command receiver, also developed at NRL, is used for a number of satellite experiments.

Fig. 5 shows the major components in the satellite. The batteries fit in the bottom of the magnesium can in the lower hemisphere. The X-ray equipment sits on top of the battery pack. The potted magnetometer sits on top of the X-ray equipment with the transmitters and command receiver on top of the magnetometer.

The satellite battery pack is made of Yardney Silvercels, partly because they are nonmagnetic. Battery capacities are designed so that batteries for all circuits should go dead about the same time. Probably the command receiver batteries will fail first. With a maximum of 50 commands per day, the magnetometer batteries were expected to last about 90 days (actual life was 84 days).

The contributions of John Drake and Kelsey Robinson to the magnetometer development are gratefully acknowledged. END

HEADLIGHT TATTLETALE

By R. E. YOUNG

How many times have you walked away from your car and left the headlights on? Once is enough. The device described and illustrated here gives a warning whenever you turn the ignition off while the lights are still on. The warning comes in the form of a buzzer or a red light.

Wire A goes to the headlight terminal on the light switch. Lead B goes to the switched side of the ignition switch. Lead C is attached to the chassis—the dash or other convenient ground. And lead D is connected to the unswitched wire on the ignition switch or headlight switch.

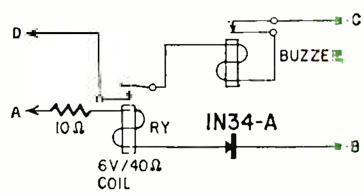
Circuit operation is easy to follow. With the headlights on, point A is at battery potential (6 or 12 volts). If the ignition is on, point B is at the same potential and no current flows through the relay. If the ignition is turned off, point B is no longer connected to the battery, but now forms a low-resistance (compared to the relay and diode) ground path through the ignition system. Therefore, current flows from A through the diode and relay, closing the relay's contacts and ringing the buzzer or lighting the warning lamp.

The diode keeps the relay from operating when the ignition is on and the lights are off. If the diode were not included, point B would be at battery potential, with a low-resistance path to ground through A and the headlamps when the ignition was on with the lights off. If it were not for the diode's high back resistance, current would flow, closing the relay and activating the alarm.

The diode connection shown is for cars with the negative battery terminal grounded. If your car has the positive terminal grounded, reverse the diode. In other words, if the alarm goes off with the ignition and the lights off, but not the other way around, the diode is connected backward.

The buzzer is not operated directly through the diode because of the high currents needed. A small lamp could probably be run directly off the diode.

The relay is a miniature low-drain 6-volt unit (Gyro Electronics, 325



Canal St., New York, N. Y.) that draws very little current. It can easily be adjusted to operate on less than 6 volts if necessary. If relay action is sluggish or nonexistent in this circuit, a quarter- or half-turn clockwise on the relay adjustment screw should be all that is needed. If the relay is mounted to the car's chassis or dash by a screw through its core, lead C is not needed, as the core is the normally open contact on the relay.

With minor modifications, this circuit can be used with a 12-volt system. The buzzer or bulb in this case should be a 12-volt unit and a resistor of about 50 ohms or so should be in series with the relay coil. END

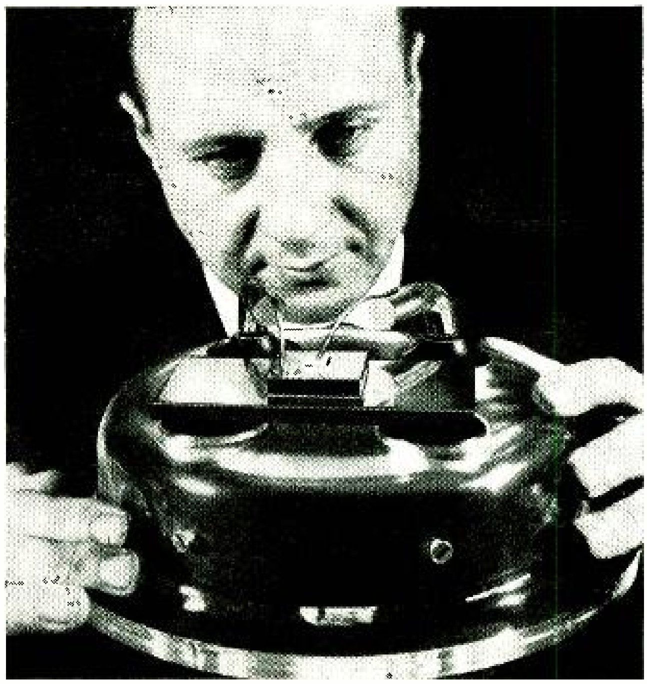
NEW SEMICONDUCTOR RADIATION DETECTOR

Solid-state device approaches molecular size; is 1,000 times as fast as earlier detectors

By **FRED SHUNAMAN**
MANAGING EDITOR

SCIENTISTS of the Hughes Aircraft Co. have just unveiled a radiation detector expected to have important applications in space exploration, military work, medical research and treatment, nuclear research and industrial processes. The device is 1,000 times as fast as the ionization chamber and operates at much lower voltages (3 to 30 volts is typical, though higher voltages can be used and in certain applications the contact potential of the diode is all that is required). It can be hooked up as a radiation-level detector to check a suspected contaminated area or as a laboratory instrument to measure the energy of the rays striking it. At present used as a detector of charged particles, it may be modified to act as a neutron detector as well.

Transistors (as well as semiconductor diodes) are radiation-sensitive. This is unimportant in most applications, but might render transistor equipment worthless in outer space, or even on earth under nuclear attack. But this weakness turned out to be a very valuable advantage when scientists started looking for a quicker, cheaper and better radiation detector. Their work culminated in the detector shown here (in enlarged model form) with the man who was chiefly responsible for its development, Dr. Stephen S. Friedland.



Dr. Friedland examines a vastly enlarged model of his new device.

The Hughes radiation detector differs from an ordinary silicon diode in only two respects—the shallowness of the n-region and the purity of the silicon. Fig. 1 shows a typical p-n junction and a solid-state radiation detector for comparison. The n-layer may be as little as 1 micron thick—the rest of the diode is p-layer.

The diode is hooked up with a battery of a few volts in reverse bias (the direction of minimum current flow). The positive voltage applied to the n-portion of the diode tends to draw all the electron charge-carriers in that portion toward the end of the diode; the negative voltage at the other end attracts the holes, thus leaving a depletion region, in which there are few charge carriers, over the larger part of the semiconductor. This depletion region is made larger than in ordinary diodes or transistors by using purer silicon.

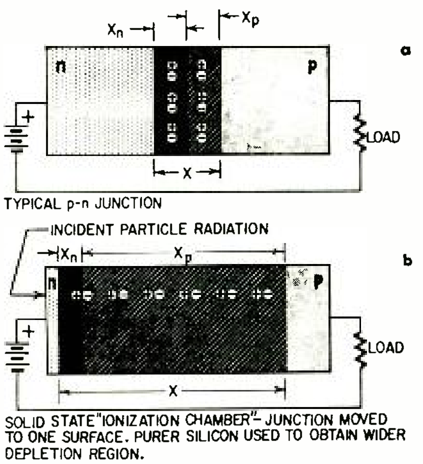


Fig. 1—Comparison of detector with ordinary n-p diode. X areas are depletion regions; X_p in p-type and X_n in n-type material.

A charged particle penetrating the surface produces electron-hole pairs in the depletion area. Because of the voltage across the diode, the electrons thus formed are drawn toward the positive end and the holes toward the negative. Thus each particle produces a pulse in the small current through the diode, a pulse that is normally applied to the input of an amplifier.

The device has been used chiefly as an alpha-ray detector, but beta-ray detection is also possible, and neutrons can be detected by coating the n-surface with a material that emits a charged particle when struck by a neutron.

The new detector's small size, ruggedness and great speed will permit applications impossible to older devices. For example, it can be used in a hypodermic needle to penetrate malignant tissue in which boron has been concentrated and irradiated to kill cancerous cells. Inability to judge the amount of boron in the tissue or the exact effects of the irradiation made it difficult to obtain optimum results with this type of treatment. With a radiation-measuring device the guesswork can be eliminated, and the amount of malignant tissue destruction by the tiny atomic bombs produced by irradiating the boron can be closely ascertained.

When designed as a radiation detector, the new instrument can be a boon to soldiers in suspected "hot" areas or civilian decontamination squads. Instead of a relatively bulky and fragile ionization chamber, a detector on the end of a long rod can be used to explore the area ahead for dangerous radiation levels.

A three-dimensional device consisting of thousands of individual detectors in a sort of cubical lattice may well open a new door to nuclear research in space. Tracks of nuclear particles are plotted today with a similar cubical device built up of stacked photographic plates or films. Placed in the nose cone of a missile, it is useful only if the nose cone is recovered and then only after painful analysis of the particle tracks by comparing each film with those between which it was sandwiched. The three-dimensional solid-state detector assembly, fitted with coincidence circuits to follow the track of particles through the unit, could radio to earth the track, speed and energy of particles striking it. A similar device could be used for nuclear research in earth-bound laboratories, superseding the costly and time-consuming equipment and methods now in use.

As more is known about the possibilities of the detector, new applications will no doubt become evident. Already it is suggested that it may have important uses in the control circuits of nuclear reactors, and its small size opens many applications in industry, such as flow measurement, thickness gauging, level checking, and other processes where radioisotopes can be used with the detector. END

TRANSISTOR AM-FM PORTABLES ARE HERE...

Sony FM-AM all-transistor portable compares favorably with vacuum-tube versions

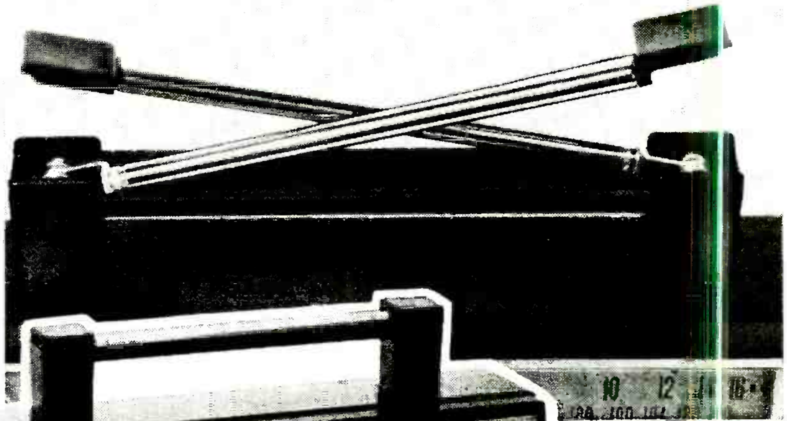
By R. F. SCOTT
TECHNICAL EDITOR

MOST of the transistor FM–AM receivers that have been announced in the past were generally pre-production prototypes that never got as far as the production line, or regenerative or superregenerative types that were sadly lacking in performance and ease or operation. The Sony TFM-151 15-transistor portable has been on the market for about a year and has just been joined by the newer 12-transistor TFM-121. These sets, Japanese imports distributed in this country by Delmonico International (42-24 Orchard St., Long Island City, N. Y.), are superhets that compare favorably with many tube type FM–AM portables.

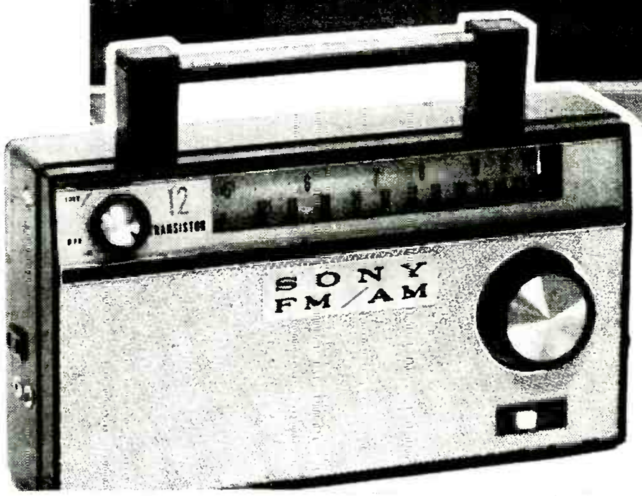
The TFM-121, described in this article, is in an unbreakable plastic case 9¼ inches wide, 5 inches high and 2¼ inches deep and weighs about 3 pounds with batteries. A close look at its circuitry and features will give you an insight into the types of sets you'll be servicing in the not too distant future.

The set uses 12 transistors and 4 diodes and is powered by 4 type C cells in series to deliver 6 volts. It has separate FM and AM front ends, a common 10.7-mc and 455-kc if amplifier, separate discriminator and AM diode detector, FM afc, a three-stage audio amplifier for FM and AM output, and detector and multiplex output jacks. Specifications of the TFM-121 are:

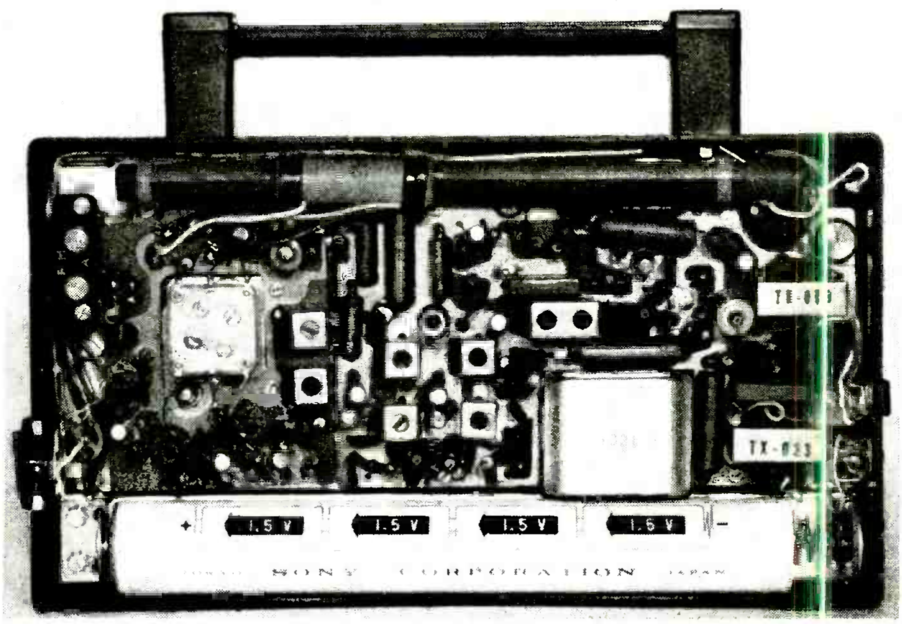
Frequency range	FM 87 to 109 mc AM 435 to 1605 kc
Intermediate frequencies	FM 10.7 mc AM 455 kc
Sensitivity	FM (max) 10 μv. This is approximately the value for 20-db quieting. 20 μv for 30-db signal-to-noise ratio. AM (with built-in antenna) 78 μv
Selectivity	FM –3 db at 150 kc off resonance AM –20 db at 10 kc off resonance



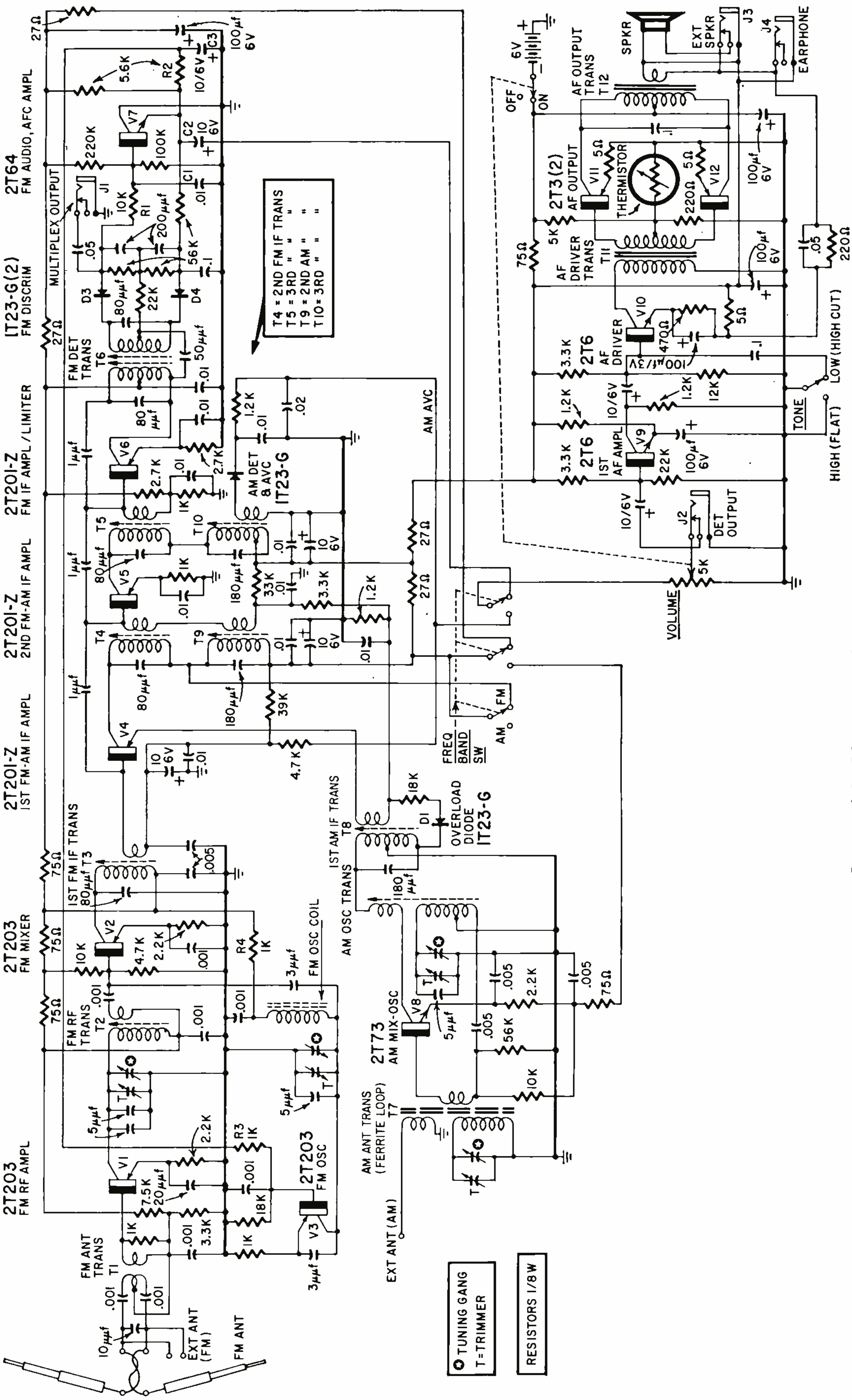
(Above) FM antenna is recessed into radio's carrying handle.



(Left) Sony FM–AM portable. The FM–AM selector switch is at cabinet's right end.



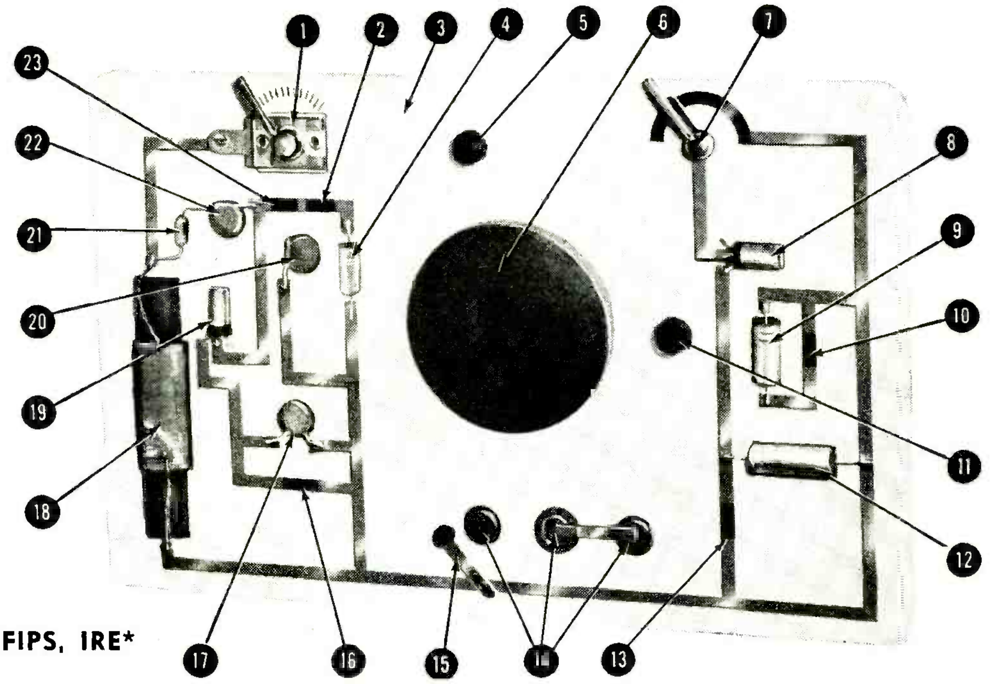
(Below) Inside the all-transistor receiver.



Circuit of the 12-transistor Sony TFM-121.

PAPERTHIN RADIO

Two-transistor receiver on a stiff sheet of paper



By MOHAMMED ULYSSES FIPS, IRE*

1 Variable capacitor, 540–1600 kc (see text)
2 10,000 ohms, 1/10 watt, resistor
3 Chassis, stiff paper, half size of letterhead
4 10 µf, 6 volts, electrolytic capacitor
5 Interstage transformer: primary 30,000 ohms; secondary 1,000 ohms (UTC DI-T23)
6 Speaker (see text)
7 Volume control, 5,000 ohms, 1/10 watt
8 2N109 transistor
9 0.1 µf, 6 volts, electrolytic capacitor
10 5,600 ohms, 1/10 watt, resistor
11 Output transformer: primary 600 ohms; secondary 500 ohms (UTC DI-T20)
12 100 µf, 6 volts, electrolytic capacitor
13 220 ohms, 1/10 watt, resistor
14 4.5-volt battery (3 Mallory RM400R cells in series)
15 On-Off switch (phosphor bronze)
16 50 ohms, 1/10 watt, resistor
17 .05 µf, ceramic capacitor
18 Ferrite-loop antenna, 540–1600 kc (see text)
19 2N109 transistor
20 .001 µf, ceramic capacitor
21 1N34-A diode
22 .01 µf, ceramic capacitor
23 100,000 ohms, 1/10 watt, resistor

Parts layout of the Paperthin radio. For best results, constructors should follow it closely.

WHEN the big boss called me into his august presence that blizzardy morning, the air was surcharged not only outside but in his office, too. There was a distinct high-tension charge in the air as the scowling big man waved me into a chair without a word.

He was puffing on a big, six-inch Havana *Morona* that jutted out into space at an ugly angle of 45°—always a sure sign that all was not well.

For a while he contemplated me silently, as if I were some loathsome transgalactic bug. Finally, he yanked the well-chewed cigar from underneath his big proboscis, rasped his throat and croaked:

"Fips, what in tarnation am I paying you a salary for here? You are supposed to be the new-idea boy on this magazine; instead you are the *no-idea* man. When, in a weak moment, I took you back after I fired you last year, I hoped that you had reformed and buckled down to work. Instead, your head is the same old vacuum—not an idea in your cranium!

"Have you any conception of what goes on in today's electronic world? Here, the Japanese are drowning us in transistors and transistor radios. If you read the papers, you will have learned that in 1959 *Japan made 50% of all the transistors used in the US.* Soon they will make all our radios—indeed, this year their first transistor TV's will begin inundating us. What next? And what are *we* doing to stem that tide? Where is our superior American know-how? What have *YOU* to offer in our hour of need?"

"Boss," I said in my most ingratiating tones, "I have just the thing you want. I have been working on it for a year—a radio that can be *completely* mass-produced by automation, hence can be made cheaper than Japanese sets. It is also the lightest, slimmest radio in the world. Yes, *we can even export it to Japan!*"

For a moment the boss was speechless, but incredulous.

"When can you show me a sample?" he demanded gruffly.

"I will have it in exactly one week from today," I promised. "And you will be delighted with it. *You'll scoop the world.*"

* * *

For quite a while I had been working on my new and revolutionary radio, but it took me many months to iron out the bugs.

My latest model is a stiff, white paperboard, the usual artist's drawing board. It measures 5 inches by 6 inches, but can easily be made the size of a postal card, 5½ inches by 3¼ inches, when mass-produced. Its thickness is about 1/16 inch for the board part. *None of the components project more than ⅛ inch* above the holding surface, hence the *Paperthin Radio* is the thinnest in the world. It is also the lightest.

The model I describe here is made of a stiff paperboard. In mass production, the chassis can be made of plastic, fiber or other insulator.

All components are set in the paper chassis and cemented in place permanently—half the component juts out on one side, half on the other. All the wiring is traced in the usual conducting

* Institute Radio Electronology.

FM de-emphasis	50 μsec
Power output	300 mw max, 150 mw before clipping
Distortion	2% at 50 mw output
Multiplex and detector output	0.1 v rms
Zero sig current drain	FM 18 ma AM 13 ma
Speaker	3 x 5-inch oval PM

Circuit analysis

The circuit of the Sony TFM-121 is shown in Fig. 1. On FM the set uses either the telescopic FM dipole built into the carrying handle or a 75-ohm external antenna. The antenna is transformer-coupled to the base of V1, which operates as a common-emitter amplifier. Primary and secondary of the coupling transformer are untuned. Although the 2T203 transistor in the rf amplifier circuit has an alpha cutoff just above 100 mc, approximately 10 db of gain is obtained through a small amount of controlled positive feedback developed by using an unusually small bypass capacitor across the emitter bias resistor.

The rf transformer's primary is tuned, and the signal is applied to the mixer's base through a low-impedance secondary. The mixer is a common-emitter type, biased for optimum conversion gain at the operating frequencies. The 2T203 FM oscillator is a Colpitts type operating 10.7 mc *below* the signal frequency. When operating below the carrier, the oscillator covers a lower range of frequencies and is more stable and efficient.

The FM if amplifier consists of three 2T201-Z high-gain p-n-p transistors as common-emitter amplifiers. These transistors have a fairly high base-to-collector capacitance so there is a considerable amount of positive feedback from collector to base. Since this causes instability and oscillation, it is neutralized by applying an equal or greater amount of negative feedback around the individual stages. The negative feedback voltage is taken from the secondaries of the second and third FM if transformers and the primary of the discriminator transformer, and fed to the bases through 1-μμf capacitors.

The third if stage (V6) is biased to operate as an amplifier–limiter to drive the Foster-Seeley type discriminator, which uses a pair of germanium diodes. Jack J1 is connected directly to the discriminator output for use with a multiplex adapter. The audio signal and the dc component are passed through the de-emphasis network (R1–C1) and applied to V7's base. This stage is operated as an emitter-follower dc amplifier. The audio signal is routed to the AM–FM switch and a three-stage amplifier through blocking capacitor C2 and the volume control. DETECTOR OUTPUT jack J2 delivers a signal of approximately 0.1 volt to an external recorder or amplifier. The audio amplifier is conventional with a class-B push-pull output stage. A thermistor stabilizes the base bias of the output transistors, ... speaker and phones, respectively.

The afc circuit

One of the characteristics of the FM oscillator is that its output capacitance varies linearly with collector voltage. Since this output capacitance is across a part of the tuning capacitance, tuning would tend to shift with battery voltage. In this set, tuning is simplified and the oscillator stabilized against variations in battery voltage by a very simple afc circuit.

The dc component of the discriminator output is filtered by R2–C3 and applied to the base of oscillator V3 through decoupling resistor R3. Varying V3's base bias varies collector voltage by varying the current flow through R4. The circuit is adjusted so the discriminator's output pulls the oscillator on frequency when it is within 100 kc of the correct setting.

The AM circuit

The AM rf section is conventional. Mixer and oscillator functions are combined in the n-p-n converter, V8. There are two if stages, using V4 and V5 and a germanium diode half-wave AM and avc detector. In vacuum-tube FM–AM circuits using separate front ends, the secondaries of the first FM and AM if transformers are either switched into the if input circuit or connected in series as is done in the input to V5. In the TFM-121, the first if amplifier (V4) operates as a common-emitter amplifier with the 10.7-mc if carrier applied between the base and ground on FM, and as a common-base amplifier with the 455-kc if carrier applied in series with the emitter on AM.

Transistor if amplifiers are easily overloaded by strong signals and it is handle the wide range of avc voltages developed by the conventional diode or class-B transistor detector. If the avc voltage is too high, it biases the transistor for nonlinear operation and the stage distorts. On the other hand, too little avc voltage causes overloading on strong signals. Most transistor radios have some form of auxiliary avc that goes into operation on very strong signals and prevents overloading. The overload diode in the TFM-121 is somewhat different from those that we usually run across.

Overload diode D1 and its 18,000-ohm series resistor are shunted across the lower half of the primary of the first AM if transformer, T8. The diode's cathode returns to ground through the tap on the transformer and its anode is connected to the high end of V4's emitter bias resistor. The effective resistance of this shunt network is determined by D1's forward resistance. When the resistance is very high, the converter's overall gain is very high. When it is low, it reduces the Q of the tuned circuit and the stage gain drops.

Under normal signal levels, D1 is back-biased to cutoff by the voltage developed across V4's emitter resistor. The resistance shunting T8's primary and the converter stage gain are high. When a strong signal is tuned in, a large avc voltage is developed across the detector load and applied to V4's base. This reduces emitter current and lowers the back bias applied to D1. The reduction in bias lowers D1's effective resistance so it looks more and more like a small resistance across T8's primary. The Q of the transformer drops and the converter's output falls below the level that overloads the if amplifier. END

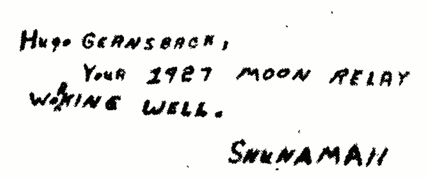
LUNA PART OF SIGNAL SYSTEM

THE moon is a component in the new communications system demonstrated by the Navy late in January. Signals originating at Annapolis, Md., were sent to the moon, reflected to a receiving site near Pearl Harbor, Hawaii, then automatically retransmitted and returned via the moon to the receiving station at Cheltenham, Md., making the round trip in 5 seconds.

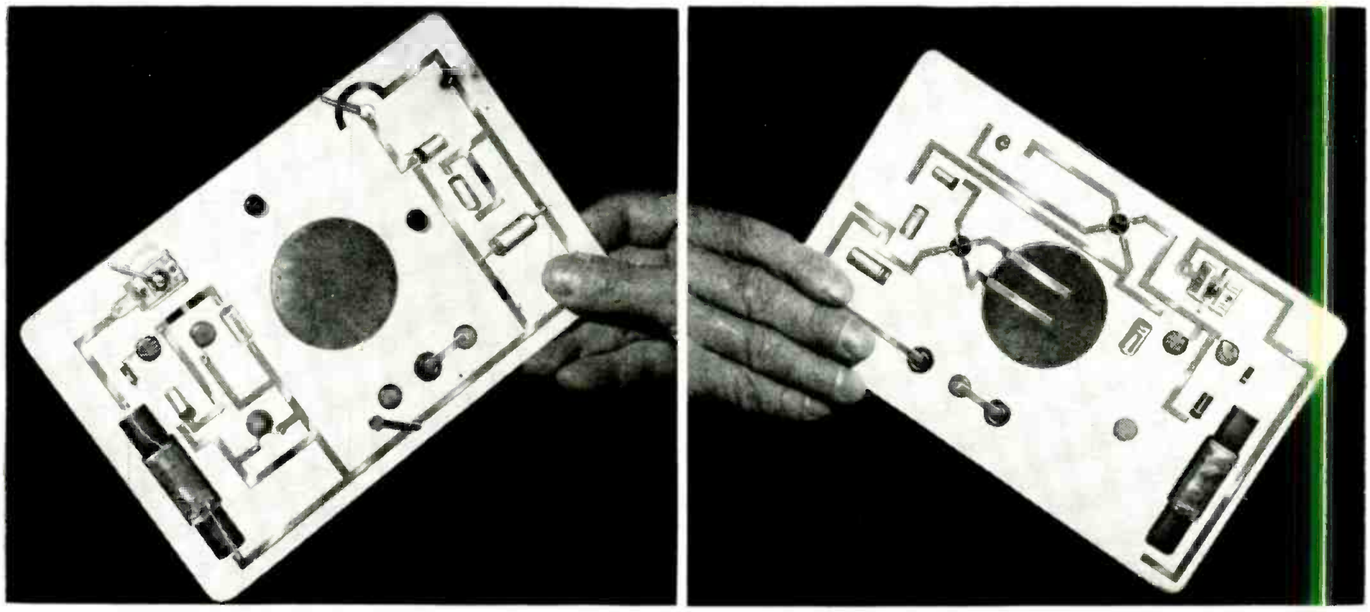
Four teletype channels were operated in a multiplex setup to which, it was stated, more channels could be added. A facsimile circuit was also in use, and voice communication is also being experimented with. This system is usable whenever the moon is visible at both terminals, a period ranging from 5 to 12 hours per day. Since moon relaying effectively places the terminals within line of sight of each other, ultra high frequencies can be used and the circuit is immune from disruption by ionospheric disturbances. It is also practically unjammable.

Power on each side is 100,000 watts, concentrated into a tight beam and raised to an ERP (effective radiated power) of 440 megawatts by high-gain, fully steerable 84-foot dish antennas at each transmitter and receiver site. The bandwidth is 16 kc and the present frequency in the order of 440 mc.

The idea of a moon relay was first proposed by Hugo Gernsback in his magazine *Radio News* in 1927, and among the messages transmitted during the demonstration was one of congratulations to him for the success of his 1927 concept. In the 1927 article, Gernsback foreshadowed the use of very short waves and beam antennas, both at the time rather unfamiliar ideas to the average communication engineer.



Facsimile message received at U.S. Naval Communications Station, Washington, D.C. from Pearl Harbor, Hawaii, via moon relay system, Jan. 28, 1960.



Front and back views of the Paperthin radio. Note that almost all components are standard and readily available.

ink. For large-scale production, standard-method printed-circuit techniques will be used.

The antenna is a flat, thin strip of ferrite wound with about 100 turns of No. 30 enamel wire. It is cemented in a *tight-fitting* rectangular hole in the paper chassis. All fixed capacitors and resistors, transformer, batteries, etc., are standard makes and are cemented in holes in like manner.

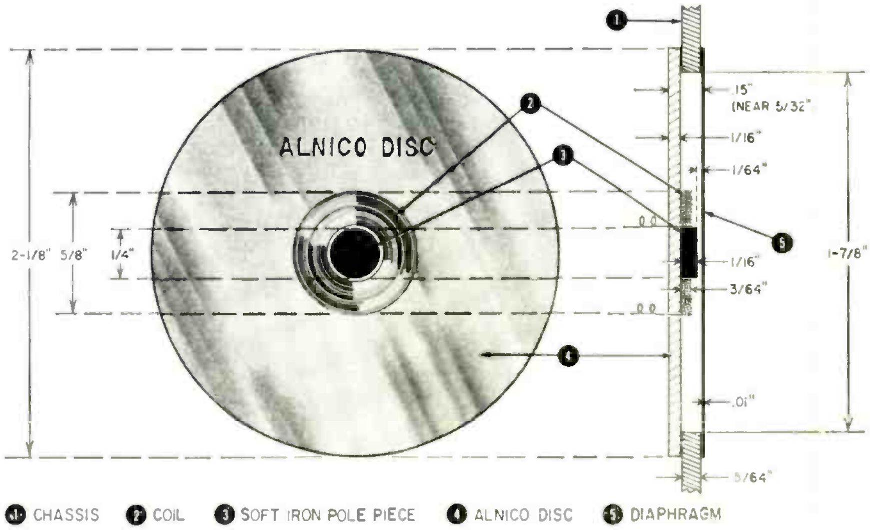
The tuning capacitor is a standard ¾ x ⅝-inch trimmer. Normally this has a capacitance of 3 to 40 μμf. This is not sufficient for broadcast tuning range, as a minimum of 360 μμf is needed. To increase the capacitance, I removed the .06-cm-thick mica insulator and substituted a .005-cm piece of special high-dielectric *polykap* plastic film.† This combination gives a little over 360 μμf.

A short length of brass rod is soldered to the adjusting screw to replace the usual tuning knob, which would take up too much room. To insulate the handle, a short piece of soft-plastic tubing is slipped over it.

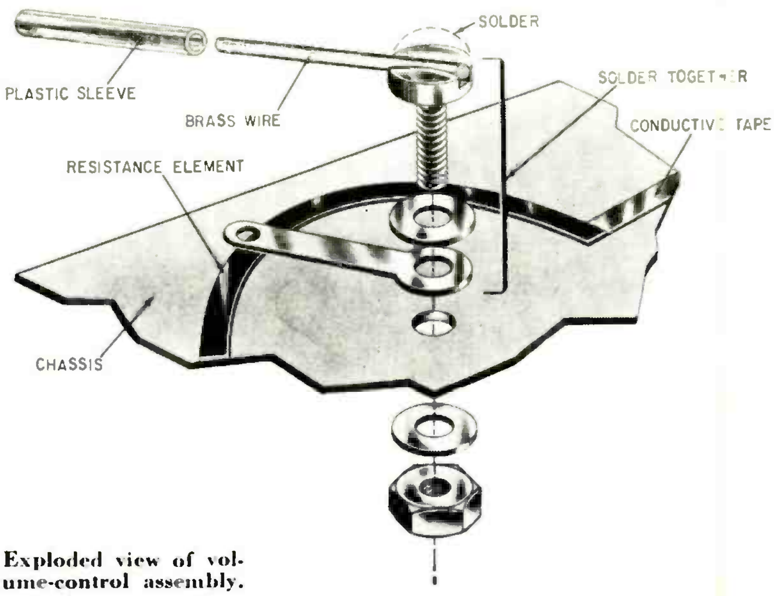
Now for the loudspeaker. This was the most troublesome component, because no *thin* electromagnetic loudspeaker is commercially available; none has ever been made. The detailed illustration explains its construction as conceived by me.

Because of its slimness, I named it the Leptospeaker (*Lepto*, from the Greek, thin.) Its main part is an Alnico disc 2⅛ inches in diameter 1/16 inch thick. It is magnetized in such a way that one pole forms the center part of the disc; the other pole is located around the rim. In the center is a soft-iron pole piece 1/16 inch high by ¼ inch in diameter. On this is wound a magnet coil of No. 38 or 39 enameled copper wire to

† Not available commercially as yet.



Details of speaker construction.



Exploded view of volume-control assembly.

the approximate impedance of 500 ohms.

This assembly is fastened with a special *epoxy* cement over a 1⅞-inch hole in the paperboard chassis. On the other side of the hole there is fastened with epoxy cement a standard 2⅛-inch iron telephone diaphragm.

The arrangement makes an excellent loudspeaker that requires no baffle, *because the stiff paperboard acts as its own baffle*. As the chassis is only about 1/16 inch thick, the vibrating speaker diaphragm is sufficiently distant from the pole piece so that it cannot touch it. (NOTE: The chassis cannot be too thin or the diaphragm will touch the pole piece and rattle.)

The two transistors are cemented *flat* into two holes cut into the chassis, one half protruding on one side, the other on the back side.

The same procedure is used with the batteries; flat spring clips for contacts are provided on both sides of the chassis—this assures positive connections.

For simplicity, one of the battery spring clips is mounted on a washer and riveted to the chassis. Moving the clip sideways breaks contact. *This becomes the off and on switch.*

The two-transistor circuit, as well as a parts list, used for the paperthin radio are given here. This receiver is excellent for city and suburban purposes. Extra transistors can, of course, be used with different circuits to increase range and output—but then the cost, too, goes up.

To increase the volume, the paperthin radio can be placed on a resonant wooden box. Ordinarily it can be placed at an angle on a simple wire frame, on a table or shelf. It needs no enclosure.

After the receiver has been tested, it should be sprayed on both sides with a plastic film to keep out moisture and dirt. When mass-produced, both sides will be covered with a tight-fitting, stiff plastic contour film (called "blister packaging"). NOTE: Tuning handle, off-and-on switch, loudspeaker diaphragm are *not* covered with blister packaging.

★ ★ ★

True to my promise, a week after our meeting, I marched into the boss' office and placed my brainchild on his desk. I switched it on and, if I must say so in all modesty, it performed beautifully, bringing in at least six stations at full loudspeaker volume.

The big boss, scowling ferociously, picked it up, turned it around and put it through its paces himself.

"And what do you call this contraption?" he bellowed.

Somewhat taken aback, I said: "This is the world's thinnest, lightest and perhaps the lowest priced *paperthin radio* ever invented."

"So," said he in his bossy voice, "and how much do you figure its cost if made by the million?"

"About $2 or $3. It could easily be sold for $4 or $5 at a good profit."

"And who would buy such a gadget?" growled the boss editor.

"Why, everybody, of course, and particularly children!"

"Great," spat out the Big Man. "And now tell me how do you repair such a toy?"

"Repair it?" I answered with some surprise. "The paperthin radio is so well constructed, it rarely needs repair. If it does, throw it away and get a new one—it's that cheap!"

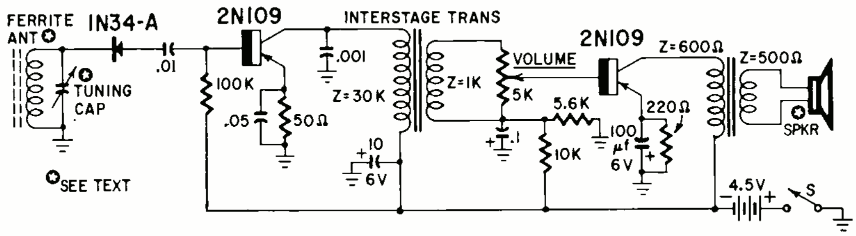
"Hah, hah, hah," exploded the chief, his neck swelling a purplish red. "That's all I wanted to know! Here we publish a respectable magazine that's supposed to uplift our industry and lead it. Then you . . . you infernal idiot, come along with a toylike thingumajig that will be sold for next to nothing so at the end of the year our set manufacturers will have built 20,000,000 of your phantom radios and will have made less profit than they make building 1,000,000 *decent* radios. On top of that, they must invest tens of millions of dollars in automation machinery, which they may not get back in 10 years!

"Worse, yet," he shrieked in an apoplectic rage, "a high percentage of our readers are service technicians, who make their living repairing sets in this country. Has it occurred to your evacuated brain how the servicing industry will receive the news of your radiotic invention? They'll boycott us for life and the radio-electronic industry will bury us, you . . . you disgustingly stupid copy of a destructive and undermining termite—get out, OUT, and stay out!"

With that, the infuriated boss hurled my radio at me with such force that it would have smashed *any* receiver ever made.

Not mine. Luckily, I caught it and ducked out of the office at top speed. Somehow, in catching it, the on switch closed. As it was exactly 11 am, Station WROT came on. Before I turned it off, the announcer had said: "Here is the news on

APRIL 1ST"



Circuit of the 2-transistor set.

INVENTORS of RADIO— Thomas A. Edison

Radio in 1885 — eleven years ahead of Marconi

By ERIC LESLIE

EDISON'S exact role in the history of wireless is clouded in confusion—of facts, of interpretations and even of language. One thing is clear. A dozen years before Hertz demonstrated the existence of radio waves, Edison had recognized a strange new phenomenon, which he named "etheric force" and predicted that it might be useful for communication.

Edison's discovery was due to his remarkable powers of observation. While working with a "vibrator magnet" one night in November, 1875, he noted a peculiar spark when a piece of metal was touched to the core of the magnet:

It seemed so strong that it struck us forcibly there might be something more than induction. We now found that if we touched any metallic part of the vibrator or magnet we got this spark. The larger the body of iron touched to the vibrator the larger the spark. We now connected a wire to X. [Fig. 1] the end of the vibrating rod & we found we could get a spark by touching a piece of iron to it & one of the most curious phenomena is that if you turn the wire round on itself & let the wire touch any part of itself you get a spark. . . . This is simply wonderful & a good proof that the cause of the spark is a *new unknown force.*"

Not everybody agreed, and when he demonstrated his new force at the Polyclinic Club of the American Institute, he created a small storm. His opponents seemed upset by the name "etheric force," which now seems either an extremely lucky accident or a marvelous burst of intuition. Others were more sympathetic, and *The Operator*, a telegraphers' journal, printed a long article, based on an interview with the young inventor, in which it was suggested that the force might be applicable to telegraphy:

"The cumbersome appliances of transmitting ordinary electricity, insulating knobs, cable sheathings, and so on, may be left out of the prob-

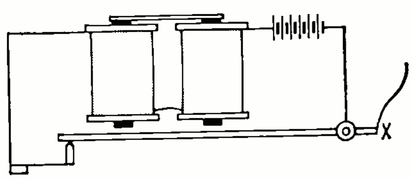


Fig. 1—Edison's vibrator.

National Park Service

Thomas A. Edison as he looked in 1883.

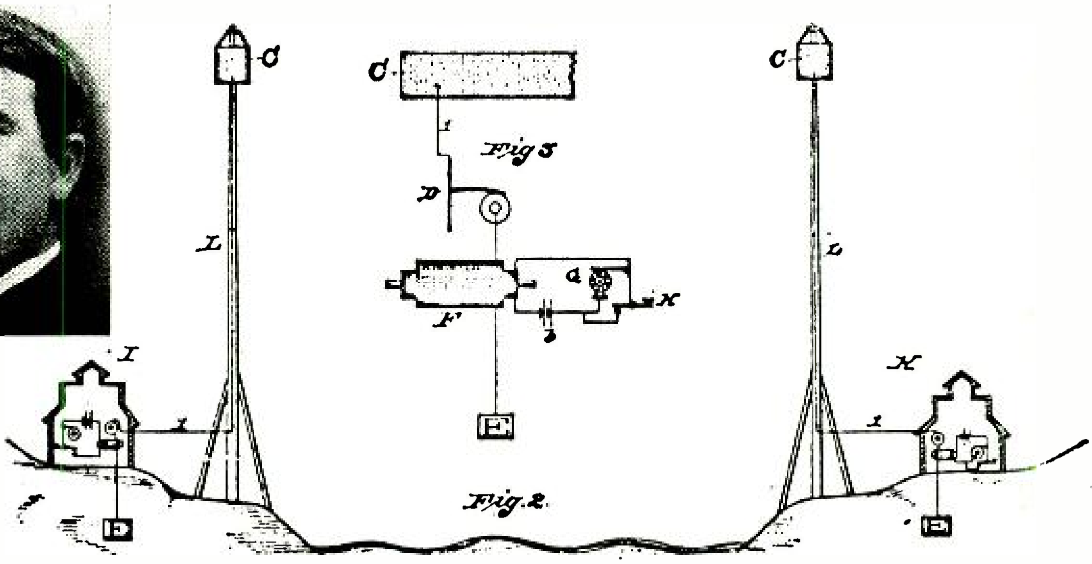


Fig. 2—Edison's patent drawing shows the works of his "Means for Transmitting Signals Electrically."

lem of quick and cheap telegraphic transmission: and a great saving of time and labor accomplished." An author in the *Scientific American*, Dec. 18, 1875, reports ". . . by this simple means signals have been sent for long distances, as from Mr. Edison's laboratory to his dwelling house in another part of the city, the only connection being the common system of gas pipes. Mr. Edison states that signals have also been sent the distance of 75 miles on an open circuit, by attaching a conducting wire to the Western Union telegraph line."

Ten years later—May 23, 1885, still two years before Hertz—Edison applied for a patent on a "Means for Transmitting Signals Electrically." The equipment (Fig. 2) consisted of an induction coil with a rotating or vibrating circuit breaker in the primary, and a high-voltage secondary with one end attached to a "condensing plate" on a high tower and the other to earth. The diagram looks like an operative radio hookup, though the type of inductance probably used and the breaking of the primary rather than the secondary circuit makes it probable that any radio frequency radiated came from the primary by capacitance, or was due to accidental sparking and arcing in the secondary. At any rate, the patent was considered good enough to be purchased for $30,000 by Marconi shortly before it expired.

Because of a confusion of language, Edison's wireless had been considered an induction device. Today "induction" is almost invariably an abbreviation of "electromagnetic induction." In 1885, with alternating current unheard of, it meant "electrostatic induction" unless qualified. The term is used in full by Edison in his patent.

The confusion is increased because the only practical application of the invention, the Lehigh Valley moving-train "grasshopper telegraph" probably depended mainly on electromagnetic induction. Yet in describing that installation to a reporter, Edison said, "This invention uses what is called static electricity."

Edison's work on the vacuum tube, and his patented "Edison effect" on which all hot-cathode electron tubes are based, are too well known to mention here. With his etheric force, his wireless transmission patent, and the Edison effect, he had in his grasp a complete radio system. But he missed the opportunity to establish the first wireless communications network because he did not realize what these three things might do in combination. He himself was heard to remark much later in life that it was a pity he had not seen any connection between them.

END

SPIRAL CONICAL ANTENNA

COVER FEATURE

By W. W. MACALPINE*

THE antenna on this month's cover, although conceived early in 1959, is not yet a finished development. It was built to see how such a design might perform. There haven't been enough tests to give any conclusive results.

The cone is made of thin sheet brass cut into a conical version of the Archimedes spiral. It is cut from a flat semicircular sheet and formed around a pyramidal frame consisting of six insulating rods. (The brass would be silver- or copper-plated in a finished model.) The slant cone has a 30-inch base diameter, 30-inch slant height, 26-inch axial height and a 60° apex angle. There are 10 turns on the spiral. An earlier model had the same cone dimensions, but only a five-turn spiral of 6-inch-wide brass.

The later model has undergone a few tests. It was mounted with its cone axis vertical to give an omnidirectional pattern in the horizontal plane. A horizontal conducting plane was set up close to the cone's apex. The plane was a brass disc, sometimes cut into a left- or right-hand spiral and at other times an uncut sheet. Feed was by coaxial cable connected between the plane and the spiral's apex; ground to the spiral and center conductor to the disc, or vice versa. This drive resembled that of the "discone" antenna (see *Reference Data for Radio Engineers*, fourth edition, page 681). However, the spiral cone was not likely to have the broad-band characteristic of the discone, since the aperture of the spiral antenna is small compared to the free-space wavelength at the lowest frequency of resonance.

The five-turn spiral cone had a resonance at 14 mc with a voltage standing-wave ratio (VSWR) of 1.25 to 1 on a 50-ohm line. A test with a transformer of 4–1 impedance ratio (stepup to spiral) gave SWR a little under 6 to 1 on a 50-ohm line over the entire range of 7 to 17 mc. The impedance plot was

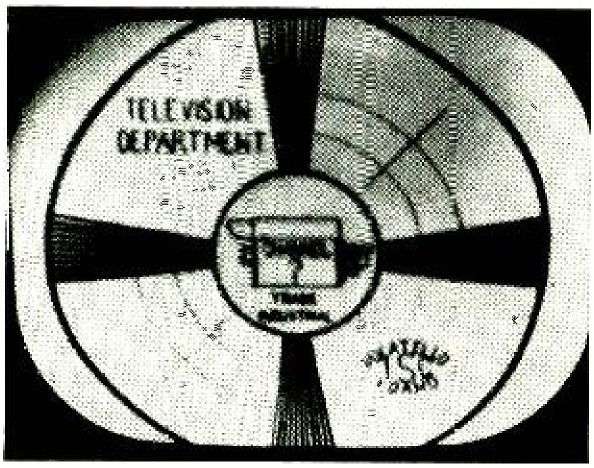
roughly a circle about one and one-half times around, on the Smith chart.

Other drive systems are possible, such as shorting the apex of the cone to the plane and driving between the apex and a tap on the cone. Another system would use two cones on the same axis with adjacent apexes as in the biconical antenna. Drive would be balanced feed to the apexes, or to taps on the cones if the apexes are shorted.

END

*Development Engineer, ITT Labs.

TELEDUCATED TECHNICIANS



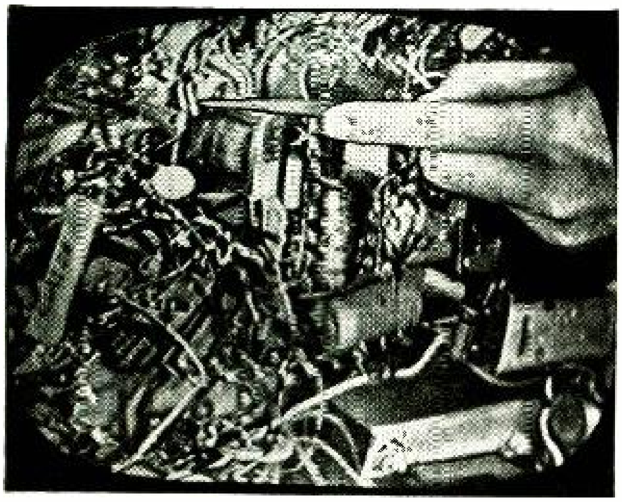
By JIM MELTON

IF TV can be used to educate students in non-technical subjects, why not use it to teach TV servicing?

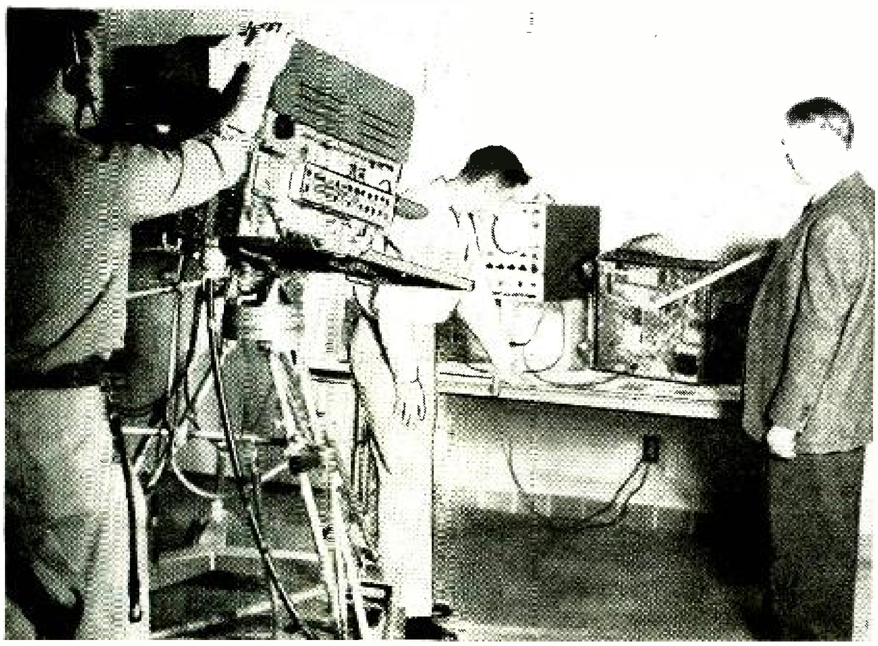
Idaho State College's school of trade and industrial education at Pocatello, a pioneer in education by closed-circuit TV, was confronted with a problem: How to give 48 students individualized instruction in TV in the face of a shortage of time and instructors.

Since 1941, the college had been experimenting with closed-circuit television, and its student-operated TV system now pipes classroom lectures and demonstrations to the Pocatello public schools. So it was only natural that the trade and industrial education school—which operates the closed-circuit teaching system—should turn to TV to teach its own student technicians.

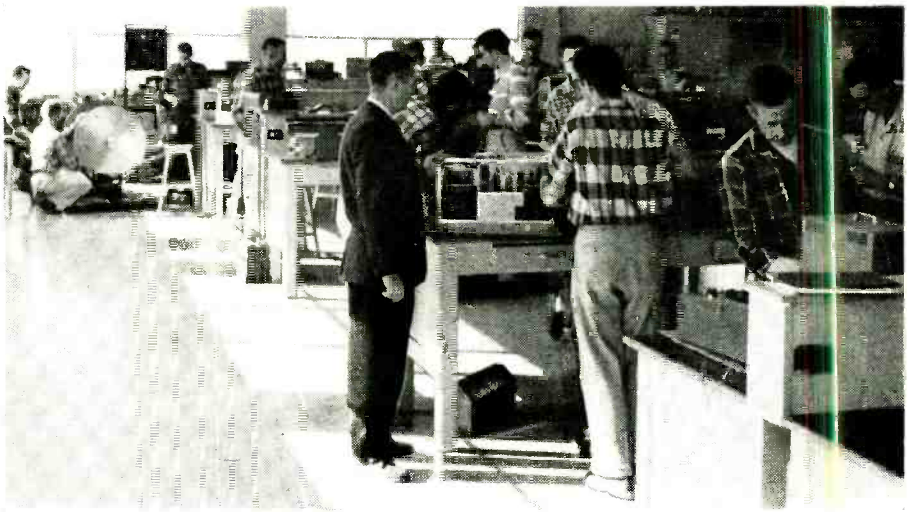
The school found that one instructor could teach TV alignment to all 48 in one-third the time it formerly took 4 teachers instructing students in groups of 4. What's more, the teleducated technicians made higher average grades in lab tests than former classes trained by conventional techniques.



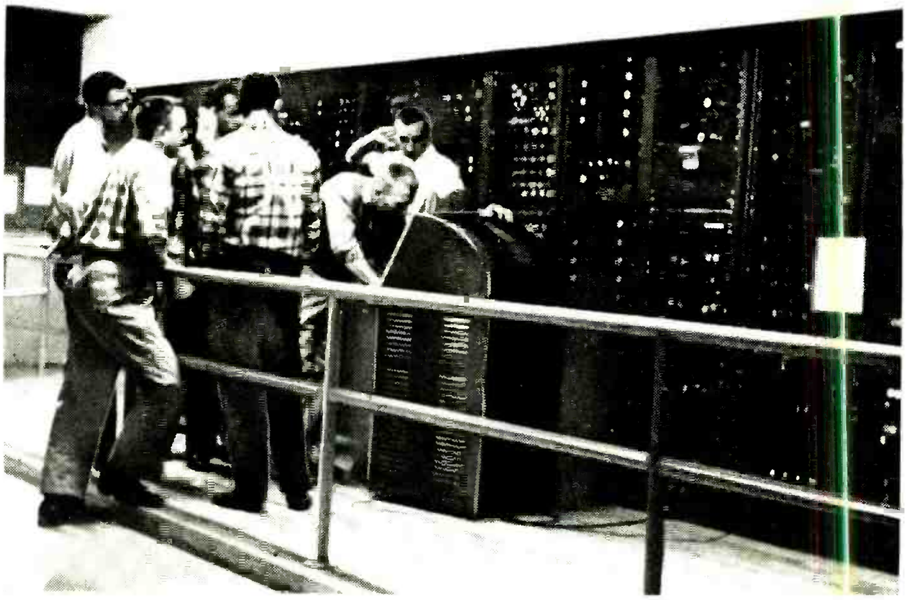
"Individualized instruction" can be given an entire class at once via 27-inch screens as the camera closes in on a chassis to let the instructor point out a component magnified to many times its actual size. In conventional classes the necessity to crowd close to the receiver limited demonstration sessions to 4 students. Patterns from a 5-inch oscilloscope are also enlarged to TV-screen size.



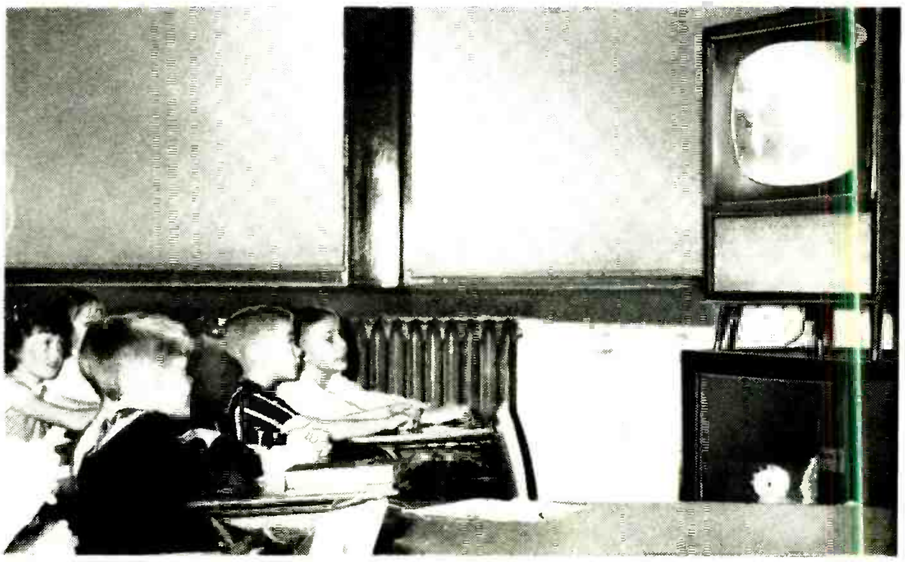
The camera focuses on a TV chassis during a lesson. Holding the pointer is William H. Shiflett, head of the school's electronics division which operates ISU's closed-circuit project. Three cameras are used in the TV servicing course—one fixed on an oscilloscope, one on the receiver and test equipment and the third following the instructor as he works on the set and uses the blackboard. A two-way sound system lets students viewing the televised courses ask questions.



Students return to the laboratory to put their lessons to practical use. In lab tests, the slower students appear to have received the greatest benefit from the changeover to tele-education. Much of the equipment used in the college's educational TV program is constructed by students in this laboratory.

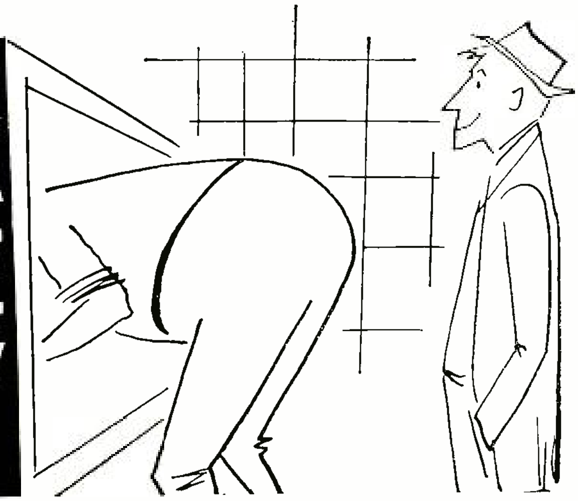


Idaho State's closed-circuit TV control room, completely manned by students, has equipment which would cost $300,000 if purchased commercially. Included are six camera chains—two image Orthicon studio units, two field units, a Vidicon and an Iconoscope. The televised signal is of commercial standard and quality.



Elementary students at Pocatello's Jefferson School watch a televised lecture demonstration on music originating from the student-operated Idaho State College TV facility. The telecourses are distributed to schools through the courtesy of a local community antenna system which has donated a cable channel for morning use. The antenna system's private subscribers can watch the school instruction in their homes.

BENCHWORK CAN BE TRICKY



Red and Fuzzball run into a couple of color TV problems during a day at the bench

By ROBERT G. MIDDLETON

"LOOKING for the built-in engineer?" asked Red facetiously. Fuzzball pulled his head out of the cabinet, bumping his slightly bald spot on the sharp edge (see Fig. 1).

"* * * * *," he replied cordially. "It shouldn't happen to a dog but it does."

"You know," offered Red, "if you remove them screws, you can lift off the sides and top of the cabinet. Save you some lumps."

"Now he tells me. Why in Sam Hill can't these color TV manufacturers standardize! Every factory uses their own ideas and gets the technician fouled up like Hogan's goat."

Red held his hands up to his head and waved his forefingers like an ant's antlers. "Stop that old stuff," he said, "and get back with us. What are you looking for in there?"

"The purity went out and won't come back," Fuzz complained. "I was looking to see if the rim magnets had broken loose."

"You must be ill," Red consoled, lifting off the sides and top from the cabinet. "Look at them rim magnets—how could they break loose (see Fig. 2)?"

"I'll buy that," replied Fuzz, "but what's happened to the purity? Besides, if you're so smart, why ain't you rich?"

"Let me clue you in, buddy," retorted Red, "I am not interested in being the richest man in the graveyard. Now, do you want me to show you how to set up the purity?"

"I'm with you."

Red watched the screen, while Fuzz fiddled with the purity magnets and the rim magnets. "The left-hand side just won't come in on a red field," he finally announced. "Did you adjust the yoke position on the picture tube?"

"I'm way ahead of you," Fuzz replied. "I also measured the high voltage, and it's right on the button."

Red's eyes narrowed slyly. "Where's the degaussing coil then?" he asked. "Trouble with you is you don't demagnetize your tools, and first thing you know you got the shield of the picture tube magnetized."

Fuzz shrugged his shoulders. "Down there under the bench," he said.

Red yanked the rim magnets back in their shunts and plugged in the degaussing coil while Fuzz lit a wilted cigarette from behind his ear. He held the coil squarely in front of the picture-tube screen for half a minute, and then backed up slowly till he reached the end of the cord. "You can unplug the coil now," he announced. "If you had degaussed the tube shield, you wouldn't have this headache."

Fuzz gave Red a double take and handed him a box of aspirin. "Take two," he advised, "they're small. For your information, I have already degaussed the tube shield."

"So you magnetized the shield again, after you degaussed it," Red countered.

"I'm listening."

"Stop listening and start adjusting them purity magnets."

Red stood confidently in front of the screen while he gave the orders. "No," he directed, "try a little stronger field—no, go back now. Turn the assembly clear around. Put the tabs clear together—no, push that rim magnet closer to the tube—where you got that purity magnet anyhow, on the base of the tube?"

Let's blast

Fuzzball managed a twisted grin. "OK, Einstein, shall we dynamite?"

"I'd like to shove that dynamite down your throat, wise guy. It only takes one like you to fox up a chassis, and ten techs to fix it."

"Maybe it's the picture tube," Red suggested.

"Maybe it ain't, too," Fuzz retorted. "That purity was OK until 10 minutes ago, and then it suddenly it went out and won't come back. A picture tube isn't going to warp and flip that quick."

"It figures," agreed Red. "Suppose we reconstruct the crime. Let's go over this case from the beginning, and see if we pick up a clue."

"Well," Fuzz sail thoughtfully, "I measured the high voltage—it's OK. I centered the yoke and slid it back and forth for the best purity. Adjusted the neck purity magnets. Then I trimmed up the rim magnets. The red field looked fine, except for the lower left-hand corner—it was out just a little bit."

"But did you get the tube in rough

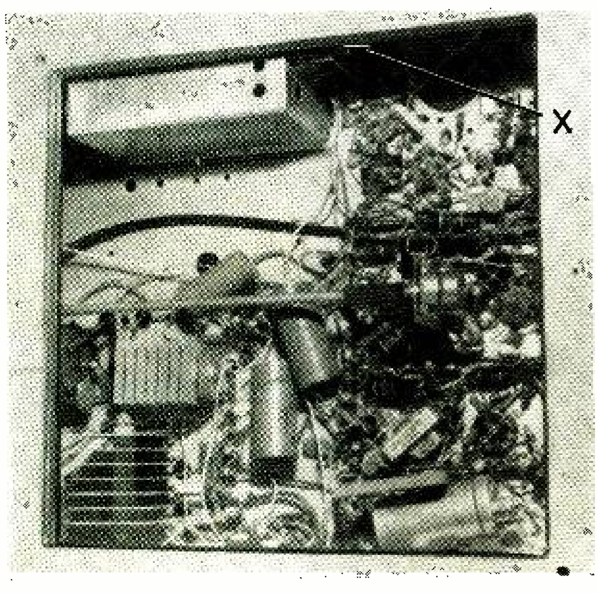


Fig. 1 — X marks the spot where Fuzzball got his lump.

convergence first?" demanded Red.

"Right," Fuzz replied, "I had the purity almost but not quite perfect. Am I getting through to you?"

"So how did you lose purity?"

"Here's when it happened—the red field looked fine, except for the lower left-hand corner."

"You said that already."

"You didn't remember."

"Nothing of the sort—let's get on with the sordid details."

"OK. I plugged in the degaussing coil because it looked like the lower left side of the tube shield was magnetized. I gave it the treatment."

"Yeah, but how about the chassis?"

"You're really reaching for it. I set the corner of the chassis over the coil and let her rip for a full minute."

"Sounds good," admitted Red. "We're still missing something here—maybe we're doing too much talking. Suppose I watch while you re-enact this crime—maybe there's something you forgot to tell."

Fuzzball plugged in the degaussing coil and held it against the screen of the picture tube. Red put his fingers in his ears. The rim magnets were chattering like false teeth at an old-maid's sewing circle.

"Lordy have mercy!" Red blurted. "You didn't retract the rim magnets into the shunts!"

"Are you supposed to?" asked Fuzz innocently.

"My friend, that degaussing coil is strictly murder. Do I have to draw a diagram? If it takes the magnetism out of a tube shield, it's going to take the magnetism out of the rim magnets, too. Next thing, you'll lay the coil down over that voltmeter and we'll have to send it in for repair too."

Fuzzball grinned sheepishly. "OK, Red, give yourself a cigar. I'll bounce. In fact, I'll buy the suds this evening."

"And that," Red remarked, "reminds of the story about Oley Olson. It seems like he got so expert running the circular saw that he could do the job single-handed. Hit a spike one day, though, and sawed off a couple fingers. So the boss asked Oley to show him how the accident happened, and . . ."

Fuzz made a threatening back-hand at Red.

After replacing the weakened rim magnets and restoring proper purity, Fuzz lapsed into silence till after lunch.

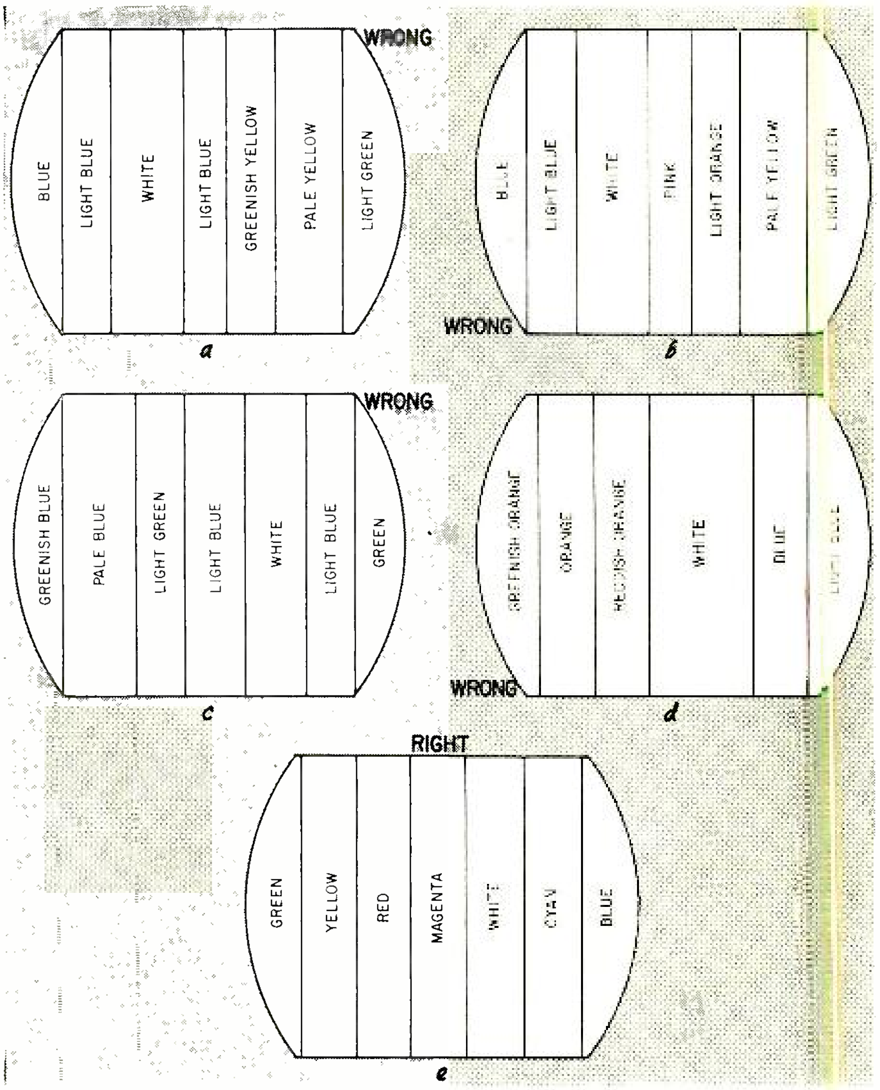


Fig. 3—Some of the patterns Fuzz was getting on the screen: a, b, c, d—all wrong; e—success at last.

In the afternoon

"This color set is for the birds." Fuzz broke the silence barrier.

Misery loves company, and Red drifted over to Fuzzball's bench to share his trouble—cautiously of course. He had the receiver fired up with a color bar pattern, and it looked like the set was working OK. The bars were locked in good, the colors bright and clean.

"So what's the bind?" Red asked.

"It's these crazy mixed-up colors," said Fuzz impatiently. "Look!"

Fuzz turned the color phasing control through its range, and Red saw that he was only saying it because it was true. This generator puts out a green–yellow–red–magneta–white–cyan–blue sequence—Fuzz was getting one or two bars to show correct colors, but all the other bars were way off. The proper bar sequence wouldn't show (see Fig. 3).

"How's about that?" demanded Fuzz, stamping on his fresh-lit butt.

"This is a jolly bit," agreed Red. "Maybe the quadrature transformer is out of adjustment."

Fuzz looked at Red with a sheepish grin. "Sure, I must have lost my head."

Fuzz reached for a diddle-stic and turned one of the slugs in the quadrature transformer. The colors changed—a couple of bars began to look better and the others got worse. "Hand me that other diddle-stick, Red."

Now, Fuzz had a stick in each end of the transformer and was turning both slugs at the same time. Red scratched his head. "Still off home base," he said. "Let me turn the color

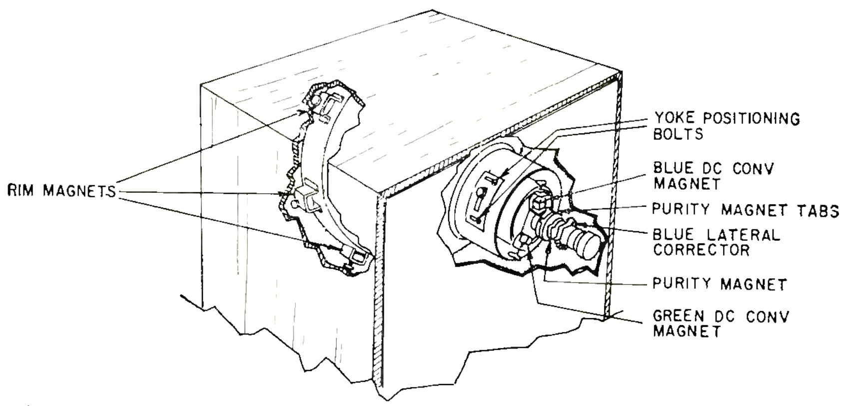


Fig. 2—The rim (field-equalizing) magnets are mounted pretty solidly, as Red pointed out.

phase control while you turn them slugs."

Red twisted the phase control back and forth while Fuzz kept working on the quadrature slugs. All the bars except the white one were changing color, and they got about any color they wanted, but not the right sequence. "No dice," announced Red finally.

"So what do we do now?" asked Fuzz, "send it back to the factory?"

"No!" exploded Red. "Let's sit down and analyze this thing carefully."

"I'm with you," agreed Fuzzball, "but we really got this dog loused up now. We're out in left field on quadrature."

"Speak for yourself," advised Red. "I'll get the quadrature in like Flynn, and we can take it from there."

Red switched the color bar generator to R − Y output, and connected a scope to the output of the R − Y detector in the chassis. A square wave appeared on the scope screen. Next, Red turned the slug for R − Y in the quad transformer, and the square wave increased in height. Finally, the square wave went through peak height and started falling. Red backed off a turn and left the slug at peak.

Then he switched the color bar generator to B − Y output. Just a little bit of deflection showed on the scope screen. Red touched up the R − Y quad slug to get a straight horizontal trace on the scope—the only sign of output from the R − Y detector was a couple of sharp pips on the trace.

"You can get a test of the R − Y detector output on an R − Y signal," Red explained, "but then you want to make the final quad adjustment on a B − Y signal, because a null is sharper and more accurate than a peak adjustment."

"That's right," agreed Fuzz. "They told us at the factory color school that an R − Y detector will null on a B − Y signal, but how about them little pips?"

"Color detectors are usually less than 100% perfect," explained Red. "An R − Y detector nulls on a B − Y signal, but there is a little spurious output from the detector when the edge of the B − Y bar is hitting the circuit."

How about the B — Y?

"Can we adjust the B − Y quad the same way?" asked Fuzzball.

"Sure thing," Red said, "let's get with it."

Red connected the scope input lead to the output of the B − Y detector, and once again a square wave turned up on the scope screen. By turning the B − Y slug in the quad transformer, Red peaked the output. The peak response was practically the same as when he was adjusting the R − Y detector.

"That shows," Red explained, "that both color detectors are putting out OK. Now, let's check the null of the B − Y detector."

He switched the color bar generator to R − Y output, and a slight touchup of the B − Y quad slug nulled the output. As before, there were a couple of small sharp pips on the horizontal trace.

"Let's see what the simultaneous display looks like now," suggested Fuzz.

Red switched the color bar generator to the seven-bar color display.

"No good," advised Fuzz. "Wait till I adjust the color phasing control."

"Save your time," advised Red. "The color phase is right when the detectors are nulled. We got some other kind of trouble here."

"How about the matrix?" Fuzz suggested. "Maybe there's circuit trouble in the G − Y matrix?"

"Could be," agreed Red. "Let's make a quick test."

He connected the scope input lead to the output of the G − Y matrix and switched the color bar generator to G − Y /90° output. A straight horizontal line appeared on the scope screen. Then he switched the generator to G − Y output, and a square wave showed on the screen.

"The matrix is working OK," Red announced with finality. "We'll find the trouble somewhere else."

"Could it be the picture tube?" asked Fuzz.

"No," Red replied, "the gray scale is OK, and all three guns have output. We saw that right along."

"So what now?"

"Let's sit down and analyze this thing calmly," advised Red.

"You said that before—you're getting in a rut," Fuzz replied.

"Do you have a better suggestion?"

"We can call the factory," came from Fuzz. "Pass the phone."

Listening to one end of a phone call can be maddening, and this one gave Red plenty of time to stew while Fuzz carefully recapped the symptoms. Red watched Fuzz's face fall—"One will get you ten that we're a bunch of high-grade idiots," he predicted.

Fuzz finally hung up the phone with a wry grin. "Carl figures we plugged the red and green chroma leads into the wrong grids of the picture tube during convergence. He says to check the service notes on this."

Silence ruled while Fuzz thumbed through the pages and checked the plug-in chroma leads. Finally he announced, "* * * * * *!" He quickly reversed the red and green leads. Now, with the generator switched to the simultaneous bar display, the picture tube lit up with the proper pattern.

Fuzz checked off the color bars in a subdued voice. "Green, yellow, red, magenta, white, cyan, blue," he chanted. "For 20 years," Fuzz remarked, "my dreams have been in black-and-white—but tonight, I will have a nightmare in NTSC colors."

"Maybe you better see a head-shrinker before you go home," suggested Red.

"Very interesting—in fact, it's fascinating," was Fuzzball's considered conclusion. END

NEXT MONTH

Poor Man's Direction Finder

An ordinary portable radio may be directional enough to make it usable as a homing instrument. A few additions can make it a really sophisticated direction finder for woodsmen or sailors.

Microminiature Transistor Amplifier

Possibly the smallest amplifier that can be built from standard components, this unit can be used in many spots where ultracompactness is essential.

Electronics Can Save Your Heart

First of series on the important subject of electronics in medicine, this article explains the electrical factors in heart action and describes two important instruments: the electronic Pacemaker and the heart defibrillator.

TV Technician Repairs a Weld Timer

How a TV man used the experience gained in his work and the instruments from his own service bench to spot trouble. and cure it, in what at first sight was an entirely unfamiliar piece of equipment.

we troubleshoot the

HORIZONTAL OSCILLATOR

By R. D. JACQUES

HORIZONTAL oscillators have become pretty well standardized, at least down to three or four basic types. Specialized sweep-circuit testers can make testing and repairing these circuits much easier. But, even with a minimum of test gear, many tests can be made.

Horizontal sweep circuits have a dual purpose. They sweep the electron beam across the picture-tube screen and provide high voltage to the picture tube's ultor. The circuit also provides pulses for keyed agc, phase-comparison afc, etc. It is this interlocking nature of these functions that makes circuit analysis so complicated so often.

In practice, if we remember the basic principles of each circuit and apply our tests in the proper order, little trouble should be found. Just take that full 10-count on the service procedures.

First, let's assume we get a set with the typical complaint—good sound, no raster. The first step is to check all tubes, preferably by substitution. If this doesn't work, leave the good tubes in the set until other tests have been completed. This avoids double troubles—defects caused or aided by tubes with marginal characteristics. Find the major trouble first, then see how many of the original tubes can be replaced without interfering with performance.

Next check point is the B-plus supply. Check the voltage at the filter input. The B-plus supply should be within 10% of normal before going further.

The next step is to check the schematic and find out what type oscillator circuit is used, what flyback circuit is used, etc. Check voltages against the schematic.

If these tests do not reveal the trouble, we start with the horizontal oscillator. Unless it is working properly, all other tests are useless. Dc voltage measurements around the stage check it out pretty well. However, a scope is much faster. Just connect a strong signal to the set and hook your scope to the video detector output.

Set the scope's sweep to hold two horizontal sync pulses on the screen. This locks it on 7,875 cycles, half the horizontal oscillator frequency. Now, transfer the scope probe, without changing the horizontal sweep frequency, to the horizontal oscillator circuit. The pattern of Fig. 1-a shows two lines of video with sync and blanking pulses. Fig. 1-b shows the oscillator running at normal speed. Fig. 1-c is too fast. Four pulses are seen. Fig. 1-d shows too-slow operation, with only a single pulse visible. Each wrong pattern points to a certain defect, as we shall see in a minute.

A scope finds horizontal oscillator troubles much faster than any other test instrument. As you can see, simply connecting it to the oscillator shows whether or not it's running. The simple test outlined above shows if it it is running at the right frequency. Actually, this test should always be made first; voltage and other measurements should come later. If the scope shows the oscillator is running on frequency, we can eliminate quite a few tests in that circuit and proceed to others in the horizontal output circuit.

Assume we have found the oscillator not running or running at the wrong frequency. Obviously, we've got to repair this trouble before we can go any further, because the oscillator signal is absolutely essential to the performance of the rest of the circuit.

Cathode-coupled multivibrator

Look at Fig. 2, a typical oscillator circuit. It is the popular cathode-coupled multivibrator, using a ringing coil for stabilization. Like others, this circuit always uses a twin-triode tube—6SN7, 12AU7, 12BH7, 6CG7, etc. Common coupling between the two cathodes makes the circuit work as a multivibrator. The L-C network in the plate circuit of the input half of the tube stabilizes the oscillator. Its natural resonant frequency must be exactly 15,750 cycles per second. At this frequency, it is shock-excited into oscillation by the sawtooth pulses from the multivibrator.

If the oscillator is not running, shown by a lack of signals on the scope, take dc voltage measurements around the circuit. Those in Fig. 2 are typical of the circuit, but the set's schematic should be consulted for exact values. The negative voltage at the grid of the output half of the tube is a fairly good indication of oscillation when a scope is not available. If the dc voltages are all within 10% of normal and the oscillator still isn't working, a detailed check of components is in order. Only a few could cause trouble under the circumstances—R5, R6, C3 and ringing coil L.

The next step is to ground the sync input grid. The control action of the horizontal afc used with this type of oscillator puts a dc correction voltage on this grid to hold the oscillator on frequency. If there is a defect in the afc circuit, too much dc will be found on the input grid, and the oscillator may be blocked or trying to run far off frequency. Grounding this grid puts it somewhere near where it should run, around zero volts. Now, if the oscillator is OK, it will be free-wheeling somewhere near the right frequency and you should be able to hold a picture on the screen by adjusting the horizontal hold control. The picture will not lock in, of course, as you have removed the sync input. If it does this, the oscillator is all right and you can look for sync troubles—defective tubes, resistors, leaky coupling capacitors, etc.

If this step does not get the oscillator working, leave the short in place and short out the ringing coil. If the plate load resistor is around the value shown,

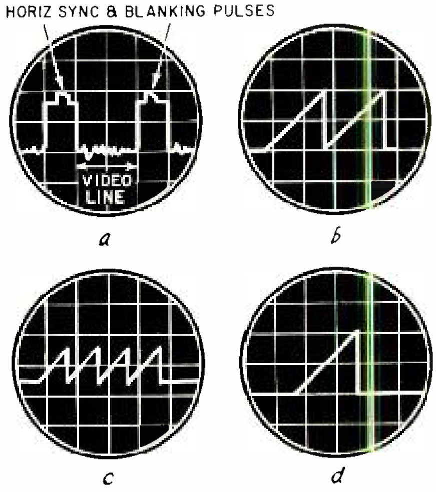


Fig. 1—Horizontal oscillator waveforms: a—two lines of video with sync and blanking pulses; b—oscillator on frequency; c—fast oscillator; d—slow oscillator

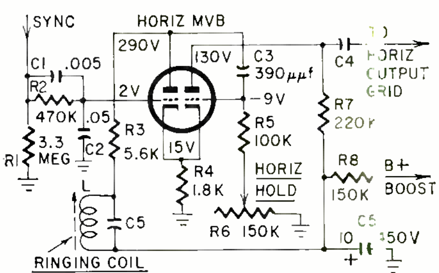


Fig. 2—Typical horizontal oscillator uses cathode-coupled multivibrator.

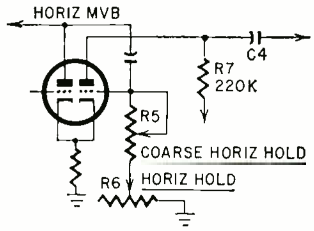


Fig. 3—Oscillator circuit has two pots in horizontal hold circuit.

5,600 ohms, add enough resistance in series with it to bring the total value up to about 15,000 ohms minimum. Otherwise, the plate circuit impedance will be too low and the circuit won't work. Now, the only frequency-determining parts left in the circuit are two resistors and one capacitor—R5, R6 and C3. If the oscillator still refuses to work, check them, preferably by replacement. Even a very small leakage in C3, for example, throws the oscillator so far off frequency that it cannot possibly work. Change in the value of R5, the grid resistor, also upsets things here. Once again you should be able to hold a picture on the screen momentarily by adjusting the hold control.

A popular variation of this circuit omits potentiometer R6, leaving only the fixed resistor R5 in the grid circuit. The ringing coil's slug is brought out through either the front or back panel of the set and marked "Horizontal Hold." In these circuits, the oscillator should work without the ringing coil in the circuit. The constants of the RC network must be such that the oscillator's natural frequency is very close to 15,750 cycles. If the circuit won't work without the ringing coil, remove R5 temporarily, substitute a potentiometer of approximately the same value, and rotate it until the oscillator is on frequency. (With the ringing coil still shorted out!) Remove the pot, measure the portion of the resistance used and install a fixed resistor of the same value for R5.

Now, take the short off the ringing coil, and adjust the slug for a locked-in picture. With this setting, the oscillator will be much more stable. We have used this method for some time on many sets with a reputation for horizontal instability and it has always given a decided improvement. At this point, we still have the input grid grounded. If this is removed and the picture promptly falls badly out of sync, there is definitely trouble in the phase-comparer circuit. Check all resistors and capacitors there, also the tube for unbalance, etc.

A variation of this circuit, used in some Philco and Zenith sets, has two potentiometers in the horizontal hold circuit (Fig. 3). This allows a very good adjustment of the horizontal hold circuit, just as we mentioned before. To adjust these, set the front-panel horizontal hold control to center, short out the ringing coil and adjust auxiliary pot R5 for a stationary picture. Then take the short off the ringing coil and adjust it until the picture is locked in. This centers the operating point of the user's horizontal hold control and makes for maximum stability.

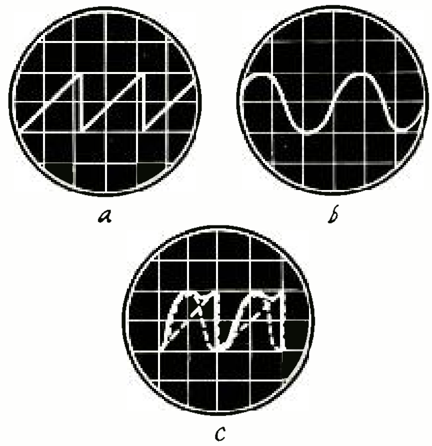


Fig. 5—Synchroguide waveforms: a—basic sawtooth developed by oscillator; b—ringing coil adds sine wave; c—results of sine wave plus sawtooth.

Philco puts this adjustment on the top or rear apron of the chassis. Zenith puts it on the rear apron and marks it "coarse horizontal." Either way, its purpose is the same and it is adjusted in the same way. In fact, if a given set is horizontally unstable, you can add this control, mounting it in an empty hole on the back of the chassis.

The Synchroguide circuit

About the next most common horizontal oscillator circuit is the pulse-width afc or Synchroguide circuit. It is similar to the circuit just described, in that it uses the same type of sine-wave stabilization as the horizontal oscillator. The major difference lies in the circuit's frequency-determining elements, which are in the coil-capacitor combination of the Synchroguide transformer, L1 and L2 in Fig. 4. Here again a twin-triode is always used, although some early versions used two separate triodes.

If we apply the same tests to this oscillator and find it isn't running properly, we can go on just as before to dig out the trouble. Remove the sync input by shorting the input grid to ground. If this doesn't clear up the trouble, leave it grounded and short out L3–C5, the waveform adjustment in the plate circuit. This leaves only L1–L2 and C4 as the frequency-determining elements in the circuit. If the oscillator cannot be brought to the correct frequency by adjusting L1's slug, and C4 is good, (not open or slightly leaky), then the Synchroguide transformer is defective and must be replaced. (We're assuming here that all dc operating voltages have been checked and the tube replaced.)

This oscillator develops a rather high negative voltage on its control grid, as you can see from the voltages given. If it is not high enough, check the B-plus supply. Many sets feed this oscillator from the boost voltage, through a 150,000-ohm resistor. Check this quite carefully, as they have a habit of increasing slowly to about 500,000 ohms, which lowers the oscillator output more than slightly!

Also, check the little 180-$\mu\mu f$ coupling capacitor very carefully. If even the slightest leakage develops across it, the oscillator can't build up enough peak-to-peak amplitude to drive the output tube. Frequency will also drift badly. Resistor R8 can also cause this drift, so check both of them, preferably by replacement, if the complaint is horizontal drift.

With the waveform coil shorted out, a fairly stable picture should be seen on the screen after the hold control is adjusted. This is exactly the procedure we followed a while ago. We made the oscillator run at a frequency which would make a picture, without the influence of the stabilizing coil. Unless the waveform (stabilizing) coil is completely open, it should have no effect on the oscillator frequency. That is, when you remove the short, you must be able to find a setting of the waveform coil slug which will lock a picture tightly in place. If you can't, the coil is definitely defective.

This oscillator generates the basic sawtooth waveform, shown in Fig. 5-a. This is what you see in the scope with the waveform coil shorted out. When we add the shock-excited ringing coil to the circuit, it generates a sine-wave signal (Fig. 5-b). The two are added together to produce the pattern familiar to us all (see Fig. 5-c). For correct adjustment, a scope should be used. Connect it to point A in Fig. 4, through a low-capacitance probe or a small capacitor, and adjust the waveform slug for a picture like Fig. 5-c. The sharp points should be just a wee bit above the peaks of the sine waves for the best sync. If the waveform comes up steeply at this point, the circuit's noise immunity will be much better. Noise pulses will not be able to trigger the oscillator too soon.

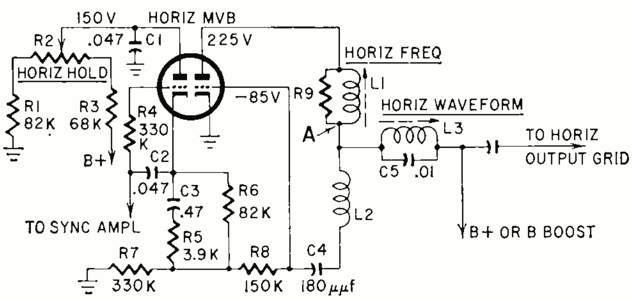


Fig. 4—The Synchroguide, another horizontal oscillator circuit.

TV Service Clinic

conducted by

JACK DARR

FOR some reason color demodulator stages seem to be about the most misunderstood parts of all color receivers. There's no reason for this because they are all basically pretty simple. I believe most of us get confused because of the complicated nature of the color signal. It's like pouring milk and water into a glass, stirring it and then trying to pour milk out one side and water out the other! Well that's exactly what we're doing! Like the farmer with his cream separator, though, we have to have some help in doing it!

Let's run over this circuit briefly. Forget all the complications and look at it one piece at a time. (All complicated circuits are made of a bunch of simple circuits, tied together!) A typical demodulator is a triode tube, like Fig. 1. Our color signal is fed to its grid, with all the color information in it—red, green, blue, etc. This information is in the form of phase differences—the modulation on any signal is in the form of differences: amplitude, phase, etc., from a given reference point.

If this were a simple amplitude detector, our input and output signal would look like the one in Fig. 1. The reference point here would be the bias voltage on the cathode. This is a simple dc voltage. Now you're all familiar with keyed stages—a pulse voltage is fed to the plate of a tube which can conduct only when the pulse is there, because there's no plate voltage at other times. These are keyed stages too. The keying voltage is the amplified 3.58-mc color-burst signal from the chroma reference oscillator. It is applied to the cathode of the demodulators.

In any color demodulation system, one set of values will be in phase with the reference signal and one out of phase by a given amount, usually 90°. Other

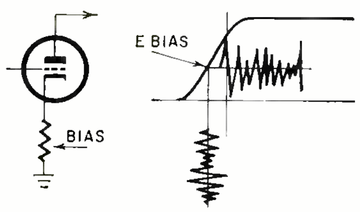


Fig. 1—Typical demodulator is a triode. Waveform shown would appear at its input and output if it were used as simple amplitude detector.

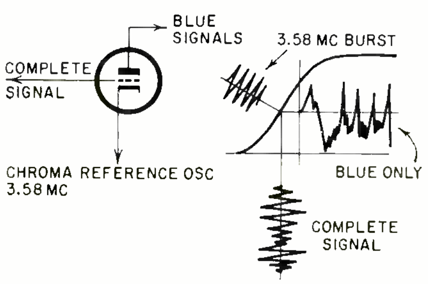


Fig. 2—We key the blue demodulator with a 3.58-mc signal applied to its cathode.

phase differences, from the combination of these, are used to give us any desired combination of colors. In the well-known R – Y B – Y system, blue is in phase, or 0 degrees, while red is 90°. Other colors are at different angles with respect to the burst.

Now let's forget the rest of the circuit and concentrate on the blue signals. The complete signal is fed to the grid of the blue demodulator. In it are certain components which denote the amplitude of the blue signals. These are in phase with the 3.58-mc oscillator signals. To extract them from the whole signal, we key the demodulator with a 3.58-mc signal by applying it to the cathode of the blue tube as in Fig. 2.

Now, the tube conducts, allowing signals to pass only when the voltage relationship between cathode and grid allows normal conduction. (Never mind any other voltages present, and concentrate on only the cathode–grid voltage relationship!) Out-of-phase signals find the tube cut off so they cannot pass (see Fig. 3). Here, the phase relationship between the reference signal, the bias voltage and the incoming signal or grid voltage is the most important thing.

This is admittedly quite an oversimplification, but the basic action of

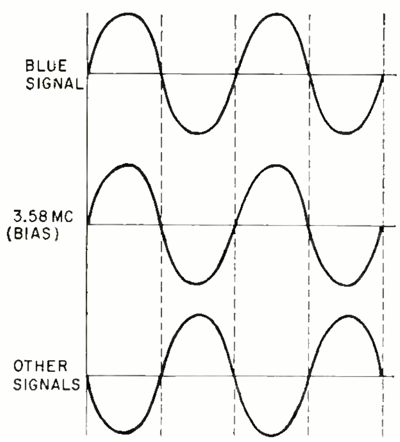


Fig. 3—Out-of-phase signals (those other than the blue signal) find the demodulator cut off.

this circuit, like all circuits, is simple! If you can keep the simple part in mind, it usually isn't too hard to grasp the principle behind the operation of any circuit. All of the other functions are merely duplications of this one. For example, the red demodulator works exactly like the blue, if we consider only the red demodulator circuit by itself. The bias voltage fed to its cathode is 90° out of phase with that fed to the blue cathode. However, we have nothing to do with the blue circuit while analyzing the red one! Therefore, circuit action is exactly the same!

If you want to analyze any circuit, no matter how complicated, try breaking it down into its most fundamental parts and working on them one at a time. Like the ancient fable about the bundle of sticks, you'll find they're a lot easier to break down singly than when you try to deal with them together!

Poor reception

Channel 6 is the nearest station, about 100 miles away. Other stations are up to 200 miles. I installed an all-band Yagi which gives satisfactory reception of channel 6 only. Could a 10-element Yagi cut to channel 6 be used to receive 5 and 7 also, with a separate Yagi cut for 11? Will an all-channel antenna bring in both 6 and 11?—E. B. J., Stambaugh, Mich.

A 10-element cut-channel Yagi is the best approach, but you should not expect satisfactory adjacent-channel reception.

Faint pix

Several of our technicians have worked on a Capehart 324 with a Standard Coil tuner, but have not been able to get more than a faint picture. Sound is OK.—R. A. R., Philadelphia, Pa.

The first step is to find where the loss of gain occurs. Start from the video amplifier and work back. Apply the outputs from an rf or if sweep and marker generator to pin 1 (input) of the 6AL5 picture-detector. This provides a video-frequency sweep voltage. END

A demodulator probe and scope at pin 11 (signal input) of the picture tube will show the video amplifier response curve. With an average scope and generator, nearly full-screen deflection should be obtained. Measure the video amplifier gain by noting the amount of vertical deflection at pin 11 of the picture tube, and then moving the probe back to pin 7 of the 6AL5 detector (detector output). The 6AH6 (video amplifier) has a g_m of about 6,000 μmhos and works into a 5,000-ohm load. A video amplifier gain of 40 or better will be found, unless there is a circuit defect. If the video amplifier is OK, check the if amplifier. Apply an if sweep signal at pin 1 (grid) of the first 6AG5 if tube. Connect a scope through a 50,000-ohm isolating resistor to pin 7 (output) of the 6AL5 picture detector. A response curve with a bandwidth of about 3.5 mc between the 50%-of-maximum points should be found. Stabilize the agc line with −1.5 volts of dc override bias.

If curve shape is poor, align the if amplifier, following the service notes for the set. The next step is to check the if stage gains. To measure gain, connect the if sweep generator to pin 1 of the 6AL5 picture detector tube. Note the deflection obtained on the scope screen. Then, move the sweep cable back to pin 1 of the third if (6AG5) tube. Observe the increase in vertical deflection.

A 6AG5 has a g_m of about 5,000 μmhos and works into a load impedance on the order of 3,000 ohms. A gain of about 15 is expected. Check the circuit components if gain is low.

The second if stage can be tested in a similar manner. Move the generator cable back to pin 1 of the second if 6AG5. Again, this should result in an increase of about 15 times in vertical deflection. If the pattern shows evidence of overload (artificial flat-topping), the generator output must be reduced.

The overall if gain is the product of the stage gains. So, if each stage has a gain of about 15, the total gain will be about 3,000.

To check the tuner response curve, apply an rf sweep signal at the antenna input terminals and connect the scope at the looker point. The bandwidth should be about 5 mc. A gain check is difficult to make. If you get a curve about 2 inches high, using average equipment, gain can be considered OK.

These tests will definitely localize the point of signal loss.

Vertical sync trouble

I am having vertical troubles with a Philco TV-300 chassis. The sync is not very good and I get retrace lines at times. This is intermittent and so is the sync, for that matter. The trouble seems to show up on different channels each time.—E. D., New York, N.Y.

There is a factory modification on

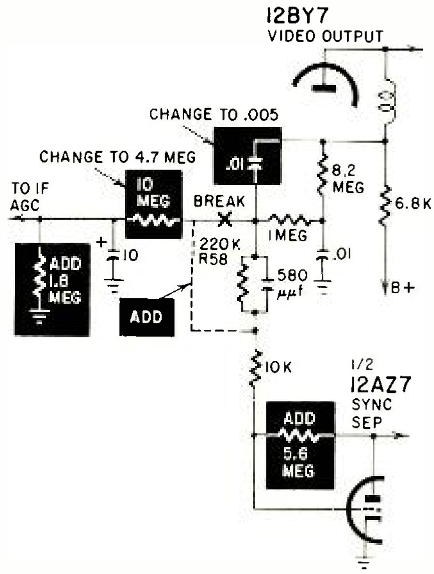


Fig. 4—Factory modification improves vertical sync on Philco TV-300 chassis.

this chassis for improving vertical sync (Fig. 4). Check the set to see if this modification has been made, and if not, make it. It will increase vertical sync amplitude and make both vertical and horizontal sync much more reliable.

The intermittent vertical retrace lines

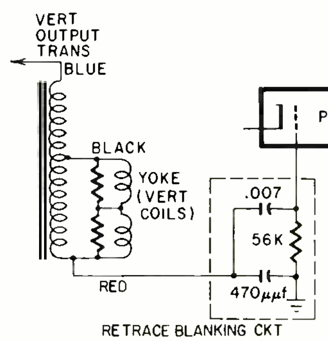


Fig. 5—Open capacitor in network causes retrace lines on the screen.

are probably caused by an intermittently opening capacitor in the network. Fig. 5 shows the original values. You can make this up out of separate units and replace the original. Be sure to get the polarity correct when connecting the network to the yoke or vertical output transformer. If retrace lines become much worse, your polarity is wrong—connect the network to the other side of the yoke.

Inadvisable conversion

Is it possible to convert a DuMont RA-103 from a 12JP4 to a 16- or 17-inch picture tube?—S. B., Cleveland, Ohio

This is not an easy conversion and requires extensive mechanical and electrical changes which would not justify the time and cost. We advise against this particular conversion.

Antenna improvement

I have antennas located on the top of a hill overlooking a valley, with open line from the antennas. I believe that reflectors are needed at the antennas. Should I use a solid sheet of aluminum or is tubing suitable? If tubing is used, should it be cut to channel? The TV stations are located 80 miles away, and the lines are ½ mile long.—C. R., Williamson, W. Va.

Metal sheets or tubular-construction planar reflectors are less effective than Yagis cut to channel.

Tuner trouble

An RCA 7T103B in the shop has me going sideways. Channels 3 and 6 are OK, but 7 shows only a raster. It is the strongest local station. The tuner has been repaired and air-checked.—E. A. P., Council Bluffs, Iowa

There are three possibilities here. The supply leads to the tuner and first if stage may be "hot," causing oscillation on channel 7. If so, there will be a high dc voltage at the picture detector output on channel 7. Better high-frequency bypassing of the supply leads to tuner and if strip should cool the circuits. The second possibility is a marginal plate-supply voltage to the tuner's local oscillator. This should be checked. Finally, the first if stage can oscillate if the tuner's output circuit is misaligned.

Faster agc

I am operating an RCA KCS-47 receiver in a fringe area about 60 miles from Indianapolis, adjacent to an airfield. There is a problem of flutter, and also of resetting the agc control on different channels. Can you advise on the feasibility of changing the agc system to a faster-acting type?—P. L. J., West Lafayette, Ind.

This is a problem which can be tackled in more than one way. Keyed agc with a short time constant helps minimize flutter, but cannot eliminate it. When signal levels vary greatly, amplified agc gives a wider dynamic range. However, before reworking the chassis, I would suggest trying stacked Yagis to get a very narrow aperture, beamed at the desired station. High-gain antennas also lessen the demands on the receiver's dynamic range. Of course, flutter will still occur if a plane flies through the antenna aperture. If stacked Yagis do not give the desired flutter reduction, reworking the chassis to optimize agc action would be the next logical step.

Horizontal foldover

I'm having trouble with a Capehart TV, model 3C312M. I have replaced the flyback, using an exact replacement made by another manufacturer. I was unable to get any high voltage until I changed the cathode resistor in the horizontal output stage from 180 ohms to 360 and the cathode capacitor from 0.1 to .05 μf. With the horizontal drive closed, there is severe foldover in the center of the screen, although there are no curved vertical lines. As I turn *the horizontal drive, I get a picture with shifting vertical lines, all curved to some extent. About halfway down from the top of the screen there is a deep bend; also right at the top of the picture, if the vertical size is cut down so you can see it. Opening the drive control all the way gives a Christmas-tree effect with possibly a loss of the raster and high voltage. Vary the width control and the same thing happens.—I. B. A., Swansea, Mass.*

You do have a large assortment of symptoms! However, two of them are significant: foldover in the center of the screen, and the fact that you were forced to change the residual bias on the 6BQ6 horizontal output tube to get a picture at all. This points to leakage through the coupling capacitor between the 12AU7 oscillator plate and the 6BQ6 grid, upsetting the bias. The horizontal instability, bending and tearing of the picture and the other symptoms are all indications of the same trouble. The leakage through this capacitor lowers the output of the horizontal oscillator by lowering the load impedance in its plate circuit. When you closed the drive trimmer, you added enough capacitance to allow more of the weak oscillator output to get through to the 6BQ6 grid, allowing the output tube to drive the flyback a little better.

The leaky capacitor is probably the .001-µf unit between pin 6 of the 12AU7 and pin 5 of the 6BQ6. It would also be a very good idea to check the .047-µf unit in the 12AU7 plate return circuit, the .01-µf between pins 6 and 2 on the 12AU7 (the interstage coupling capacitor), and the 820-µµf capacitor in the shaper network between the horizontal discharge tube plate and the 6BQ6 cathode. Leakage in any of these can cause trouble. If any of them are bad, replace the resistors associated with them, such as the 6,800-ohm unit in the shaping network. Heavy currents through them may have caused a shift in their value.

Note: When you changed the cathode resistor, you increased the dc bias on the output tube to the point where the tube could conduct almost on the right portion of the curve and get a little output. The positive voltage leaking through the capacitor was bucking out enought of the normal bias to make the tube inoperative.

Poor sync and vertical roll

A G-E 17T14 chassis has an intermittent vertical roll. The set uses a 6CS6 clipper, and video can be seen feeding into the vertical oscillator grid at high contrast levels. Apparently the video gain (contrast) control has a lot to do with this. When the picture is too pale to be visible, the vertical hold is OK. When the contrast control and the local–distance switch are advanced to give good contrast, the picture is stable until a scene with much black in it appears. Then the vertical hold loses

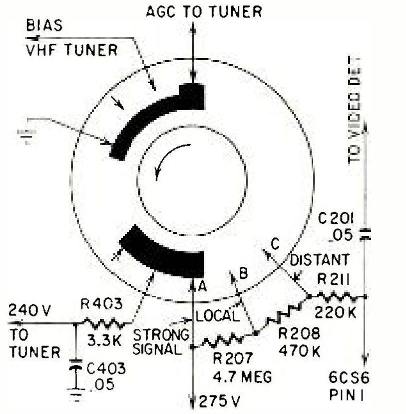


Fig. 6—Original connections of *LOCAL-DISTANT* switch on G-E 17T14 chassis.

control and the picture runs free until the scene goes lighter. We figured that the relative amplitudes of the signals fed to the 6CS6 had changed, causing imperfect clipping. Shunting capacitors from pin 7 of the 6CS6 to ground causes all hold (vertical and horizontal) to be lost. Shunting pin 1 gives an improvement. Video data are not seen at the vertical oscillator grid and the picture is much more stable. We are reluctant to add an unspecified part to the set, but we can't give it back to the customer in this shape.—M. M., Baltimore, Md.

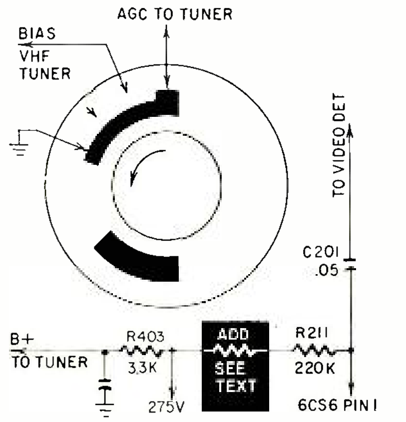


Fig. 7—Revised switch connections give best noise-cancellation action.

This is a common trouble with this series. It occurs because the agc is switched by the same wafer switch which controls the sync and noise inverter 6CS6—the local–distance switch (Fig. 6). When the switch is set to the point where agc is right for the signal level, the sync is being clipped by the noise inverter! When the noise inverter is right, agc is too weak, and so on.

The repair we have found best for this is to rewire the switch as shown in Fig. 7. Take the noise-canceller components completely off the switch and substitute a 5-megohm pot for the resistance. Set the switch to the point where agc voltage is best, giving the best picture. Adjust the contrast control for a satisfactory picture. Now adjust the 5-megohm pot for the best noise-cancellation action—this is usually just before the picture shows signs of sync clipping. Turn the control until the picture becomes unstable, then back it up until the picture is steady. Measure the amount of resistance in the circuit, and substitute a fixed resistor of the same value. Leave all noise-cancellation functions completely off the local–distant switch; the variation in picture quality caused by the change in agc will still make the customer happy.

If the vertical hold is not good enough, try rebuilding the vertical integrator. Use a smaller resistor in place of the present 82,000-ohm unit and increase the .0047-µf capacitor to about .02 µf. This allows a slightly higher level of 60-cycle sync to get through to the vertical oscillator, improving vertical hold action on this set immensely. This same trouble occurs in the M and MM series of portables.

TV check tube

I have a 5BP4 which I would like to use as a substitute tube for testing TV's. I understand some of the boys have wired up a 5-inch tube (any type) for this.—L. O. T., Los Angeles, Calif.

You have a good idea, but the wrong type of tube! The 5BP4 is an *electrostatic-deflection* tube, used for oscilloscope work. Unfortunately, this type of tube cannot be used for a substitute TV tube. You can use any tube of this kind which has *magnetic* deflection, like the larger CRT's used in the sets.

Probably the tube you have heard of is the type 5FP7/1812P7. This is available in surplus and has been used as an inexpensive substitute picture tube. For details on its use, see "Economy Test Tube" on page 57 of the March, 1958 issue.

Pix-tube change

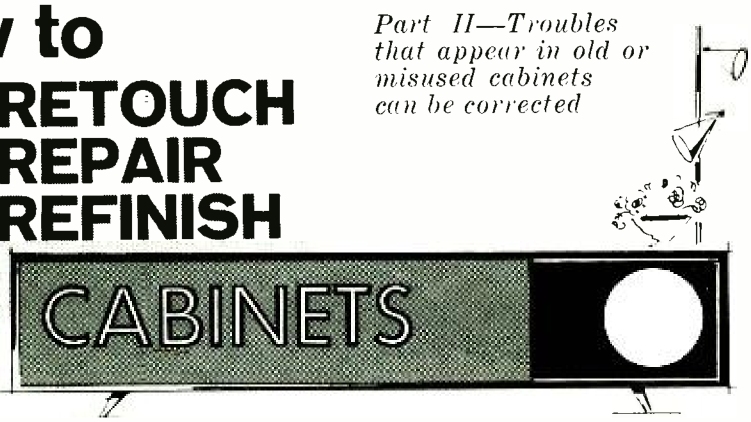
Is it possible to replace a 16ZP4 with a 16GP4 in a Philco 51-T-1604 without any major reworking of the chassis?—J. A. L., Tipp City, Ohio

The 16GP4 is a 70° tube, while the 16ZP4 has a 52° deflection angle. Accordingly, the chassis would need reworking. END

"Remind me to take this customer off the books, Imgwanna."

How to RETOUCH REPAIR REFINISH CABINETS

Part II—Troubles that appear in old or misused cabinets can be corrected



By JEFF MARKELL *

THE first half of this series (March, page 109) showed how to handle burns, scratches, gouges and other imperfections in TV and hi-fi cabinet finishes. This half goes on to tell what can be done to correct crazed finishes, loose legs and moldings, open joints and loose or blistered veneer. Refinishing is also discussed.

Cracked, crazed or alligatored finish are terms that denote various types of deterioration of aging finishes, although occasionally they may appear on a relatively young piece of furniture. For example, a cabinet subjected to considerable vibration—such as a speaker enclosure—may craze before it is very old. Cracks in the finish can be depended upon to occur over any cracks or checks in the underlying wood. Alligatoring is so called because the finish crazes in a pattern like alligator skin. It is usually a disease of old age. You have probably seen it on old pianos. It can occasionally occur on a relatively new piece of furniture if the finishing was done in a cold room.

With any of these conditions you may want to pause before deciding whether to try to repair the finish, strip the old finish off and refinish, or throw the whole piece away. A moderately crazed finish can sometimes be restored with a 50–50 mixture of linseed oil and turpentine plus a good deal of elbow grease. Commercially available scratch-fixing and crack-eradicating mixtures will often work wonders on crazed or cracked surfaces. Also an overall French polishing (see page 110, March issue) will often do the trick. It's a lot of work, but it can give you a lovely-looking surface on a piece that had become a dismal mess.

It is claimed that a combination of treatments first with crack eradicator and then French polishing will clear up an alligatored finish. But I am afraid that, if the alligatoring is very bad, your best bet is to strip the whole thing down and refinish it, or discard the cabinet.

Grille cloth

A common cause of shabbiness in a basically sound and good cabinet is a baggy or torn grille cloth. The cloth need not necessarily be ripped, frayed or even pulled loose to make the cabinet look miserable. It may merely be dirty and discolored. Grille cloth is not expensive, particularly if you consider how much replacing a tired one can do toward sprucing up the entire appearance of an open-front TV console.

Loose, peeling, blistered veneer

Veneer that starts to loosen or peel will most often let go along an exposed edge, where atmospheric dampness can get under it. The most common places will be along the back of the top or sides, along the bottom of the sides, or along the hinge sides of doors. A good preventive for this kind of trouble is to seal such edges thoroughly with lacquer or varnish. Once they have started to go, of course, you are a wee mite late for prevention. If they haven't gone too far, they can be repaired, after which it would be a good idea to seal the edges thoroughly to prevent any recurrence.

If you have a few spots where the veneer is loose for lengths of 2 or 3 inches (and the veneer is still all there), you can repair it. But if you see a major area of a side or top that perhaps got thoroughly soaked, with the veneer checked, blistered and loosened up over a large area—don't even try.

A small area of loose veneer can be easily corrected by forcing some glue under it with either a brush or a squeeze bottle. Then apply pressure to hold the veneer tight against the core while the glue sets. This can be done with clamps or by resting the entire weight of the cabinet on the affected side. By the way, if you use a squeeze bottle, be careful not to get too much glue in. It will only come squirting back out when you apply pressure.

In the occasional case of a panel where the veneer has stayed tight around the edges but has blistered somewhere toward the middle of the panel, you've got quite a tricky situation. This kind of patient does not usually respond well to treatment. But if you insist on trying, here is what I would suggest. Take an extremely sharp thin-bladed knife of the Exacto type and make a slit through the veneer, running lengthwise with the grain right down the center of the blister. Now, holding down one side of the blister with your fingers, squirt glue in under the other side, then repeat the process for the other half of the blister. Next take a little roller and roll the glue from the center line where your cut is—and where you squirted in the glue—out toward the edges of the blister. When you feel you've got it pretty well worked out, apply pressure, allow it to dry, and see what sort of results you've got. If you were able to get the glue thoroughly distributed under the blister, it will take well. If not, you may find a half a dozen little blisters where you had one big one before, but that is the chance you took in trying to meddle with the thing. The cabinet was probably useless as it was so you can't have done any real damage.

Open joints

If a cabinet is cracked open along a joint (and hasn't been dropped or abused), it is usually because the glue has dried out and let go, or excess humidity (or dryness) has warped the panels.

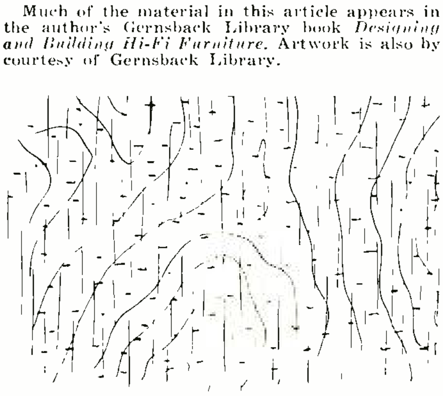
If the glue has given way, you haven't too much of a problem on your hands, but if warpage has set in you have a bit of trouble.

The basic cure for an open joint is glue and pressure. Whether you'll be able to use internal glue blocks (triangular wood strips placed inside the joints) or cleats and screws depends on the type of cabinet and the location of the open joint. For example, the inside of a speaker cabinet is never seen, nor is the inside of the tuner or amplifier compartment of an equipment cabinet. In such cases you have a good chance of effecting a successful repair even if the panels are warped because you can get inside to install glue blocks or cleats and screws to re-enforce and pull the halves of the joint back together. If the open joint is in a part of a cabinet that is readily visible, you'll have to rely entirely on glue and pressure.

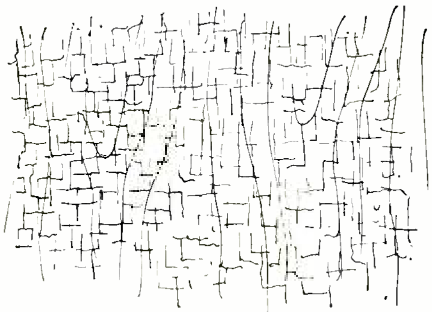
In any event try to clean out the old glue before forcing additional glue into the open joint. Lumps of old glue re-

* Markell Associates, Cabinet Design and Construction.

Much of the material in this article appears in the author's Gernsback Library book *Designing and Building Hi-Fi Furniture*. Artwork is also by courtesy of Gernsback Library.



Crazed finish caused by age or vibration.



Alligatoring is crazing in a pattern like an alligator skin.

maining in the joint will make it difficult if not impossible for you to clamp the joint closed and keep it that way.

The ideal clamping tools for adequate and continuous pressure are cabinetmaker's pipe or bar clamps. If these are not available, another way of developing the required pressure on the joint is to run a heavy rope completely around the cabinet. Where the rope touches the corners of the cabinet they must be protected first with a thick wad of tissue, toilet tissue, or soft rags, and then, on top of that, L-shaped blocks of wood. When all the corners are adequately protected, take up on the rope by putting a rod or pipe through it and twisting it in the manner of a tourniquet. This method is a bit cumbersome, but it will develop considerable pressure.

Loose legs

Actually, I think more loose legs result from misuse than old age, so this defect may be listed in the wrong place. After all, if you load a cabinet full of heavy equipment (TV chassis, stereo amplifier, etc.) plus a lot of records and then start dragging it across the floor, you cannot blame old age or faulty construction for legs loosening. They are being subjected to lateral strains they were never intended to stand. Of course, legs can also loosen as a result of merely holding up a heavy load for a long time.

In tightening up a loose leg the first step is to find out what is loose. This in turn will depend on how the leg was attached in the first place. A common method of attaching four separate legs independently is with hangar bolts. A hangar bolt has a thread like a lag bolt at one end, and a machine-screw thread where the head ought to be. They are mounted by driving the lag bolt thread into the leg, then the machine screw thread fits into the bottom of the cabinet.

The possible sources of trouble here are:

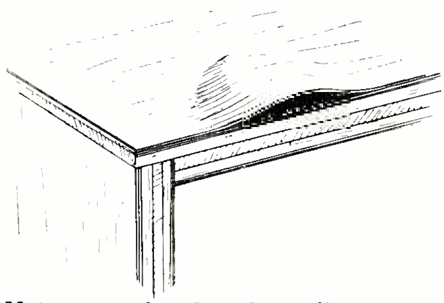
1. The plate is loose from the bottom of the cabinet.
2. The leg is partly unscrewed from the plate.
3. The hangar bolt is loose in the leg.

In the first two cases the solutions are obvious. If the plate is loose from the cabinet, tighten the screws. If the hangar bolt is loose in the plate, turn the leg to tighten it. If the bolt is loose in the leg, you've got one of two problems. The bolt has come loose by stripping the threads in the leg or the leg is split.

In both cases the best thing to do is to replace the leg. If this is not possible (perhaps you cannot get a leg that matches) then you have to try to repair it.

Take the hangar bolt out of the leg and determine whether the trouble is a stripped thread or a split leg. If the thread is stripped squirt glue or one of the all-purpose adhesives into the hole, run the hangar bolt back in, then let the whole thing set. When the adhesive is thoroughly dry and hard, remount the leg. If the leg has been split, squirt glue in the hole and run the bolt back in. This will force glue out into the split. Now clamp the split closed, let it dry, and remount.

If the legs on your cabinet were not individual but attached to each other by a frame forming a base or bench under the cabinet, you'll find either broken dowels running from the frame into the legs, or glue failure again.



Moisture under the edge will cause veneer to lift or loosen.

Lay the cabinet on its back to repair this and take the whole base off. Now examine the base for loose joints. Any that are loose should be knocked completely apart. Now look for broken dowels or splits in the rails near the dowel holes. If all the parts are OK, clean the old glue out of the dowel holes, reglue, reassemble and clamp until dry. If any of the dowels are broken, they should be replaced. By the way, use a hardwood such as birch for the replacement dowels if possible. The common pine doweling is not very strong, and the loads that go in audio cabinets are pretty heavy. What do you think broke that dowel in the first place?

If any of the rails have been split, force glue into the split and put a separate clamp on that part when you reassemble the whole base.

Loose molding

This is another case for cleaning out old glue and regluing. With moldings it is often desirable to hold them in place with very small wire brads rather than by clamps. It's often difficult to get a clamp onto a small molding, and you may crush it. The brads used should be extremely small. Their purpose is not to hold the molding permanently, that is the job of the glue. The brads are merely to hold the molding while the glue sets.

You will notice that in discussing repairs to the wood structure of cabinets I have made very little mention of screws and nails. This is because furniture is basically held together not with fasteners but with glue. Granted that speaker enclosures are re-enforced with screws, the basic fastening is still glue. This is what held the cabinet together originally, and this is what you can rely on to repair it.

Refinishing

Doing this properly is a big job and I would recommend it only for a piece you love very dearly. The worst part of the job is stripping off the old finish and preparing the cabinet for refinishing. The first requirements are liberal quantities of paint remover, a scraper and a good deal of persistence. Different paint removers are used in different ways, so follow the directions on the can and be sure to get all the old finish off. You won't miss on the large areas like the top or sides, but watch it around moldings, doors and legs. You'll never get a decent new finish unless you remove all of the old finish.

Finishing new work was discussed in a previous article (August 1959, page 35) and, once you've gotten the old finish completely removed, the refinishing procedures will be the same as if you were finishing a new piece.

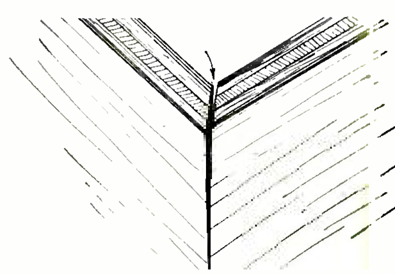
After you are through with the paint remover and have all the old finish off, wash the cabinet down well with turpentine or benzine to take off any paint-removing chemicals that may still be on the wood. Then sandpaper as for a new piece and, as with a new piece the better your sanding, the better your final results will be.

If you wish to stain the cabinet, you will have no trouble if you did a good job of getting the old finish off. But any spots where the old finish has not been fully removed will not take the stain.

If you were thinking of bleaching—don't. In bleaching an old piece you are almost certain to get spotty results.

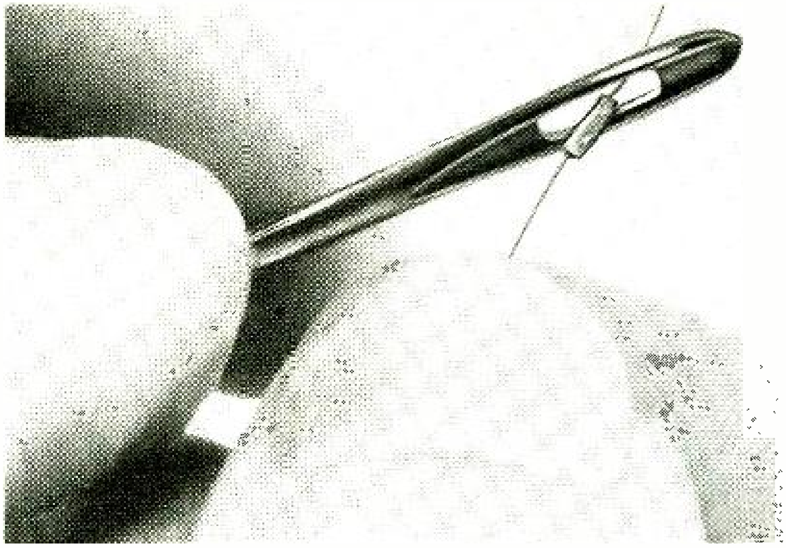
The filling, sealing, finishing and rubbing operations in refinishing an old piece will be exactly the same as if you were applying the initial finish on a new unit, and you can expect just as good results.

As a final word of caution I'd like to remind you when refinishing an old cabinet—after you have completed the removal of the old finish, examine the entire unit very carefully for any structural defects. Remedy any you find before you start the refinishing procedure. END

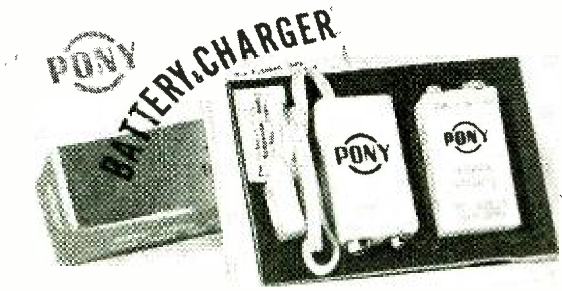


A typical open joint.

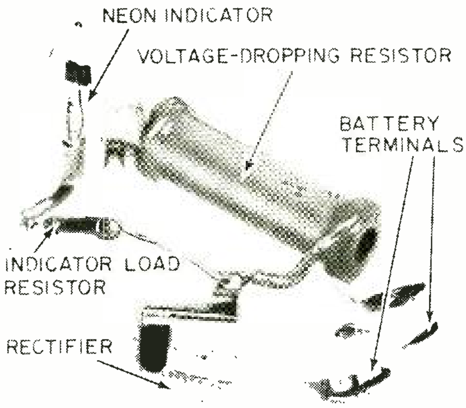
what's new ?



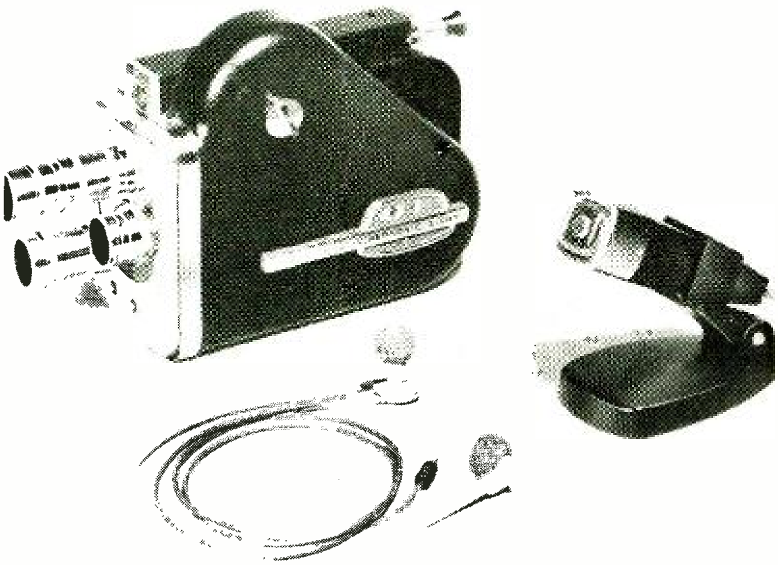
TINY LAMP by Sylvania Electric Products is the smallest incandescent lamp ever produced on an assembly line. This lamp is expected to be useful in many phases of microminiature circuitry. Operating voltage 1.5, current 40 ma.

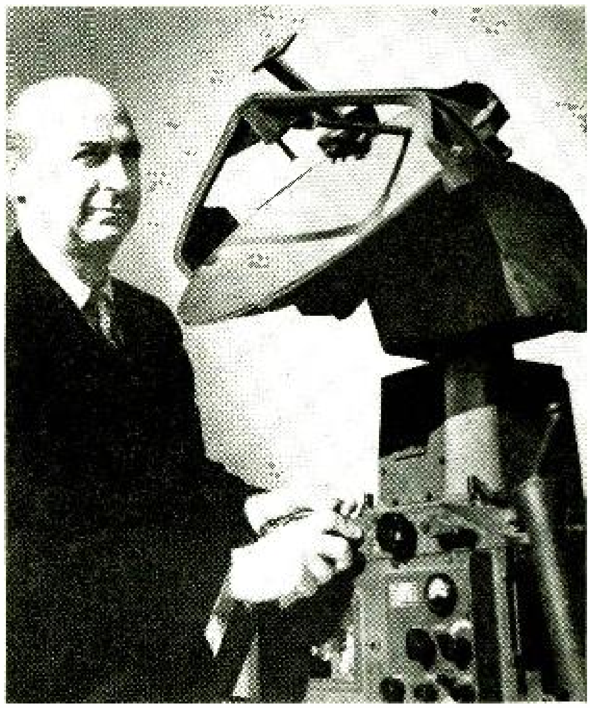


RECHARGEABLE BATTERY can be used in many small transistor radios. This 9-volt battery will operate for about 15 hours before it needs recharging. It can be recharged over 100 times, giving about 1,500 hours of use. The battery and the 117-volt charger (left in photo, in exploded form below) are imported from Japan by B & K Mfg. Co. of Chicago.



MOVIE CAMERA and projector can record sound on 8-mm film. Projector can add sound to existing movies while camera can record sound in exact synchronization with action. The Fairchild Cinephonic Eight series will shortly be placed on the market by Fairchild Camera & Instrument Corp. The company has color film available and can sound-stripe existing movies.



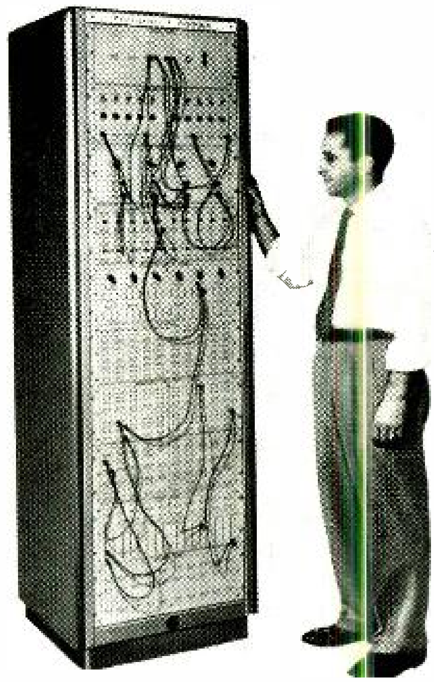


TELEMETRY SYSTEM can break through the layer of ionized air that surrounds a re-entering satellite or vehicle. The re-entering object has a "sheet" of highly conductive air at 2,000 to 3,000°F. around it. This system developed by International Telephone & Telegraph Corp. uses extremely high frequencies that get through this barrier where low and medium frequencies cannot. Installed in test capsules of various sizes and construction, the telemetry equipment will transmit such information as exterior and interior temperatures, the number of "g's" (multiples of the force of gravity proportionate to acceleration and deceleration factors) a pilot would have to withstand on re-entering, and the effects of vibration as the capsule plows into the earth's atmosphere.

STATIC CONTROLS in INDUSTRY

Magnetic amplifiers are the key to control devices that have no moving parts

By TOM JASKI



Westinghouse computer for network calculations made from Ramey magnetic amplifier units.

WHEN you turn a motor on or off with a switch, you use digital control. Any on–off, all-or-nothing kind of control is digital. When you regulate a motor's speed with a rheostat, you use analog control—a gradual kind of change.

Obviously, most industrial controls are digital in nature. Just consider the gillions of motors turned on or off by switches or relays and contactors. And even many complex machine operations can be controlled with digital signals.

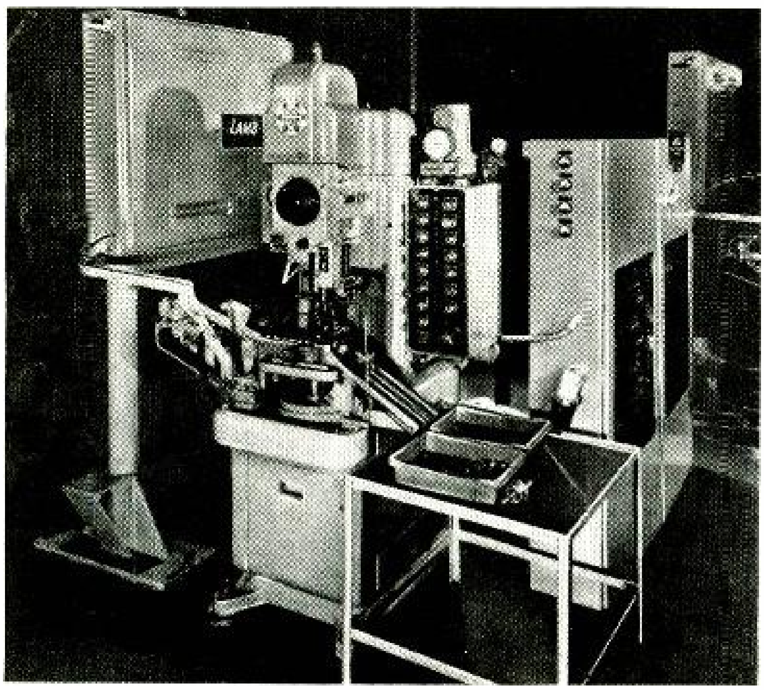
In analyzing machine controls we find that certain patterns or combinations of signals keep recurring. We can produce such signals with *LOGIC* units. These units are combinations of circuit elements which combine several input signals to produce a given output. Logic is not used here in the usual sense. Instead it is derived from a logical kind of algebra (Boolean algebra) which was explained in RADIO-ELECTRONICS by Edmund Berkeley (late 1950 and early 1951 issues).

Here we need not concern ourselves with it. Instead we will look at the kind of control elements which form logic units and how these units are used to control machinery.

Magnetic-amplifier principles

Most of the important units are derived from magnetic amplifiers so, to be sure of our ground, let's review their operation briefly.

The magnetic amplifier is based on the principle that an alternating current sent through a coil wound on a ferromagnetic core meets considerable impedance resulting from the magnetic field being built up and broken down each half-cycle. But the iron core tends to keep its magnetization, so the building up and breaking down of the field does not proceed exactly the same way as the ac magnetizing force.



CYPAK control (right) for automatic machine tool.

This is shown in Fig. 1, a magnetization or, more commonly, a B–H curve. (H is the magnetizing force caused by the current in the coil and B is the magnetic flux density resulting from it.)

Notice, when we increase H, B increases along a certain path of curve (from a zero value to *a*). As current is reduced and reversed, demagnetization and reverse magnetization do not follow as quickly. When the magnetizing field has dropped to zero, the level of magnetism in the core is still high (*b*) and considerable magnetizing force in the reverse direction must be applied to demagnetize the core completely (*c*). Now the core magnetizes in the opposite direction to point *d*, equivalent to *a*, and back through *e* and *f*, which are the opposite numbers to *b* and *c*. The process graphically produces what we call a *hysteresis loop*.

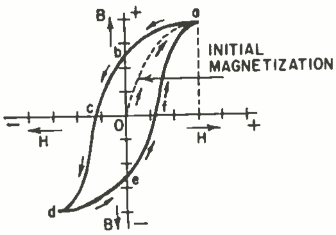


Fig. 1—Magnetization curve of iron core.

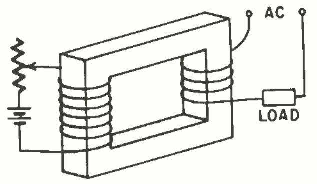


Fig. 2—Basic saturable reactor

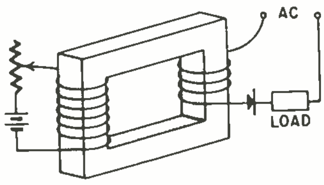


Fig. 3—Adding rectifier assures control at all times, but field induces voltage in control winding.

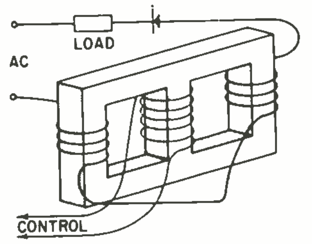


Fig. 4 — Basic magnetic amplifier. Opposed fields from split load winding cancel in center (control) leg.

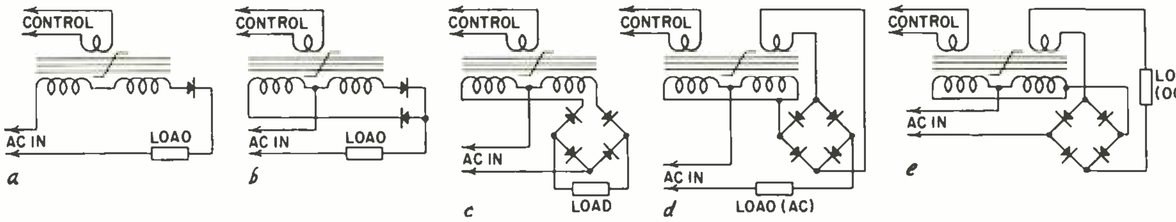


Fig. 5—Magnetic amplifiers in various circuits: a—Schematic representation of magnetic amplifier; b—magnetic amplifier with full-wave rectifier; c—full-wave bridge isolates ac and dc circuits; d—adding feedback winding can increase gain—shown with shunt feedback; e—series feedback uses heavy feedback winding capable of carrying load current.

It represents the losses in building up and breaking down the field. And the necessity of building up the field each time reduces the current we can send through the coil since we average the current to measure the total.

But consider what would happen if we had already magnetized the core, say to point *a*, and then sent the current through. Obviously, the current would be much greater, and at (a) it would be maximum. Thus we have a way to control such a current and do so by winding a second coil on the core and supplying it with dc from a convenient source. We regulate the magnetization with the dc.

This is called a saturable reactor (Fig. 2). If we magnetize in one direction, current in that direction would be heavy and much less in the other since we are building an opposing field. If we insert a rectifier in the load winding to make sure that we always have a load current in the same direction (magnetically) as the control current, we have control at all times (Fig. 3).

There is only one thing wrong here—the core with two windings acts as a transformer, and the load current may induce a high voltage in the control winding.

To avoid this, the load winding is divided into two parts—each on one leg of the core—wound so their fields oppose each other. A third leg is used for the control winding (Fig. 4), which is no longer affected by the load current. Basically, this is the magnetic amplifier as we use it. We can vary it by adding more windings or by using more rectifiers (Fig. 5), but in essence this is the basic component.

There are many ways to use magnetic amplifiers directly for control, and we can make digital and logic devices from them in several ways. One method was developed by Dr. Ramey, and his units are used as examples because they have some advantages and are widely used in industry. They are marketed by Westinghouse in a *CYPAK* system.

Basic Ramey unit

With a core material which has the B–H curve shown in Fig. 6, the possibility of designing a digital device is much better if we can use the two extremes—the two saturated states of the core—as our two distinct states, our on and off. If we take such a core, add a winding, hook it up as in Fig. 7-a and supply enough current, the unit saturates itself one way or the other. If we add a second winding and apply a current 180° out of phase with the first one, the unit does not saturate when it is on. This was Ramey's idea—he called it a reset winding. Fig. 7-b shows the basic Ramey unit.

To understand its action, you must realize that, once the core is saturated, there is no reason for it to lose its magnetism unless a current which opposes the magnetism is applied to one of the coils. So, if we let the core saturate by blocking the reset current, in a half-cycle the unit saturates and produces a load current. But notice that the load current starts a half-cycle after the signal has been applied. This half-cycle is used to magnetize the core in the direction opposite to that which we could get from the reset winding.

When we want to use a number of these units together, we run into two contradictory demands: we need a low impedance in the reset winding to insure proper resetting, yet we need a high impedance to avoid loading the signal source. To satisfy both, we use rectifiers and a dc bias source (Fig. 8).

The bias current in the reset winding flows continuously, and to balance this effect we also have the same bias current in the load winding. If bias current is always a little greater than the current supplied by the reset voltage source (E_r), D1 would appear to have a low impedance—the alternating reset current adds and subtracts from the bias so current I_2 looks to the reset winding as if E_r were right across the coil. But if we supply an input signal current, it can cancel the bias current so that E_r—with no dc to add to and subtract from, and faced by the high impedance of the blocking diode D1—cannot send current through the reset winding. Resetting cannot take place and a half-cycle later there will be an output from the unit.

Looking at Fig. 8, here's what happens. We have already stated that to get an output the core must be saturated. But the reset current is 180° out of phase with the saturating current and prevents saturation. The reset current flows only because there is a bias current. If there were no bias current (I_3), point A is at a lower voltage than point B and I_2, the reset current, sees a high impedance for it simply reverse-biases diode D1.

But when we pass a bias current through D1 (ignoring D1's resistance), point A is brought to the same potential as point B. Now the impedance from A to B appears to be low (same potential, you see) and I_2 can pass in the direction shown. Now if we supply a signal through diode D3, point A is brought to a higher potential than point B and the reset current (I_2) is blocked. (The signal we applied to block the reset current cannot go through diode D2 or D1.) With the reset current blocked, the core can saturate and we get an output signal on the next half-cycle.

Logic units

By simply adding inputs, we can

(*Continued on page 68*)

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An impressive list of electronic and mechanical features make this tube tester one of the finest values in the industry. Tests Gm (amplifiers) from 0-24,000 micromhos, Emission, Leakage, Grid current (¼ microampere sensitivity), Voltage regulators (Built-in Variable DC Power Supply), low power thyratron and eye tubes. Features 300, 450 and 600 ma constant current heater supplies, Life test, Hybrid tube test, built-in switch operated calibration circuit. Large easy-to-read meter, constant tension free rolling roll chart mechanism. Includes 7 wiring harnesses. Assembly skill of technician or higher recommended. Assembly time, 40 hours average. Black leatherette case with white trim, nylon feet, removable top. (27 lbs.)

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Completely portable . . . superb modern styling in high impact plastic . . . powerful 6-transistor circuit operating from long-life mercury batteries or ordinary pen-light cells. Does everything you expect from a clock-radio—and costs you so little! Handsome cabinet measures only 3½" H. x 8" W. x 7½" D. for ease of placement anywhere in the home. Batteries not included. 5 lbs.

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HEATH COMPANY Benton Harbor, Michigan

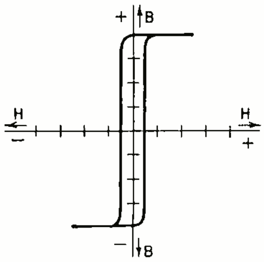


Fig. 6—B-H curve for special core material in Ramey units.

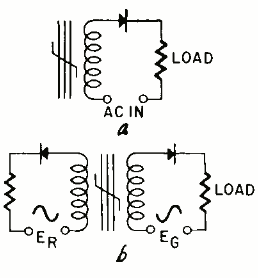


Fig. 7-a—Unit with rectifier can be self-saturating; b—basic Ramey unit with reset winding. Reset, supply voltages 180° out of phase.

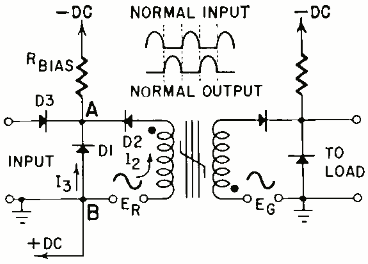


Fig. 8—Adding bias and rectifiers gives the Ramey units desired impedance characteristics.

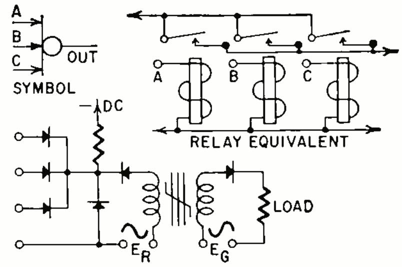


Fig. 9—Ramey *OR* unit and its symbol.

(*Continued from page* 64)
create a unit which can be made to give an output for any one of the input signals, one OR the other. We call this an *OR* unit. Such a unit is shown in Fig. 9 with three possible inputs and the symbol we use for it in control diagrams.

If we add more bias rectifiers and give each of them an input rectifier to cancel, there will be room for the reset current so long as there is one bias rectifier without a signal on it. This means that we must make sure there are as many input signals as bias rectifiers, and we call this an *AND* unit, shown for three input signals in Fig. 10.

If we design a unit in which we make the reset current the input signal, then we have a unit which will not produce an output when we have an input signal. This we call, simply enough, a *NOT* unit (Fig. 11).

For logical control we need at least one more basic unit—a memory unit. This we can make from two *OR* units and two *NOT* units as shown in Fig. 12. If *NOT 1* produces a signal which is fed to *NOT 2* through *OR 2*, *NOT 2* will fail to produce an output in the next half-cycle, and *NOT 1* will thus provide the reset for *NOT 2* each half-cycle. But an input at 1 will reset *NOT 1*, so it will fail to produce an output for the resetting of *NOT 2*, which then will produce an output a half-cycle later. This output through *OR 1* will reset *NOT 1*, and thus each cycle *NOT 1* will repeat its failure to produce a signal, whether or not there is an input at 1. The state of the unit has changed, and it can be changed back only by applying an input to 2. Fig. 13 shows the actual circuits. Notice that we need not use four separate cores, but only two. By making the reset an input, we can use the *OR* units simultaneously as *NOT* units and save components.

This memory unit retains its setting as long as the power remains on. If power fails, the unit may show the wrong saturation when the power comes back on. It is a little like turning on the gas without making sure the pilot light is lit. To avoid this, where necessary, Westinghouse can provide what is called a retentive memory circuit. It is shown in Fig. 14. Actually Fig. 14 shows the elements which make the memory retentive. Core SL is kept unsaturated by alternating voltages applied to the windings. When power fails, the core is left saturated in one direction or the other. If power is reapplied in the same phase as before, operation continues as before. But if there has been a phase shift, an output is obtained at either of the output terminals. This output is used to block the feedback current which resets the

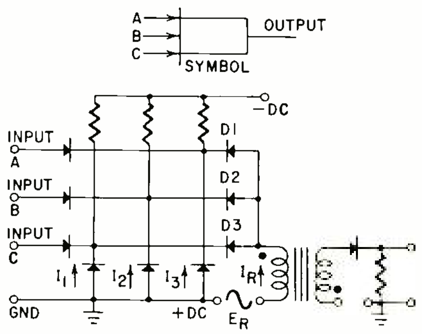


Fig. 10—Ramey *AND* unit requires three inputs to produce an output.

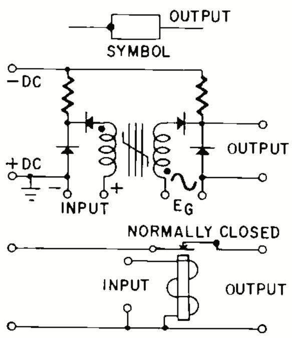


Fig. 11—*NOT* unit uses input for reset.

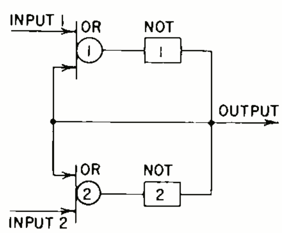


Fig. 12—Basic action of memory unit.

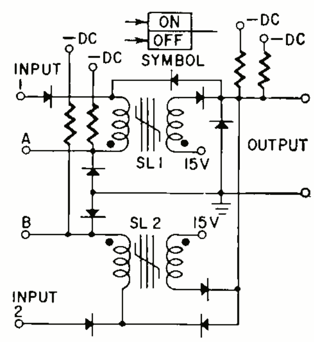


Fig. 13 — Memory unit and its symbol.

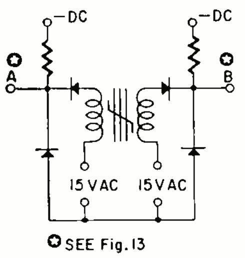


Fig. 14 — Additional core can make memory retentive. Points A and B tie to A and B in Fig. 13.

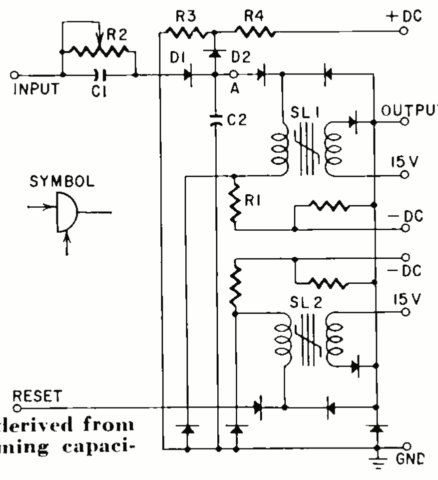


Fig. 15—Delay circuit derived from memory unit. C2 is timing capacitor. R2 adjusts timing.

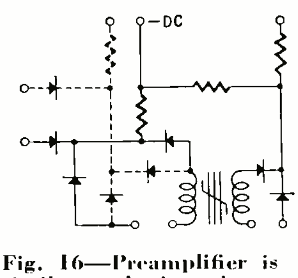


Fig. 16—Preamplifier is similar to basic unit, or with more than one input to *AND* circuit.

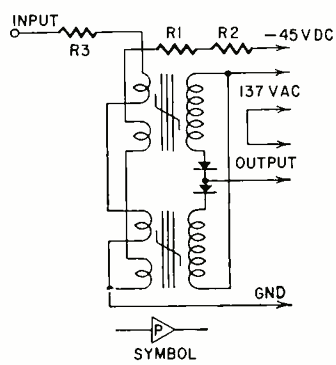
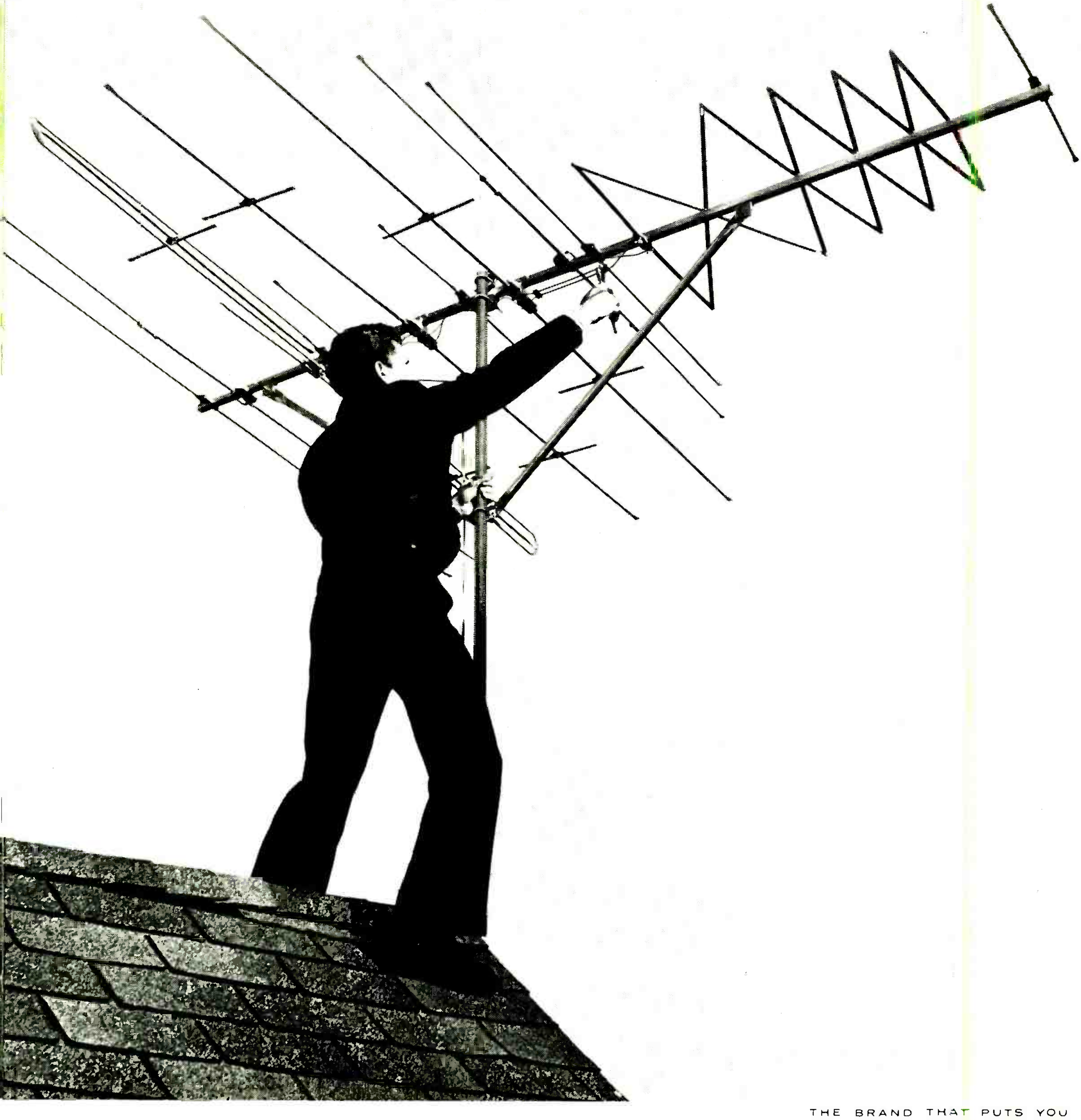


Fig. 17—Typical Ramey output amplifier (full-wave output). Extra windings are needed to connect core inputs in series.



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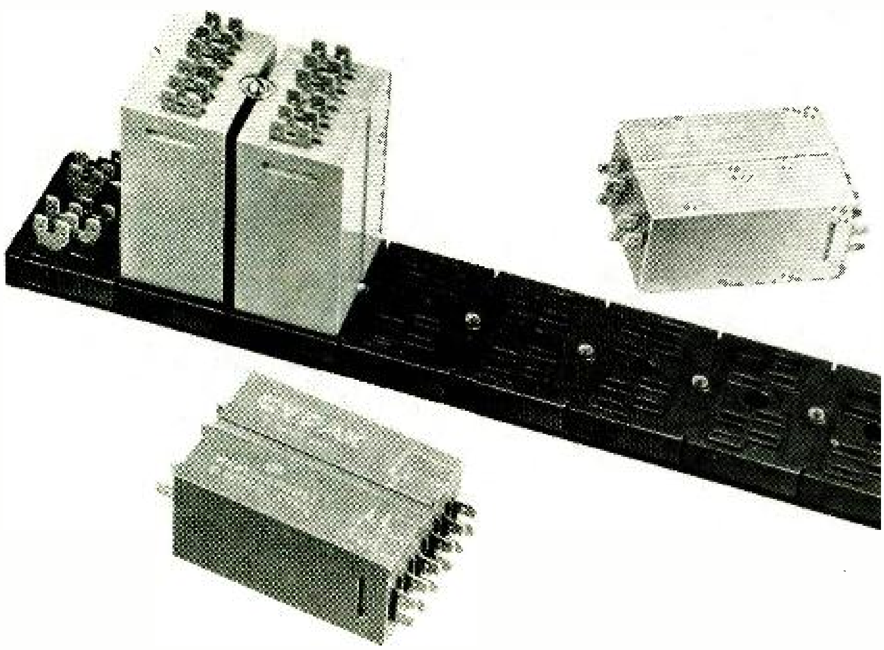


CYPAK Ramey units and their bus system.

memory, preventing the change of state of the memory. The retentive unit is tied into the memory unit at points A and B as in Fig. 13.

An important control element for sequential operations is a time-delay circuit. It too can be built from Ramey switching units. The diagram is shown in Fig. 15. It looks like a memory unit, but has in addition R1, R2, R3 and R4 and C1 and C2 as well as D1 and D2. C1 is small compared to C2. From an input signal a little charge is put into C1 each cycle. C1 tends to discharge through R2 at a rate determined by R2's setting. Each increment of voltage at the input will be too small to reset unit SL1 until after C2 builds up enough charge (up to the clamping voltage set by R3, R4 and D2). C2 discharges when a *RESET* signal is applied to the reset input. With a signal at both inputs, the time delay will start as soon as we block the reset input, and this could be done by a *NOT* unit somewhere. Until reset, the unit will continue to produce an output.

Other units important to control are preamps and output amplifiers. Preamps are similar to *AND* units, but with only one input (sometimes two-input preamps are used) and Fig. 16 is self-explanatory by now. Typical power amplifiers (Fig. 17) consist of magnetic amplifiers with their input circuits in series and their outputs paralleled, providing full-wave output. They are needed to operate the final device—a relay or contactor, if we are dealing with motors—which does the actual switching.

Using logic units

Logic units can be used to make any two propositions interdependent or mutually exclusive. A typical simplified example would be as in Fig. 18. To smoke a cigarette, a man must have the cigarette *AND* the match *AND* the desire to smoke. A three-input *AND* element is used. But perhaps a pipe would do instead. Then we would need a pipe, and tobacco, and a match and the desire to smoke, and this would require a four-input *AND* element. He must then make up his mind which he wants to do, and we need an *OR* element for the choice. However, if he finds himself in a no-smoking area, he will hold off until he is out of there, requiring a *NOT* unit, which will receive no signal as soon as he is out of the area, and thus will allow him to proceed with the smoke. The memory unit then allows the operation to proceed. Note that a number of *conditions* have been satisfied.

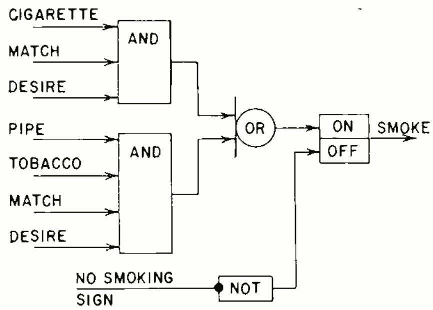


Fig. 18—Simplified illustration of the use of logic units for control.

Applying this kind of logic thinking to, say, an elevator, we could operate the car if there is no open door on the car or corridor, and if the emergency brake has not operated and if there is no power failure. We can then operate the car by pushbutton *OR* by manual control. This kind of logic control can be applied to most kinds of machinery which can be controlled with digital signals. For an example, look at Fig. 19, which shows two diagrams with partial relay controls and their CYPAK equivalent. The letters labeling the components explain the operation, if you think of the signals at the input of the CYPAK elements as substituting for the relay coils of the contacts shown.

CYPAK applications

The photo shows a CYPAK control for an automatic honing machine. (The control system is shown at the right.) But this is a modest application. Actually CYPAK has been used to control automatically huge industrial installations such as blast furnaces, steel rolling mills, mine hoists, etc. It is feasible to build a digital computer from CYPAK units, and Westinghouse has built one of these.

Why would we use such a system? The answer is almost too obvious. The control functions we have discussed would normally have to be carried out by relays of many kinds. And relay contacts, although reliable to a degree, require a great deal of maintenance, particularly in unfavorable environments—vapors, dust, danger of explosion and excessive vibration. CYPAK or similar controls without moving parts except for the final element, with no arcing relay contacts, with no mechanical wear reduce maintenance to almost nothing, will not wear out and are extremely durable and reliable. And this is why the system is called a *static* control system—it uses no moving parts!

As we said at the beginning, we can take magnetic amplifiers and build switching units. Or to be strictly impartial, we can use transistors or vacuum tubes and several other kinds of devices and build static control systems, and this is being done. Here we selected the CYPAK system because it has found many important applications in industry and is a prime example of a coordinated system of units which can perform all necessary control functions for quite complicated machinery.

This is the first of a series on static controls. The next article will appear in an early issue. END

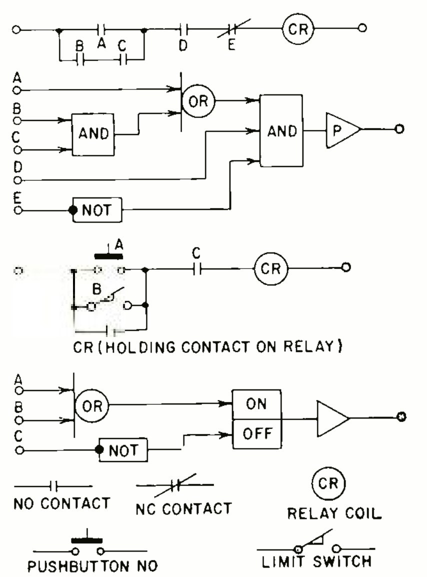


Fig. 19—Translating relay diagrams into CYPAK static control and vice versa.

PREVENTIVE MAINTENANCE KEEPS RELAYS WORKING

By H. B. CONANT

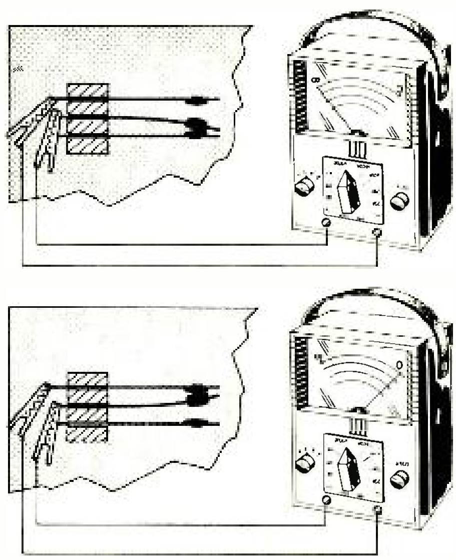
EVEN today that old saying about the ounce of prevention holds true. Preventive maintenance keeps equipment working at top efficiency and greatly extends the periods between major repairs.

Contacts are commonly neglected parts of many kinds of electrical equipment, and the only attention they receive is when they need filing or replacement. Of course, some are enclosed in sealed housings and are not accessible for servicing. Others use a wiping action (rotary tap switches) and are self-cleaning to a degree and seldom give trouble. However, contacts which simply touch as in relays, leaf switches, automobile ignition systems and the like can be kept in top condition by a simple service operation performed at regular intervals before real trouble shows up.

Contact efficiency is directly related to their ability to form an intimate metal-to-metal contact without any intervening film of metal oxide or sulfide or plain dirt. Any film adds unwanted resistance to the circuit which can cause heating, further oxidation, and burning or pitting of the contacting surfaces. A common trouble in very sensitive relays whose contacts close with very light pressure is occasional failure to make contact.

Contact resistance is easily detected with a *low-range* ohmmeter and usually measures between a substantial fraction of an ohm to several ohms. Operating the contacts manually with the ohmmeter connected may disclose that contact resistance changes from one operation of the contacts to the next. Such a condition needs attention, and the following operations will insure freedom from contact trouble for long periods.

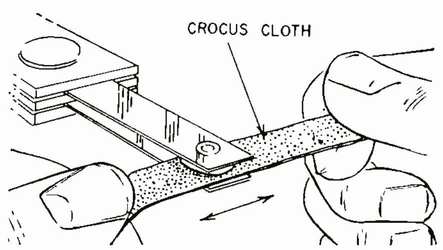
If the contacts have rough surfaces, but are not burned badly enough to require replacement, give them a light dressing with a contact file. Then cut a strip of crocus cloth so it is narrow enough to fit between the contacts and as long as can be manipulated conveniently. With the strip between the



Checking contact resistance with a vom.

contacts, press them together manually and draw the strip back and forth several times. Turn the crocus cloth over and repeat the operation. Finally, repeat the process with a strip of clean wrapping or letter paper to pick up any residual particles. Now the ohmmeter should read practically zero resistance but, if some resistance remains, more work with the crocus cloth is needed.

Crocus cloth is available at most hardware stores and is made in only one grade. It is used for polishing metals, and the more it is used, the higher the polish. For a good job, use



Rough surfaces on relay contacts can be cleaned with strip of crocus cloth.

a new strip to start and finish with an old worn strip. Polishing the contacting surfaces in this manner removes the many microscopic high points and leaves a much greater area of metal surface for contact without removing as much of the contact metal as would a file. Also, the thin crocus cloth strip does not alter the relative angle between contacting surfaces. A file does.

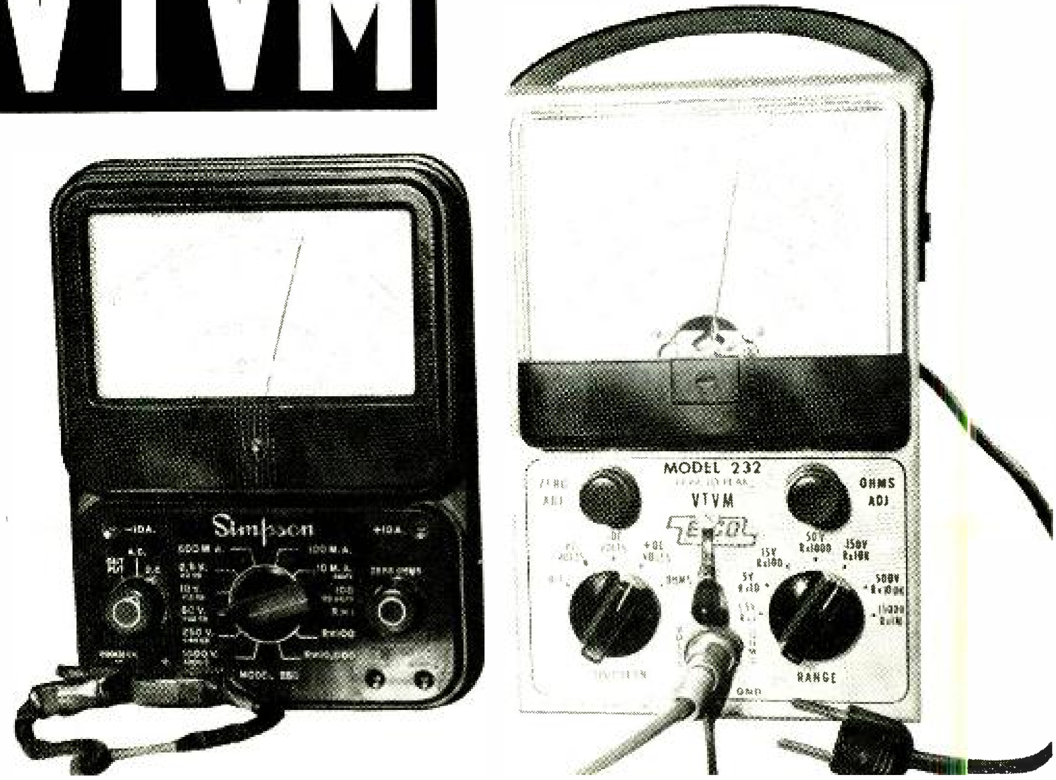
Contacts polished this way will operate more reliably and for longer periods than new contacts, because new contacts are not usually polished.

Another form of contacts is the electrode tip of a resistance or spot welder intended to generate the welding heat within the metals being welded. Continued solid welds are insured and electrode life greatly extended if the electrode tips are kept polished. Some instability and drift in dc amplifiers can be traced to less-than-perfect contacts of tube pins and sockets. Polishing tube pins sometimes works miracles. END

GET DOUBLE VALUE FROM YOUR VTVM

Simple modification makes a vtvm into a portable 2,000-ohm-per-volt voltmeter

By W. S. GUERTIN, JR.



Modified instrument is checked against a vom—readings are identical.

EVER out on a job, want to make a voltage reading and have no place to plug in your vtvm? I have, and it has made me modify my vtvm so I can use its voltage scales with or without 117 volts to power the meter.

Fig. 1 is the circuit of a typical vtvm when switched to DC VOLTS. Such circuits vary only in the value and location of the zero-adjust pot, the meter and the bias resistors. The voltage divider, which is what we're concerned with here, is usually the same.

Fig. 2 shows the voltmeter circuit after R1 and R2 have been added. See the table for the exact values. Pots slightly higher in resistance value than those shown in the table should be used to allow for exact calibration.

Total current through the circuit is 500 μa for full-scale deflection. R1 limits the current through the meter to the appropriate value (either 200 or 400 μa, depending on the manufacturer), while R2 bypasses the rest of the current around the meter. The circuit could be made more sensitive by designing it to operate on less current, but a new meter face would be needed. By using the values shown, the original markings on the meter can be retained.

Use decals or masking tape to mark the RANGE switch. Notice that the new

(Continued on page 78)

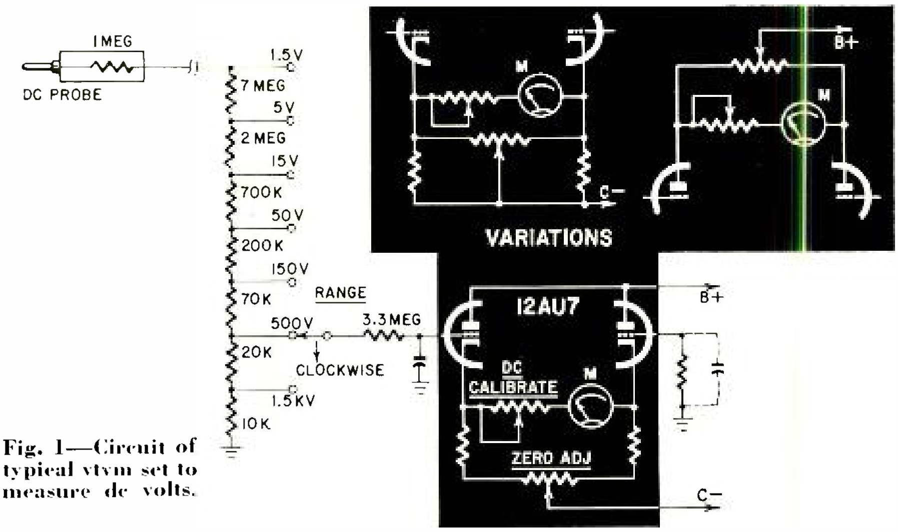


Fig. 1—Circuit of typical vtvm set to measure dc volts.

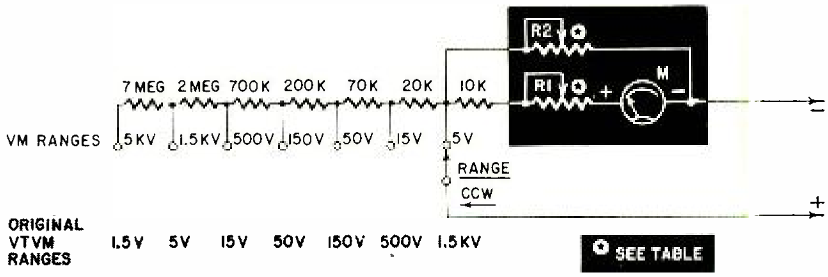


Fig. 2—Modified circuit reverses the range values.

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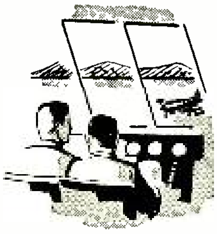

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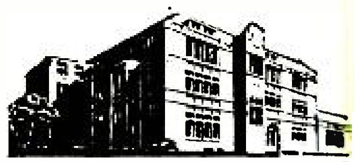

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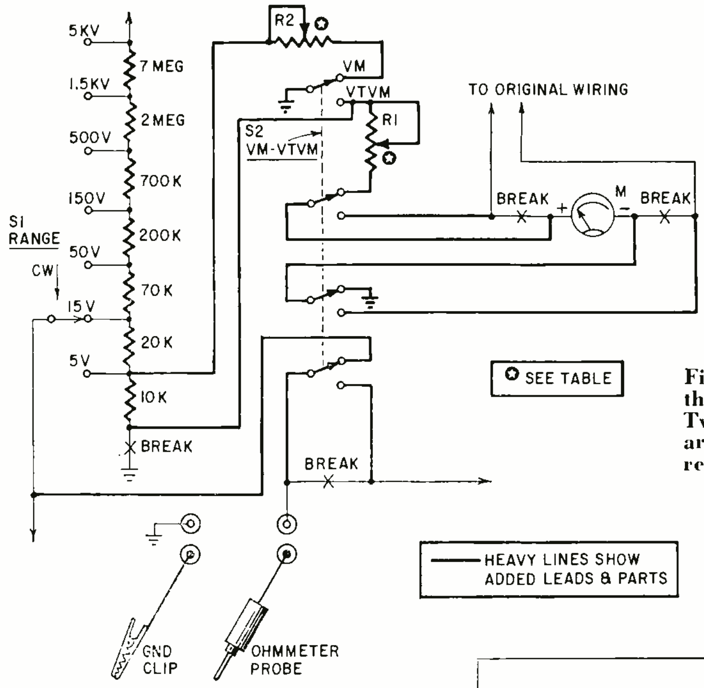


Fig. 3—Circuit of the modified unit. Two pots and a switch are the only parts required.

METER TYPE	R1	R2
400 μa–600 Ω (EICO, PACO, etc.)	1.9K	50K
200 μa–1200 Ω (Heath, Knight, RCA, etc.)	13.8K	16.6K

(*Continued from page 73*)

scales are reversed. Although the vtvm normally measures 1.5, 5, 15, 50, 150, 500 and 1,500 volts full scale as the RANGE switch is moved clockwise, it measures 5,000, 1,500, 500, 150, 50, 15 and 5 volts, respectively, when operating as a voltmeter.

The complete circuit is shown in Fig. 3. The original FUNCTION switch is set to the OHMS position. This isolates the voltage divider from the rest of the circuit, simplifying the switching circuit.

Calibration

To calibrate, turn the VTVM-VM switch to VM, the FUNCTION switch to OHMS, and the RANGE switch to 5V (the extreme clockwise position). Connect the leads to a known dc voltage of 5 or less, and adjust R1 until the meter reads this voltage. A fresh 4.5-volt battery is ideal. The voltage is measured between the ground and ohmmeter leads to insure a direct connection to the multiplier resistors. If a Uniprobe type of lead is used (two leads in one), the probe must be switched to ac-ohms—this shorts out the built-in 1-megohm resistor. The meter's 5-volt range is now calibrated. In this position, R2 does not affect the reading since it is simply connected across the battery.

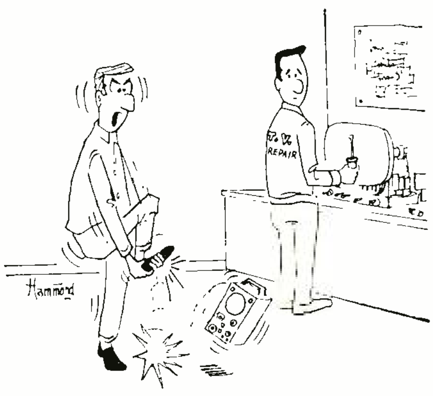
Now switch to the 15-volt range and adjust R2 until the vtvm reads the same voltage it did on the 5-volt range. This completes the calibration. (You could use a higher-voltage battery and adjust R2 for its value but, in any case, only two calibrations are necessary: one on the 5-volt range, and one on any other range.)

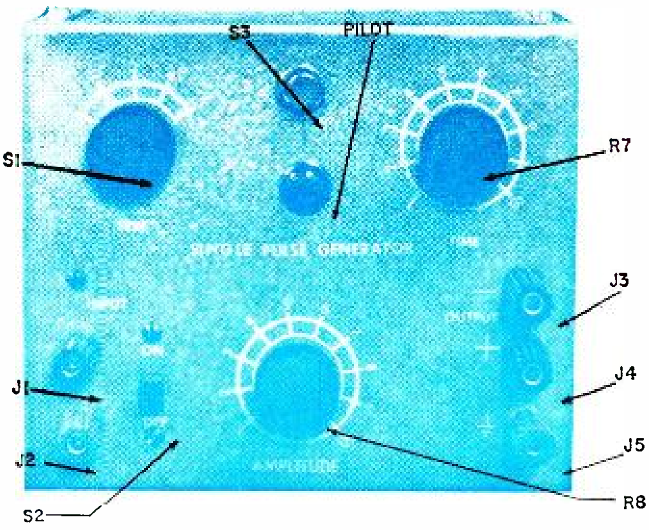
Using the meter

When operated as a vtvm, the original switch markings are used. To use as a portable voltmeter, set the added switch to VM, and the RANGE switch to the desired range as indicated by the new markings. The FUNCTION switch may be left in any position. Measure the voltage with the ground and ohmmeter leads and read the voltage on the 5- or 15-volt scale.

These changes can be made to any vtvm very easily. Any four-pole two-position switch that fits may be used. I used an anti-capacitance lever switch.

Aside from drilling the hole for the switch (the pots can be mounted inside on a bracket), total wiring time should be no more than an hour and will be well worth the effort. For the price of two pots and a switch, you will own another piece of test equipment—a voltmeter with a sensitivity of 2,000 ohms per volt. END





SINGLE PULSE GENERATOR

It delivers the one shot so often needed when working with industrial and experimental circuits

By J. H. THOMAS

FOR experimental work and servicing counter, multivibrator, flip-flop and control circuits, as well as many other purposes, a single clean pulse controllable in duration and height, is very desirable. In fact, it is just about essential. To get such a clean square-topped pulse without switching transients may appear simple, but is more difficult than it might seem. The simple generator described here does deliver just such a pulse. Length can be anything from 1/5 second to about 1 μsec. Pulse height is variable from 0 to nearly 100 volts, positive or negative.

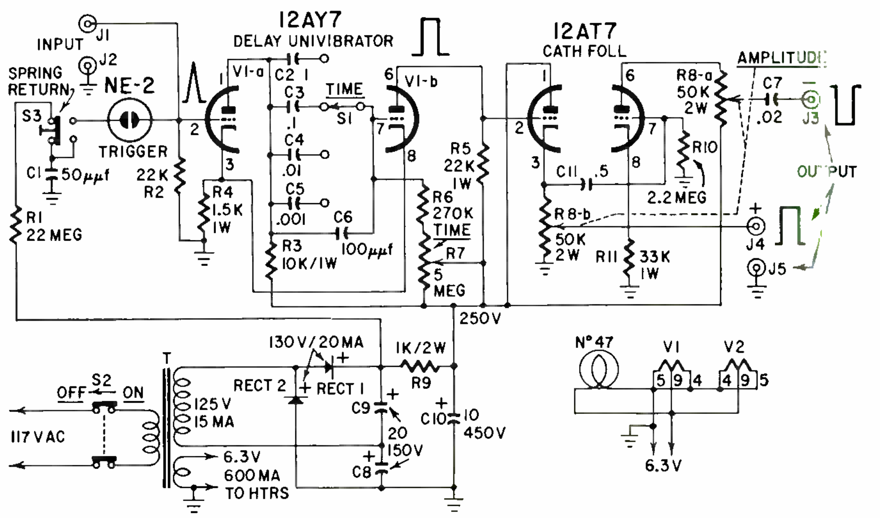
A single pulse is normally delivered, but an input is provided for repetitive trigger. It uses any sharp spike pulse of about 30 volts to cause the same square-topped output, as fast as the duration of the pulse plus about 10% up to about 50 kc. Above 50 kc, recovery time becomes longer in proportion to the pulse.

The circuit

How we get such a single pulse is shown in Fig. 1. We start with a capacitor (C1) which is continuously charged through the normally closed contact of switch S3. Depressing the switch connects C1 to the NE-2 in series with the 22,000-ohm grid resistor. The NE-2 fires once, but only once, because the 50-μμf capacitor has just enough stored energy for that. When the neon fires, it places a positive pulse (about 70 volts) on V1's grid. This trips the multivibrator, which normally has the second half (V1-b) conducting. The return of the 12AY7 to the normal state is delayed by selecting time constants with switch S1 and control R7 to control the length of the output pulse.

The multivibrator pulse is applied to the cathode follower's grid. This prevents multivibrator loading and keeps the timing from changing. From the cathode follower we get a positive output pulse. From here we also feed the pulse through a reversing amplifier, which puts out the negative equivalent of the positive pulse. The high cathode resistor for this triode (V2-b) assures that the negative pulse has about the same level as the positive pulse at the same setting of the level control.

The power supply is a voltage doubler, providing the 250 volts dc necessary for the multivibrator and allowing the use of a small instrument-type power



R1—22 megohms
R2—22,000 ohms
R3—10,000 ohms, 1 watt
R4—1,500 ohms, 1 watt
R5—22,000 ohms, 1 watt
R6—270,000 ohms
R7—pot, 5 megohms
R8—dual pot, 50,000 ohms, 2 watts, each section
R9—1,000 ohms, 2 watts
R10—2.2 megohms
R11—33,000 ohms, 1 watt
All resistors ½-watt 10% unless noted
C1—50 μμf, disc ceramic
C2—1 μf, paper
C3—0.1 μf, ceramic
C4—.01 μf, disc ceramic
C5—.001 μf, disc ceramic
C6—100 μμf, tubular ceramic
C7—.02 μf, disc ceramic
C8—20 μf, 150 volts, electrolytic
C9—20 μf, 150 volts, electrolytic
C10—10 μf, 450 volts, electrolytic
C11—0.5 μf, paper
All capacitors rated at 250 volts minimum unless noted
J1, 2, 3, 4, 5—binding posts
RECT1, 2—selenium, 130 volts, 20 ma, miniature
S1—1-pole 5-position rotary
S2—spdt slide
S3—spdt pushbutton, spring return
T—power transformer; primary, 117 volts; secondary, 125 volts, 20 ma; 6.3 volts, 700 ma (Thordarson 26R32, Stancor PS-8415 or equivalent)
V1—12AY7
V2—12AT7
Neon lamp NE-2
Pilot light assembly with No. 47 bulb
Sockets, 9-pin miniature (2)
Case, 4 x 5 x 6 inches
Chassis to fit (see text)
Miscellaneous hardware

Fig. 1—Two-tube circuit is easy to build.

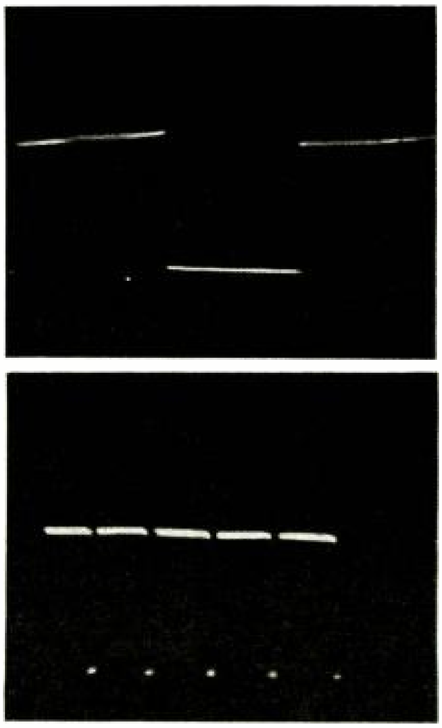


Fig. 2—Generator patterns: a—1/20 second pulse; b—100-μsec pulse.

transformer. Pulses produced by this generator are shown in Fig. 2.

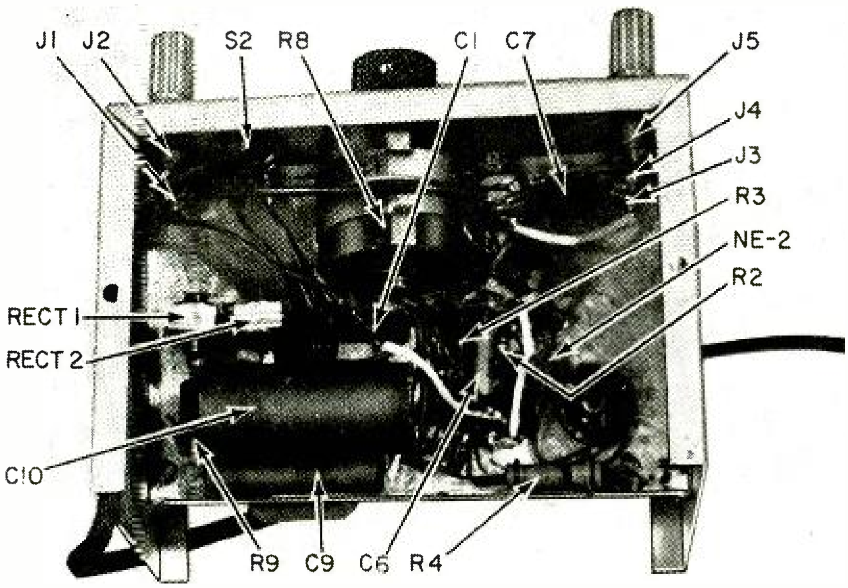
Building the unit

Construction is conventional. The unit is built into a 4 x 5 x 6-inch utility box, with a piece of 24-gauge galvanized sheet metal for a chassis. I like to use galvanized sheet metal because it is cheaper than copper and I can solder ground connections direct to the chassis. Nothing in the circuit is critical, *but do not ground one end of the high-voltage winding on the transformer,* as you may be accustomed to doing. The photos show top and bottom views of the chassis. This layout works fine, but it can be changed if desired.

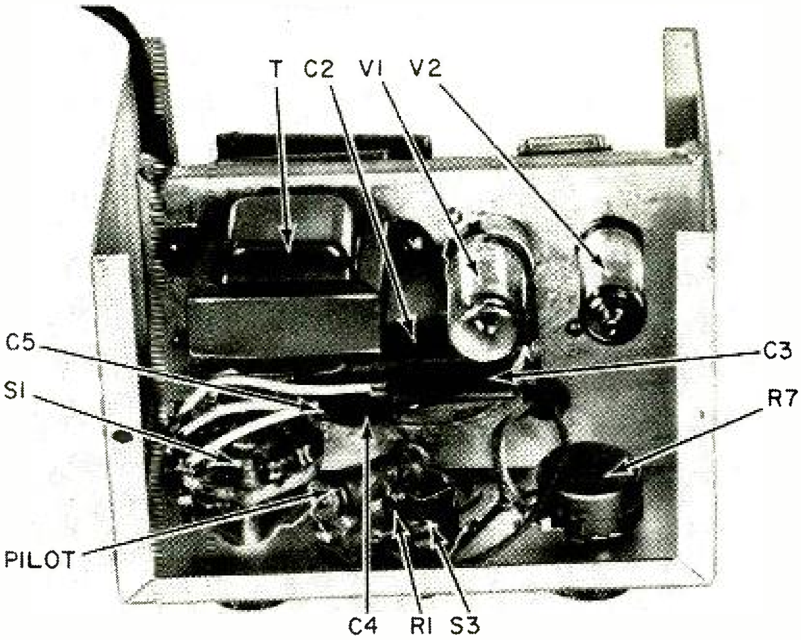
Using the generator

Nothing could be simpler than using this pulse generator. Just plug it in, connect it to the device to which you want to feed a single pulse, select the length and pulse height desired, and push the button. The generator will deliver one pulse each time you push the button. For repetitive operation, connect a sharp spike source to the input. If you prefer, move jack J1 to the other side of the neon tube (away from V1-a's grid). Then any pulse of sufficient height (about 70 volts) will trigger the device.

To calibrate the pulse height, use a scope and scope voltage calibrator as with any other waveform. Time calibration is a bit more difficult. The best procedure is to use a trigger with a known repetition rate and sync the scope sweep until only one or two (preferably) pips are shown. The sweep speed is then known (from the repetition rate) and you can measure the distance between pips and the length



Inside the case and under the chassis. Note the two miniature rectifiers on the left.



Top chassis view of the single-pulse generator. A shielded transformer is not required.

of one pip. Thus, if the repetition rate is say 50 kc and you have two pips, the time between pips is 1/50,000 second or 200 μsec. If the pip length is 1/10 of this, you have a 20-μsec pulse. At very short pulse lengths this is an accurate measurement only if you stretch the sweep out as long as possible.

Using single pulses

Other than triggering counter circuits for servicing and experimental purposes, there are a host of other uses for this gadget. You can use it to produce, electrically or mechanically, a single sweep trace on a scope if you have a triggered scope sweep generator. The single pulse of moderate amplitude is frequently used in biological experiments on nerve tissue. Also to trip a camera solenoid. Checking control circuits in another application. You could use it to step a stepping switch one step at a time. For this a relay is used between the generator and the stepping switch as not enough energy is available to step the switch directly. Anywhere a single pulse is needed, this generator will come in handy. It can also be used as a square or rectangular-wave generator, starting with pips or a sawtooth. I have found it well worth the small investment to add this generator to my bench equipment. END

TEST INSTRUMENTS

SIMPLE DRY CELL AND BATTERY TESTER

THE best type of dry-cell tester (loaded voltmeter) can be made for a few cents. All you do is use your vom or vtvm plus specified resistors across its leads. Battery manufacturers agree that this is the best type of tester, but no commercial units are available because of the multitude of resistors (½ watt, 10%) needed for such a unit. However, the average shop encounters only a limited range of dry cells and the resistors needed to test them represent only a very small investment.

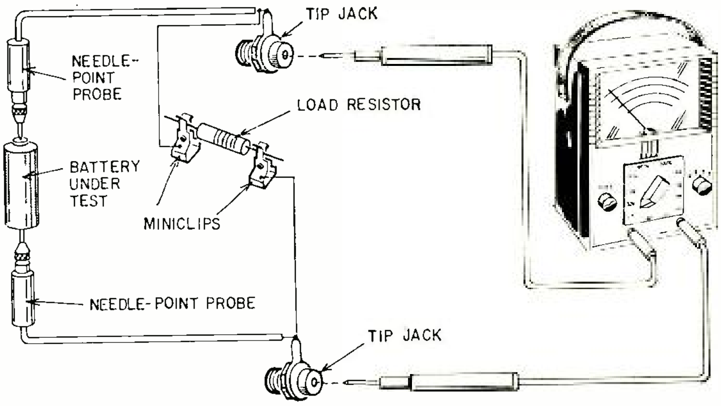
Needle-point prods are used with the tester to insure good contact with the battery. All leads are No. 24 stranded hookup wire. One end of each load resistor is bent into a loop so it can be mounted key-ring style on a paper clip.

Values for the load resistors are based on "suggested current range" (from Eveready *Battery Engineering Bulletins* available from National Carbon Co., 30 E. 42 St., New York 17, N. Y.). The GOOD–FAIR–POOR quality ratings are based on discharge curves supplied by the Burgess Battery Co. However, both loads and ratings are strictly my interpretation of the data supplied.

My rating theory is: GOOD if voltage is no more than 2% below nominal; FAIR if voltage is more than 2% but no more than 5% below nominal; POOR if voltage is more than 5% but no more than 10% below nominal. My load theory is: maximum of suggested current range if cell is normally subjected to a heavy drain (as in a flashlight or low-range ohmmeter); middle of the suggested current range if normally subjected to light loads (as in a high-range ohmmeter). For example, my table of loads and ratings reads:

BATTERY	LOAD (ohms)	VOLTAGE RATINGS GOOD	FAIR	POOR
Z, 915 (penlight)	56	1.47	1.42	1.35
1, 935, small flashlight	18	1.47	1.42	1.35
2, 950, large flashlight	10	1.47	1.42	1.35
U15, 412	22K	22.0	21.5	20.0
U20, 413	27K	29.5	28.5	27

—*Joseph H. Sutton*



Dynamic TRANSISTOR CHECKER

How one manufacturer solves the problem of checking transistors with a meterless circuit

MANY transistors can be unplugged from their sockets for testing. However, in a number of circuits the transistors are soldered into place. Because the service technician has to deal with both arrangements, a transistor checker that handles in-circuit as well as out-of circuit testing is especially convenient. One unit that does just this is the Seco model 100.

This checker is designed for the service technician and has several innovations that help him in his work. It determines whether a transistor is an n-p-n or a p-n-p unit without damaging it. It also gives a comparative rating of transistor gain on a 0–100 scale. In addition, it checks power transistors.

How it works

When a transistor is plugged into the checker or connected to its clip leads, an oscillator circuit is formed with emitter-to-base feedback to sustain oscillation (see Fig. 1). Control R3 regulates the amount of feedback.

As long as the circuit oscillates transformer T steps up the collector output to light the neon lamp. As control R3 is turned up, feedback is reduced until at some point oscillation ceases and the neon lamp goes out. R3's dial reading (on a 0–100 scale) gives a measure of comparative gain. For finer voltage measurements, a vtvm or oscilloscope can be connected across the output jacks on the face of the tester. Naturally, the lamp brightness is in direct proportion to transistor output amplitude. When a vtvm or scope is used as an output indicator, the lamp is switched off to prevent limiting or clipping.

When more voltage than the tester

(*Continued on page 86*)

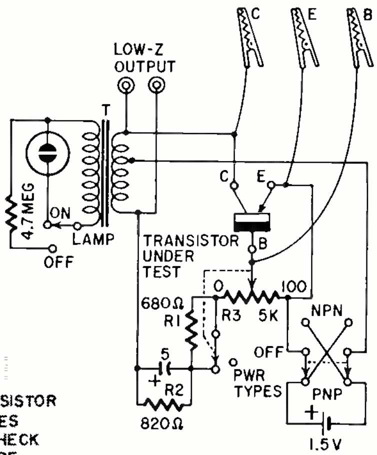


Fig. 1—Circuit of the Seco model 100.

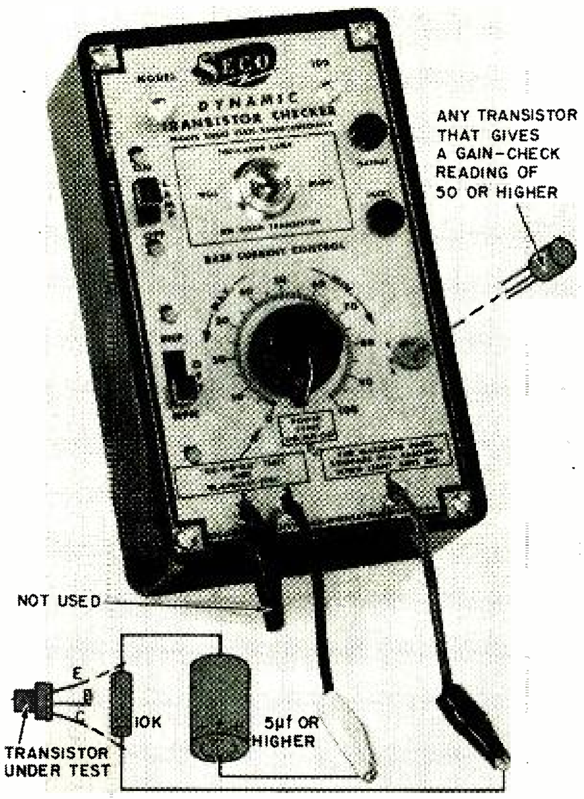


Fig. 2—This simple test detects transistors that dissipate too much current internally.

NOW YOU CAN HAVE YOUR CHOICE OF CENTURY'S UNIQUE Peak-to-Peak VACUUM TUBE VOLT METERS

Model VT-10
LINE OPERATED

NEW

WITH LARGE EASY-TO-READ 6" METER

featuring the sensational new *MULTI-PROBE* *(Patent Pending)*

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

❶ DC Probe ❷ AC-Ohms Probe ❸ Lo-Cap Probe ❹ RF Probe

No longer do you have to cart around a maze of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to function as either a DC Probe, AC-Ohms Probe, Lo-Cap Probe or RF Probe.

LINE OPERATED
Ideal for use on the test bench. Designed to run cool even under continuous operation . . . Line isolated.

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Completely portable . . . Invaluable wherever line connection is undesirable or unavailable . . . Unique circuitry assures low battery drain.

Model VT-1
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Model VT-10 **$58.50 Net**

TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

Model VT-1 **$58.50 Net**

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FEATURES OF VT-1 and VT-10

• New advanced pentode amplifier circuit • Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.s • Simplified multi-color easy-to-read 4-scale meter • No heat operation assures stability and accuracy • Amplifier rectifier circuit with frequency compensated attenuator — a feature found only in costly laboratory instruments • Meter completely isolated • Hand-crafted circuitry eliminates the headaches of printed circuitry • 1% resistors used for permanent accuracy • Rugged gray hammertone steel case provides necessary shielding and eliminates plastic case drawbacks of cracking or melting • Deep brushed long lasting etched aluminum panel • Matching cover protects instrument face — snaps on and off instantly.

FUNCTIONS OF VT-1 and VT-10

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

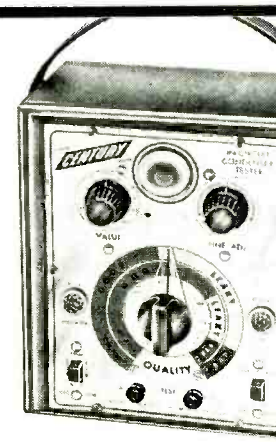
ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

SPECIFICATIONS OF VT-1 and VT-10

- **DC Volts** — 0 to 1.5/6/30/150/300/600/1500 volts
- **AC Volts (RMS and Peak-to-Peak)** — 0 to 3/12/60/300/1200 volts
- **Ohms** — to a billion ohms, 10 ohms center scale — RX1/10/100/1K/10K/100K/1M
- **RF** — Peak reading demodulator supplied for use on all DC ranges
- **Zero Center** — available on all DC volt ranges with zero at mid-scale
- **Decibles** — from —10 Db to +10/22/36/50/62 based on the Dbm unit: ODb-IMW in 600 ohms
- **Impedance** — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- **Input Capacity** — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model CT-1 IN-CIRCUIT CONDENSER TESTER



Here is an **IN-CIRCUIT CONDENSER** that **DOES THE WHOLE JOB!** The CT-1 actually steps in and takes over where all other in-circuit condensers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.

in-circuit checks:

- Quality of condensers even with circuit shunt resistance . . . (This includes leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of condensers . . . (This includes leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for even greater accuracy
- Isolated power line
- Deep brushed long lasting etched aluminum panel
- Housed in sturdy gray hammertone finish steel case . . . comes complete with test leads

Model CT-1 **$34.50 Net**

TERMS: $9.50 within 10 days. Balance $5 monthly for 5 months.

10 DAY *FREE* TRIAL ON CENTURY INSTRUMENTS OF YOUR CHOICE

See for yourself at no risk why thousands of servicemen all over the country selected CENTURY test equipment above all others. Send for instruments of your choice without obligation . . . try them for 10 days before you buy . . . only then, if satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD

Model CRT-2 **$57.50** Net | TERMS: $13.50 within 10 days. Balance $11 monthly for 4 months.

Model CRT-2 CRT TESTER-REACTIVATOR

TESTS, REPAIRS and REACTIVATES

- ***ALL BLACK AND WHITE PICTURE TUBES*** *(including 110° tubes)* . . . from 8" to 30", whether 12 pin base, 8 pin base, 14 pin base . . . and the very latest 7 pin base.
- ***ALL COLOR PICTURE TUBES***. . . Each of the red, green and blue color guns is handled separately.

CHECK THESE EXCLUSIVE FEATURES

✔ **THE MULTI-HEAD** (Patent Pending) . . . **A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD** —A tremendous advance over the maze of cables and adapters generally found with other testers.

✔ **WATCH IT REACTIVATE THE PICTURE TUBE** — You actually see and control the reactivation directly on the meter as it takes place. This allows you for the first time to properly control the reactivation voltage and eliminates the danger of stripping the cathode of the oxide coating. It also enables you to see whether the build-up is lasting.

✔ **CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION** — Stronger than any found in other testers — high enough to really do the job — yet controlled to avoid damage to the picture tube.

✔ **UNIQUE HIGH VOLTAGE PULSE CIRCUIT**— Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.

✔ **VISUAL LIFE TEST** — Enables both you and your customer to see the life-expectancy of any picture tube right on the meter . . . helps eliminate resistance to picture tube replacement when necessary.

✔ **SPECIAL LOW SCREEN VOLTAGE TUBES** — Will handle new type picture tubes with special low voltage of approximately 50 volts.

✔ **SEPARATE FILAMENT VOLTAGES** — including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.

✔ **NEW 'SF' PICTURE TUBES** — Accommodates the different base pin connections of this new type picture tube.

THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

TEST
- For quality of every black and white and color picture tube, employing the time proven dynamic cathode emission test principle.
- For inter-element shorts and leakage up to one megohm. Separate short test provided for each element in the picture tube.
- For life expectancy.

REPAIR
- Will clear inter-element shorts and leakage.
- Will weld open elements.

REACTIVATE
- The "SHOT" (high voltage controlled pulse) method of reactivation provided by the CRT-2 will restore picture tube to new life in instances where it was not possible before. The high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- The "BOOST" method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will also improve definition, contrast and focus greatly and add longer life to the picture tube.

Housed in hand-rubbed oak carrying case complete with CRT ADAPTER

Model FC-2 **$69.50** Net | TERMS: $14.50 within 10 days. Balance $11 monthly for 5 months.

Model FC-2 FAST-CHECK TUBE TESTER

Simply set two controls . . . insert tube . . . and press quality button to test any of over 900 tube types completely, accurately . . . IN JUST SECONDS!

The FAST-CHECK enables you to cut servicing time way down, eliminate unprofitable call-backs and increase your dollar earnings by selling more tubes with very little effort on your part. You make every call pay extra dividends by merely showing your customer the actual condition and life expectancy of the tube. The extra tubes you will sell each day will pay for the FAST-CHECK in a very short time.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK
Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

✔ Checks quality of over 900 tube types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes, OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
✔ Checks for inter-element shorts and leakage.
✔ Checks for gas content.
✔ Checks for life-expectancy.

SPECIFICATIONS

• No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers • No annoying roll chart checking . . . tube chart listing over 900 tube types is located inside cover. New listings are added without costly roll chart replacement • Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale • 41 phosphor bronze beryllium tube sockets never need replacement • 7-pin and 9-pin straighteners mounted on panel • Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out • Special scale on meter for low current tubes • Compensation for line voltage variation • 12 filament positions • Separate gas and short jewel indicators • Line isolated — no shock hazards • Deep brushed long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

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Yes, I want to take advantage of your 10 day FREE try-before-you-buy offer. Ship on approval the instruments I have checked. After I have tried the equipment for 10 full days I will either send you the down payment and agree to pay the balance in the monthly payments shown, or I will return the units and owe nothing.

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Please print clearly

Address ....

City .... State ....

TEST INSTRUMENTS

(*Continued from page* 83)

provides (1.5 volts) is needed to test a particular transistor, insert an external battery in series with the collector of the transistor being checked. When testing power transistors, connect a 500-ohm potentiometer across the output terminals for additional loading.

Out-of-circuit tests

To test a transistor simply plug it into the socket on the face of the tester or connect it to the colored clip leads. Then, with the base current control at zero, turn the lamp switch on. Next push the type selector switch to n-p-n or p-n-p. If you don't know what type transistor you are checking, flip this switch first in one direction (p-n-p) and then in the other (n-p-n). The transistor will oscillate and light the lamp only when the type selector is in the proper position. The transistor cannot be damaged by this test as long as the base current control is set at zero. Now turn the base current control up slowly. When the light goes out, the dial reading shows the unit's gain.

If a transistor gives a reading of less than 40, it may be dissipating too much current inside itself. To check this, connect a resistor and capacitor as shown in Fig. 2 (solid lines) and plug a known-good transistor into the checker. Now turn the base-current control up until the light goes out. Note this reading. Next substitute the transistor for the 10,000-ohm resistor (dashed lines in Fig. 2). If the transistor is good, the indicator lamp will light and the transistor can be expected to work in all transformer-coupled and resistance–capacitance-coupled circuits. If the indicator lamp goes out during this test, the transistor may work in a very-low-impedance circuit, but is likely to create loss of sensitivity and distortion in most radio receiver applications.

In-circuit tests

For in-circuit tests, turn the checker on as before, but leave the transistor in the circuit. If you are working on a radio or audio amplifier, advance all gain and volume controls. Most of the time the checker, by placing the transistor under test in an oscillator circuit, will introduce an audio tone in the amplifier or audio section of the radio that can be heard from the set's speaker. This is ideal for circuit tracing. Start with the output stage and work back. Of course, when testing if and converter stages, the oscillations will not be passed on the speaker. For these stages connect a vtvm or scope across the instrument's output jacks to check for transistor oscillation.

When power transistors are to be checked, more base current is desired to give a better test of their ability. To do this a switch is included in the tester to add R1, a 680-ohm resistor. This increases base current 50 ma or more. R1 is normally shorted out on small-signal transistors. END

DESIGN YOUR OWN PREAMP

Part IV—Volume and loudness controls, direct and feedback types

By NORMAN H. CROWHURST*

IN the early days the volume control was just a potentiometer connected at a suitable place in the circuit. No one paid particular attention to just where it was connected, so long as a suitable point could be found. Nowadays we should call such a control a gain control. But because the name volume was used then it still remains, although volume is practically synonymous with loudness.

When engineers began to think about making a control that would alter the loudness of the reproduced program, rather than merely adjust the amplifier's gain, a new name had to be thought up to distinguish between the two. As a result we have volume controls and loudness controls. The volume control merely adjusts the amplifier's gain while the loudness control puts in some frequency compensation to produce a subjective effect equivalent to changing the loudness with which the program is played.

Before going further, perhaps we should explain briefly why a loudness control has to provide for loudness difference. If program material is recorded and replayed at the same sound intensity, through a system that has an overall flat response, reproduction will be nearly perfect. The relative intensity of all the component frequencies will be reproduced in exactly the same proportion as the original. So for this one reproduced level, no loudness compensation is needed.

Loudness adjustment becomes necessary when the reproduction is played at a level different from the studio level. Frequently one will not want to play the program material as loud in one's living room as it was played in the recording studio, because the room is smaller and possibly slightly more reverberant in relation to its size than the studio. A *loudness* rather than a volume control is needed to cut the level because reducing the intensity of a 1,000-cycle tone by 15 decibels makes about the same change in loudness sensation as about a 6-db reduction in the region of 50 to 100 cycles. If a volume control were used to change level by 15 db all the way, the reduction in apparent level at 50 cycles would be equivalent to a 40-db change at 1,000 cycles. The bass would be all but inaudible. This can be seen from the Fletcher-Munson loudness contours of Fig. 1.

The loudness control should accentuate the lower frequencies so a 15-db drop in level at about 1,000 cycles will be accompanied by a drop of only about 6 db at 50 cycles to produce a similar apparent loudness. Some adjustment is also desirable at the high end but not to such a great extent. About 2- to 3-db progressive boost between 3,000 and 10,000 cycles should accompany a 15-db reduction in level.

Turning down to a low level, by reducing the intensity at 1,000 cycles about 30 db, would require only a 10- or 12-db reduction at the low-frequency end. This means an 18- to 20-db boost will be necessary at the low end. Fig. 2 shows the response variation a good loudness control should give, based on the data of Fig. 1 and a studio loudness of 70 db.

Position in amplifier

The loudness control should be as close as possible to the preamp output so turning the loudness down will give the quietest possible background. This minimizes any noise developed in earlier stages.

A gain or volume control, on the other hand, should be close to the preamp input. It has to adjust for differences in the recorded level that may

* Author: *High-Fidelity Circuit Design* (Gernsback Library).

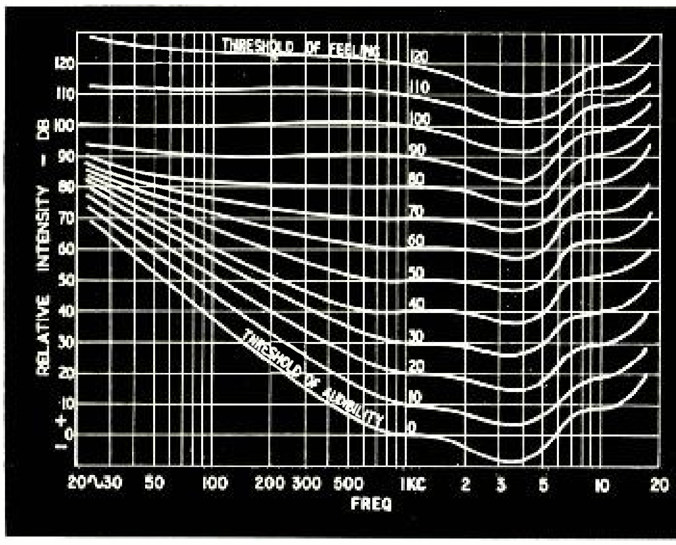

Fig. 1—Fletcher-Munson average loudness contours.

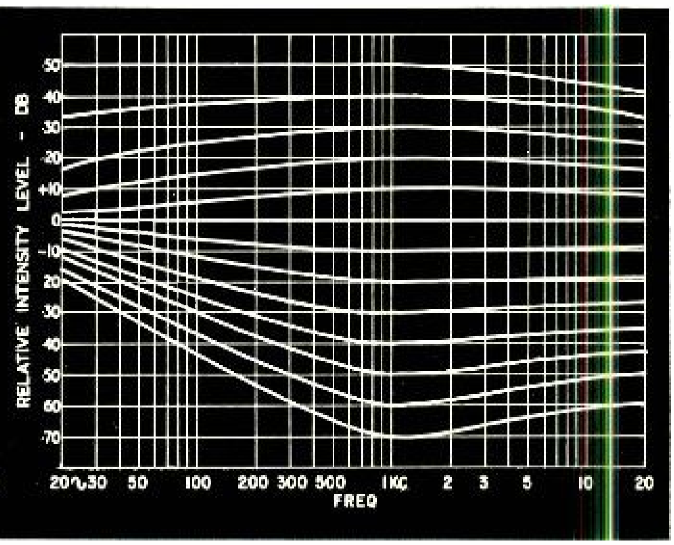

Fig. 2—Loudness compensation required, using the 70 db reference level of Fig. 1 as a standard.

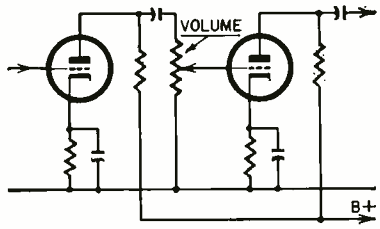

Fig. 3—The simple, conventional volume control circuit.

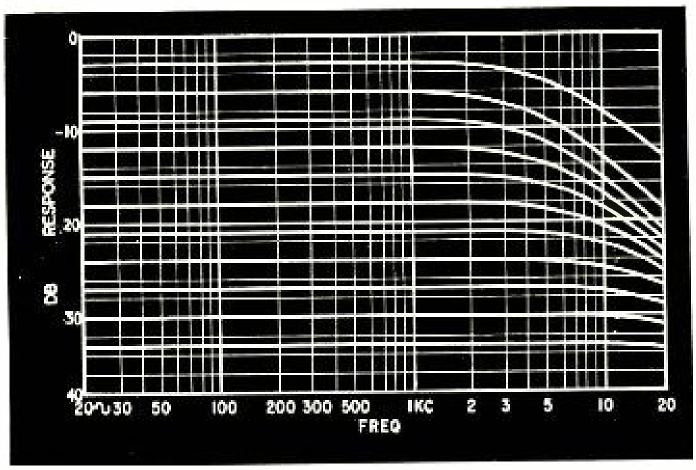

Fig. 4—If the potentiometer in Fig. 3 has too high a value, frequency response will vary as shown here. Curves are for a 1-megohm control with a 120-μμf input capacitance.

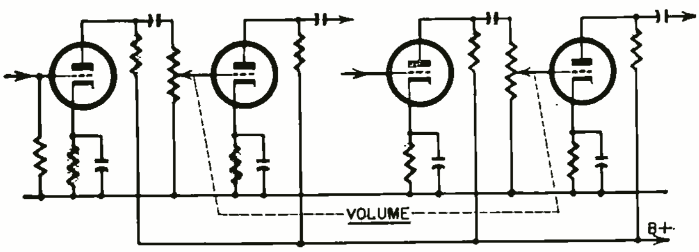

Fig. 5—Where a preamp has to handle a wide range of input signal levels, a divided control is helpful.

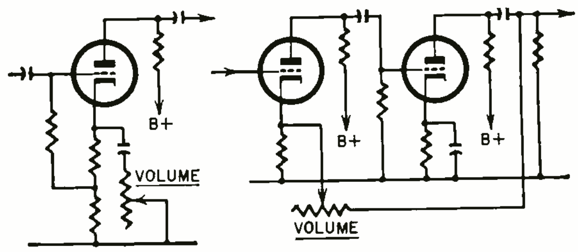

Fig. 6—Two feedback volume control circuits.

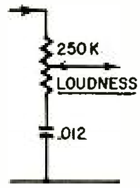

Fig. 7—Simplest form of loudness control. Capacitor adds variable bass boost.

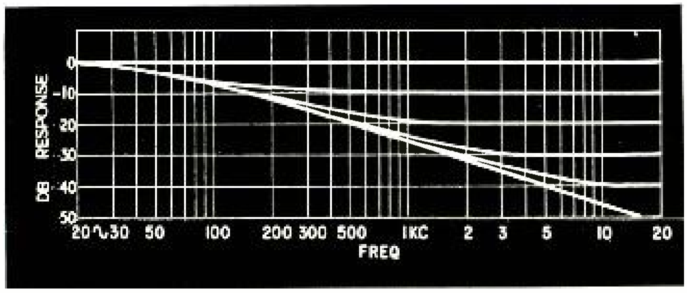

Fig. 8—Response range produced by circuit of Fig. 7.

not be caused by corresponding differences in original loudness. So it should be as close to the input as possible without hurting the noise level.

If the volume control is inserted immediately after the first stage and is kept turned well down, the level at the grid of the second stage is sometimes lower than that at the first, and the preamp's noise level suffers. So it may be best to get in two stages of amplification ahead of the volume control.

An alternative is to use a ganged volume control so only part of it immediately follows the first stage. This is particularly useful where a preamp is likely to have widely divergent input levels.

Direct type volume control

Both loudness and volume controls can be either direct or feedback types. The direct volume control uses a potentiometer connected between stages as in Fig. 3.

A volume control should adjust level without varying frequency response. To do so, the pot's value should not be too high. A value of 100,000, or at the most 250,000, ohms is satisfactory. If a 1-megohm volume control is used, response deteriorates as the control is turned down a little way from the top (full-volume) position. Adjusting the control varies the response as shown in Fig. 4. This can be compensated for to some extent by using a capacitor from the top end to the slider, but even then response does not remain uniform. The best solution is to use a lower-resistance potentiometer.

The taper should be logarithmic to get good control with only one potentiometer. The regular log taper provides one-tenth the total resistance at the halfway rotation point, which means that the top half of the rotation causes a 20-db change in level. The overall effectiveness of the volume control is a little more than a 40-db range and includes an off position by turning to the extreme bottom end. It is satisfactory for most volume control purposes.

If a linear taper is used, the 20-db range requires nine-tenths the full rotation of the control and levels lower than this are compressed into one-tenth the rotation.

If two controls are used in cascade, one following the input stage and one later in the preamp (Fig. 5), a semi-log taper for each is better, although the log taper can also be used if a very wide range of input level is expected.

Feedback volume control

A feedback control can follow either of the circuits in Fig. 6. The difficulty in designing such a circuit is that response is almost certain to change with level. Also, even applying maximum feedback does not give an off position. The maximum range of the control is the same as the gain of the amplifier over which the control is placed.

A difficulty arises in many circuits, except single-stage types, because adjusting the feedback over a wide range causes considerable variation in the circuit's stability criteria. Thus the frequency response changes drastically with level. This can be minimized by using feedback over only one stage, but then there wouldn't be enough gain to provide an effective range of control. Of course, the change in stability criteria can be used to produce loudness-control compensation.

For these reasons, the regular gain or volume control is usually a straightforward potentiometer. The idea of using a feedback volume control has been practically abandoned.

Direct loudness control

For a loudness control, we will first

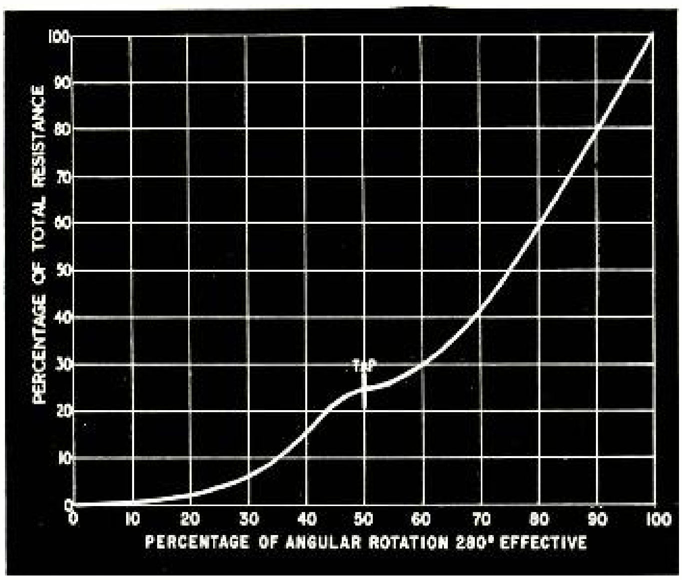

Fig. 9—Standard resistance curve used for making loudness controls in single step.

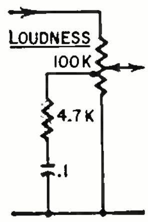

Fig. 10 (right)—Loudness control circuit using resistance taper of Fig. 9. Indicated values give 14 db maximum boost between 70 and 350 cycles.

consider the straightforward type that uses a simple potentiometer arrangement with various modifications. The simplest arrangement is to insert a capacitor at the bottom end of the potentiometer as in Fig. 7. It produces the variations shown in Fig. 8. This is somewhat unsatisfactory because the bottom end position produces a continued 6-db-per-octave downward slope throughout the entire frequency band and gives very muffled reproduction. It can be restricted by inserting a fixed resistor as well as a capacitor at the bottom end, but this also restricts the range of the control.

If we want the loudness control to act like the original volume control—to start from an off position—the simplest approach is to use a tapped potentiometer with the taper shown in Fig. 9, connected in the circuit shown in Fig. 10. However, it will have a much more restricted amount of boost than the circuit of Fig. 7.

A better control is formed by using two potentiometers, one with a linear and one with a logarithmic taper, connected as in Fig. 11. The first pot provides a satisfactory off position for the control. When the control is operated in the range from mid-position to the top, the change in volume adjustment provided by the linear part is only a matter of 6 db. The second part of the control, using a logarithmic taper, produces a 20-db change in level over this same range of movement, resulting in a 26-db total level change for the top half of the control. The second part of the control can be designed on the same basis as the simple circuit of Fig. 7.

At about 50 cycles, the reactance of the capacitor inserted in the bottom end should equal the whole resistance of that section of the control. If a 100,000-ohm control is used, the capacitor should be about .03 µf. This control should give a pretty good approximation of the correct loudness adjustment for the first few db change in level at the low end (Fig. 12).

It does not provide any compensation for the high end, and compensation at the low end is hardly adequate for the lower loudness levels. The only way to get adequate compensation for the lower loudness positions is to add another stage. This can be done by using a tapped control for the first half.

If a 100,000-ohm control with a linear taper and a center tap is used, a 10,000-ohm resistor, in conjunction with a capacitance with a reactance of about 50,000 ohms at 50 cycles (this works out to .05 µf), would be near enough for this purpose. It provides double the rate of boost from the center point on down. With this revised arrangement, at 1,000 cycles, the first stage attenuation is 17 db. It is calculated as follows: The 10,000-ohm resistor is in parallel with the bottom half of the 50,000-ohm potentiometer, because the capacitor's reactance is negligible at the middle and upper frequencies. This produces a combined bottom-end resistance of 8,300 ohms. The top half of the resistance is 50,000 ohms so the attenuation is the ratio 58.3/8.3, or 7 to 1, which corresponds to 17 db.

The second half of the loudness control gives about a 20-db attenuation, because of the log taper, as before. So the overall level reduction at the midpoint is approximately 37 db. This means the revised arrangement gives all the desired loudness adjustment in the top half of the control's rotation. The bottom half provides a control that goes right down to an off position.

The simplest way to add high-frequency compensation is to use a resistance and capacitance between the top end of one of the potentiometers and its slider. To give about 6-db maximum boost, which is about satisfactory, the resistance should be equal to the pot's overall resistance. In this case, the second potentiometer is probably the best one to apply it to, because it is the control principally responsible for the change in gain over the upper 25% of rotation. So the resistor should be a little less than 100,000 ohms to produce a maximum of about 6-db boost, say 82,000 ohms, and the appropriate capacitance can be calculated.

With a 6-db ultimate boost, the first critical frequency gives a lift of about 2 db. This should be at about 4,000 cycles. Then there is 4-db boost at 8,000 cycles, rising to an ultimate of 6 db. So the reactance should be about 160,000 ohms at 4,000 cycles. A 250-µµf capacitor should give about the right amount of boost. The complete circuit is shown in Fig. 13.

An alternate loudness control arrangement that we will not go through in

(*Continued on page 92*)

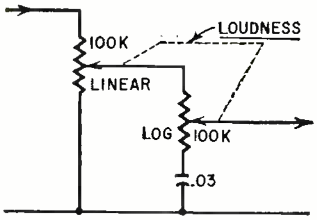

Fig. 11—This ganged control gives good response variation, especially at higher levels.

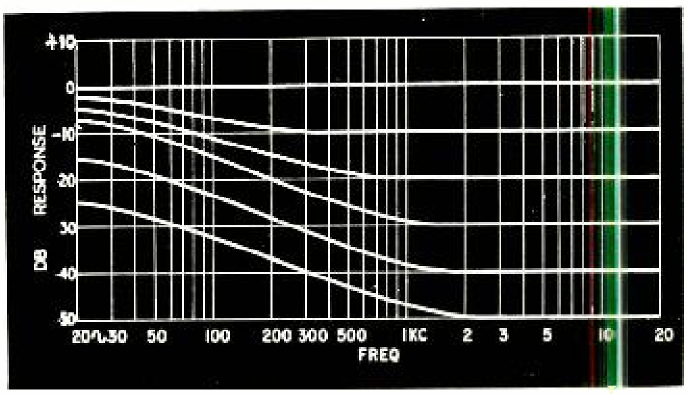

Fig. 12—Range of responses given by the circuit of Fig. 11.

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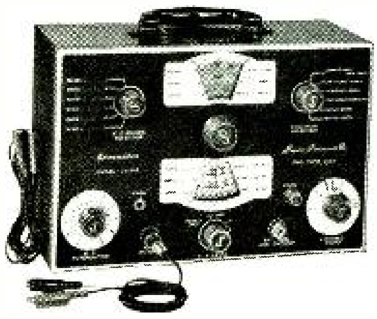

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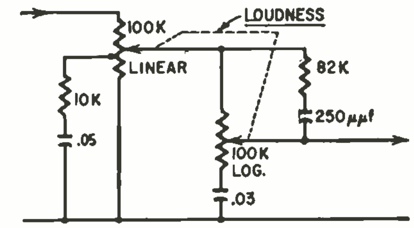


Fig. 13—Complete 2-section control, including high-frequency compensation.

(Continued from page 89)
detail here and which gives better possibilities of accurate compensation, uses switched positions. It is based on the philosophy that people usually listen at only certain ranges of level, rather than requiring a continual adjustment of loudness. According to this idea, we usually listen to our music either loud, medium or quietly played. For a moderate degree of adjustment at any of these general levels, the ordinary volume control can be used without producing too serious a deterioration in the loudness contour. This lets us use a switched high-medium-low arrangement like the one in Fig. 14. We will not go through this one in detail, because we also want to cover the feedback type in this article.

Feedback loudness controls

There must be a tremendous number of feedback loudness-control designs, but a relatively simple one that shows the general method is in Fig. 15. It is built around the two halves of a 12AX7. The first half uses a 100,000-ohm coupling resistor with 470,000 ohms in the following grid, and a 2,200-ohm bias resistor which also serves as the feedback bottom-end resistor. According to the tube manual, this gives a gain of 52. The second stage uses a 100,000-ohm coupling resistor with a 2,200-ohm bias resistor, as before, but the resistance into which the stage works varies according to the feedback.

If maximum feedback uses a minimum resistance of 100,000 ohms, the second stage's gain under this condition is about 40, yielding an overall gain for the two stages of about 2,000. Attenuation caused by the feedback is about 45 to 1, which leaves us with a loop gain in the region of 2,000/45, or 45.

Now to see what we require. We will assume a range of 40 db. At the lowest level, we need a 3-db boost at about 500 cycles, with about 30 db of boost at 25 cycles. If the time constant in the feedback gives the 3-db point at 500 cycles, the 6-db-per-octave slope will produce 26 db at 25 cycles. So we need an extra 4 db because of the feedback. If we make the unity slope point (e) for loop gain at 25 cycles, it will be the leveling-off point, before the response

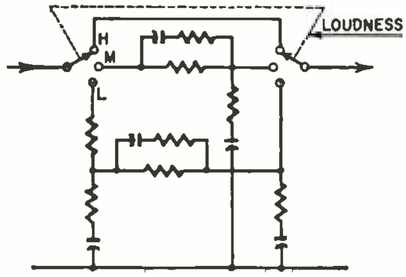


Fig. 14—Alternate approach uses fixed compensation equalizers.

falls off. The unity slope point (e) will be 500 divided by the square root of the rolloff ratio ($\sqrt{n}$) to get the no-feedback reference, and by the feedback extension factor to get the actual point. So the product of $e\sqrt{n}$ must be 20 with 4 db at the unity slope point. Using the chart we showed last month (RADIO-ELECTRONICS, March 1960, page 55, Fig. 3), we select a rolloff ratio of 12 and a feedback extension factor of 5.8, and feedback comes out to about 30.5 db. This makes the forward rolloff at 41.6 cycles.

For the top level, we need to know how the time constants change with feedback. Thus, 30.5 db of feedback corresponds to a voltage ratio of 33.5 (this is the ratio by which feedback reduces gain). The loop gain is 1 less, or 32.5. If we drop to 8-db of feedback, a voltage ratio of 2.5, we need a loop gain of 1.5. The time-constant ratio changes in proportion to the loop gain because it is controlled by the resistance associated with the capacitor. The change in loop gain is a ratio of 32.5/1.5, or 21.6. So from being a 12/1 rolloff ratio in one direction, it finishes up 1.8 in the opposite direction.

The 8-db feedback with a time-constant ratio of 1.8 gives a unity slope point of −2.5 db. This reference is $41.6/(\sqrt{1.8} \times 1.58) = 19.7$ cycles. (The 41.6 is the forward rolloff, 1.8 is the rolloff ratio and 1.58 is the feedback extension factor corresponding to 8-db feedback.) The feedback path has a 3-db point at 41.6/1.8, or 23 cycles. So the two effects practically cancel, leaving a slight boost before the rolloff.

Now to try a mid-level, using a loop gain of 7, which gives 18 db of feedback corresponding to a voltage ratio of 8. The rolloff ratio is 2.6 in the original direction, so the 3-db point in the feedback is at $41.6 \times 2.6 = 108$ cycles. The combination of 18-db feedback with a time-constant ratio of 2.6 gives 2 db at the unity slope point. This comes at $(41.6 \times \sqrt{2.6})/2.8 = 24$ cycles. (The 2.8 corresponds to 18-db feedback.) The boost caused by the feedback path is 13 db, making a total boost of 15 db. (Rolloff at 108 cycles is

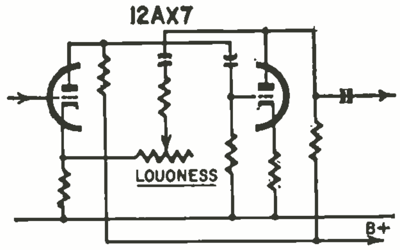


Fig. 15—Basic circuit for a feedback type loudness control.

13 db down at 24 cycles. So total boost is the 13 db here plus 2 db caused by feedback interaction.) This is just half the final value. Now we have to trim the gain so these responses come in the right places.

To get a 30.5-db feedback, with a forward gain of 2,000, the feedback fraction needs to be 2,000/32.5 = 62. The cathode resistor is 2,200 ohms so the

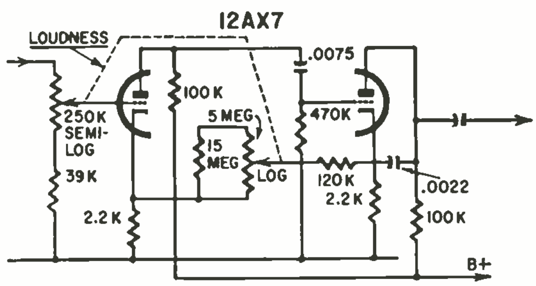


Fig. 16—The circuit of Fig. 15 designed for good low-frequency compensation over a 40-db loudness range. High frequencies are not treated, as this depends on stray capacitance which, in turn, depends on how the circuit is laid out.

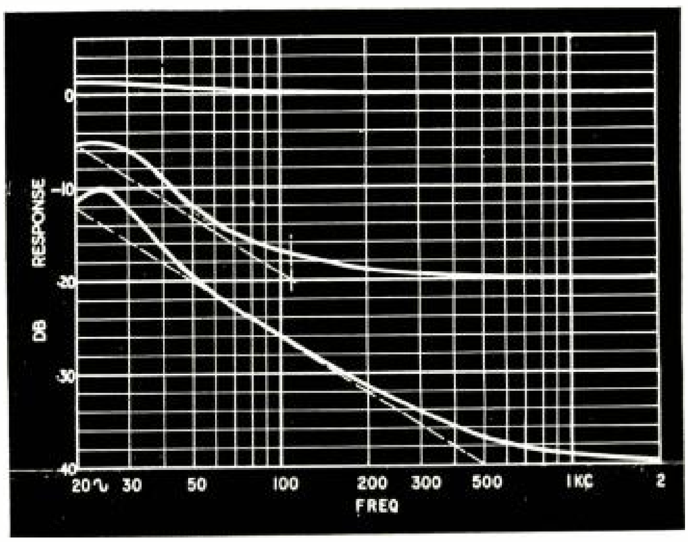


Fig. 17—The three selected responses discussed in the text to show the behavior of the circuit of Fig. 16.

feedback resistor should be 135,000 ohms. Using 120,000 ohms will allow a slight margin. At the other end, 8-db feedback, with a gain which will rise to about 2,500, requires a feedback fraction of 2,500/1.5 = 1,670. The feedback resistor needs to be 3.7 megohms. A 5-megohm pot with 15 megohms in parallel will produce this. The midpoint should produce 18-db feedback. The forward gain we can estimate as about 2,400. So the fraction needs to be 2,400/7 = 340, requiring about 750,000 ohms. With the 120,000 ohms fixed, the variable needs to provide 630,000 ohms. This means we need a 5-megohm pot with a log taper (since maximum feedback is zero on the pot and gives minimum level).

Now to square up the gain differences. We are using 8-, 18- and 30.5-db feedback for loudness levels separated by 20-db intervals. So a straightforward potentiometer adjustment must provide a stretch of 40 − 22.5 = 17.5 db of extra range, a ratio of 7.5 to 1. A 250,000-ohm pot with a bottom-end resistor of 250/6.5 = 39,000 ohms will serve. At the middle position, the feedback makes a difference of 10 db out of the total 20, so the pot should provide an additional 10 db. This means the tapping should be 289,000/3.162 minus 39,000 ohms from the bottom end, or 53,000 ohms. On a 250,000-ohm pot this requires a semi-log taper.

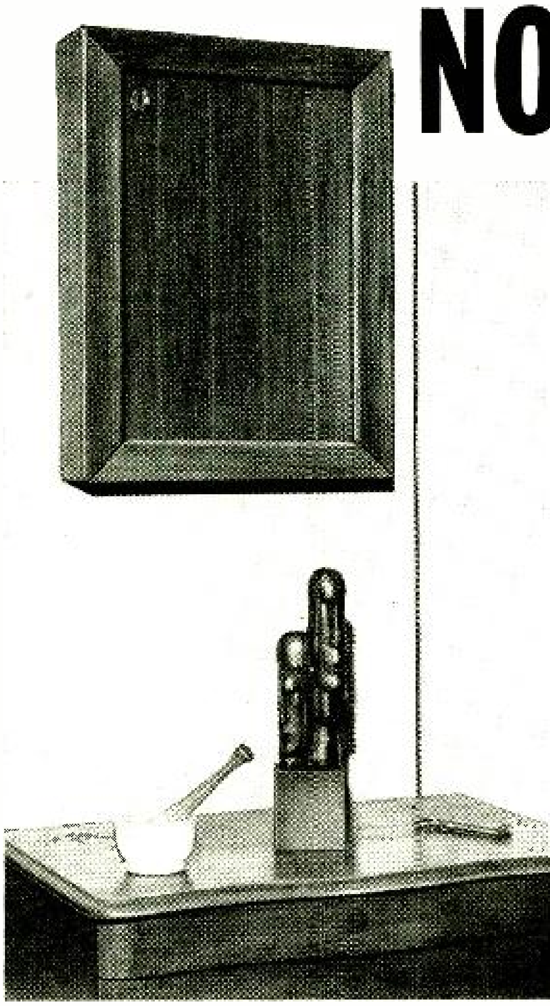
This has all the resistance values fixed. Now we need only to select capacitors that give a forward rolloff point of 41.6 cycles, with a 520,000-ohm circuit resistance, and a feedback rolloff point of 500 cycles, with a 135,000-ohm circuit resistance. This yields values of .0075 μf and .0022 μf, respectively. The complete circuit is shown in Fig. 16 and the responses in Fig. 17.

So we have a feedback circuit that provides a reasonable approach to loudness control. This circuit can be changed in a number of ways. Other circuits could also be devised, which would produce variable boost and rolloff (and none of which may produce exactly what is required although there are endless possibilities to try). The simplest and best approach is to use the straightforward passive equalizer type and work out a circuit that does get pretty close to the responses required, such as the one in Fig. 14.

Of course, it would be possible to figure out a feedback circuit, using switched components for fixed level compensation that would come close to the required response because then the coupling capacitors and other elements can be changed to get the right value for each particular response. But it probably does not pay to be too critical. After all, the Fletcher-Munson curves are the response of an average ear. No individual has such a convenient set of parameters. Everyone deviates from average one way or another. So provided we can get a reasonable approximation, we have served the purpose of a loudness control.

TO BE CONTINUED

NEW SPEAKER HAS NO CONE



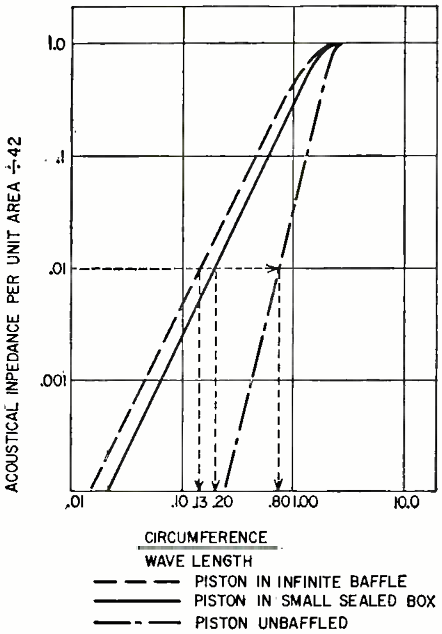
A SPEAKER with a conventional voice coil, but using a flat 15 x 22-inch wooden panel instead of a cone, was demonstrated recently by Abraham Cohen, veteran loudspeaker engineer who was formerly engineering manager for University Loudspeakers, and author of popular hi-fi books as well as technical engineering papers.

As the photo indicates, the reproducing area of the speaker is a perfectly flat sheet made, according to its designer, of strips carefully matched for strength and compliance. A framework to hold the perimeter of the panel rigid and support the mechanical assembly increases the dimensions to 24 x 18 inches, and the depth to 4½ inches.

The extreme flatness of the speaker lends itself to a number of mounting methods. Normally standing on a low base on the floor, it can be built into the doors of a hi-fi cabinet, mounted in the wall between two rooms or installed in the picture-on-the-wall fashion shown here. The speaker is bi-directional, projecting sound to the rear practically as well as to the front. This gives it the name Bi-Phonic Coupler. The rear of the speaker, in the floor-mounting models demonstrated, was finished with strip bamboo.

The Bi-Phonic coupler, its inventor pointed out at the demonstration, is a sound radiator using a completely unbaffled large rigid piston. Physically, a radiating piston does not care what kind of baffle confines it as long as it sees the necessary radiation resistance into which to develop the proper power. Although the Bi-Phonic radiator is unbaffled, as low a frequency as is desired may be obtained if piston size is chosen so its radiation resistance is equivalent to that of a baffled piston of a smaller size.

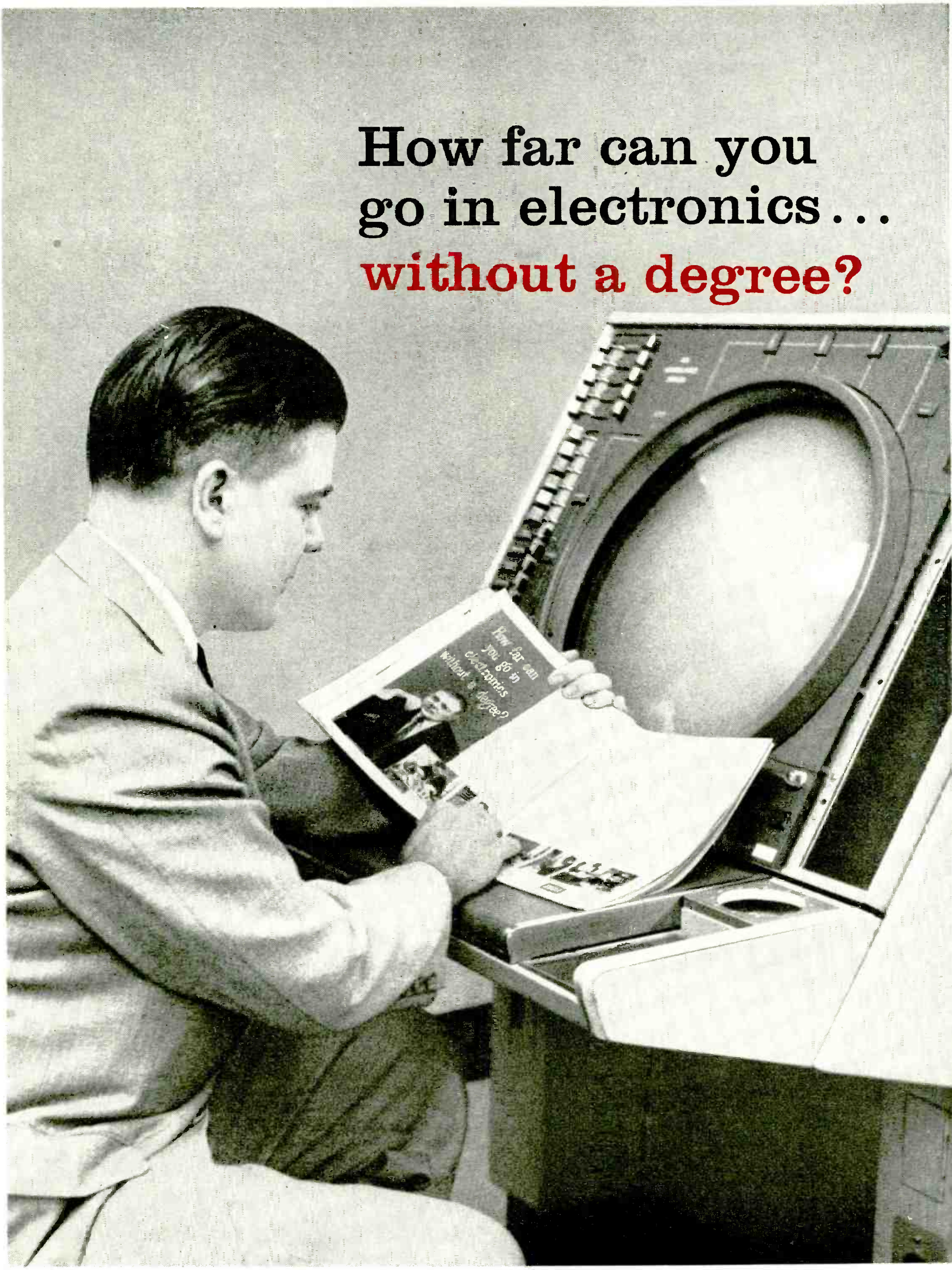
However, the type of baffle will determine the radiation resistance that the piston sees. Determined by the baffle conditions, the piston size will vary for a given radiation resistance into which acoustic power may be developed. An



infinite wall baffle presents the maximum radiation resistance (per unit area of piston), while for a small sealed box, nominally under 7.6 cubic feet, the radiation resistance for the same-size piston is approximately half that in an infinite baffle. Similarly, a completely unbaffled piston has presented to it an even lower radiation resistance. These relative characteristics of different types of baffles are shown in the accompanying curve, a modified composite representation of radiation resistance characteristics from "Acoustical Engineering" by H. F. Olson (1957 edition). For a given radiation resistance it is possible to select three sizes of pistons that will radiate the same acoustic power per unit area *for a given frequency*, depending on whether the piston chosen is mounted in a true infinite baffle, a small enclosed box or left unbaffled. The 440 Bi-Phonic coupler piston size (15 x 22 inches) was chosen to produce the same power output per unit area when unbaffled as that produced by a 12-inch diameter piston in a sealed bookshelf enclosure, Mr. Cohen stated.

The vibrating panel is driven with a 2-inch voice coil cemented to its center. The rest of the speaker assembly consists of a 7½-inch diameter ceramic magnet assembly weighing 20 pounds. Because of its rigidity, it moves very slightly, even for the loudest notes. It is this feature, plus its large area, states the designer, that permits it to reproduce notes down to 30 cycles without additional baffling. With the help of the small tweeter seen mounted in the corner of the panel, response is extended upward beyond the limits of audibility.

The new speaker is in production, being manufactured by the Advanced Acoustics Corp. founded by Mr. Cohen. He is now its president. END


How far can you go in electronics...
without a degree?
How far can you go in electronics without a degree?

At the SAGE display console, Dick Brani reads 1957 magazine story about his IBM career.

Two years ago, when Richard F. Brani was first asked to review his field engineering progress at IBM, he'd been recently promoted to computer instructor. Now, he has a new and more crucial responsibility: Group Manager of 20 field engineers who keep a SAGE computer operating at its peak, bulwarking America's air defenses. Here's his story.

GIVEN IMPORTANT ASSIGNMENT. "In my first four years with IBM, my field engineering career has taken several giant steps forward—despite my lack of a college degree," reports Dick Brani. "When I joined the Company, my special training consisted of graduation from a technical school, an F.C.C. license, and some Army engineering training. Now, I have a responsible management job in the SAGE Project, my knowledge of electronics has grown tremendously, and my future looks as promising as I could wish it.

"How did I make this progress? IBM believes that—after comprehensive training—technicians like me can handle assignments generally performed by graduate engineers. And IBM has been proved right. Hundreds of technicians are now functioning successfully as IBM field engineers."

20 WEEKS' COMPUTER TRAINING. Dick Brani joined IBM in the fall of 1955. He was immediately enrolled in a 20 weeks' computer units training program. "You learn how the different units of large-scale computers like SAGE operate . . . how the computer itself can help diagnose and locate trouble . . . and how to make fast, precise repairs," he says. "Once assigned to a SAGE Site, field engineers may also attend classes—during regular working hours, by the way—to keep up with advanced developments in electronics. Our site, for example, recently had a course on the new, increased-capacity SAGE 'memory'."

ADVANCES RAPIDLY IN FOUR YEARS. "I know of few other companies that offer technicians better or more valuable training than IBM," Dick Brani says. "This training can prove an 'open sesame' to engineering and management opportunities not usually available to men lacking college degrees."

After his training, Dick Brani's abilities won him a position as instructor in IBM's education program. For two years, he taught courses in computer units and systems. Then, a little over a year ago, he was promoted to Group Manager of 20 field engineers assigned to install—and maintain—a SAGE computer at a new site. "I'm responsible for the successful operation of the computer. I have to check out repairs my men do, schedule maintenance activities and supervise all new engineering changes."

Introducing a new field engineer to SAGE operations.

Dick Brani (right) discusses the new SAGE "memory" with a field engineer.

WHAT IS SAGE? SAGE is a vital part of America's air defense system. At the core of the SAGE system is a network of fast, extremely reliable electronic computers. In each sector of our nation, a SAGE computer is constantly in operation. 24 hours a day, helping the Air Force prevent surprise aerial attacks. Here's how SAGE works: The computer receives radar data from many observation points. It checks this information against known air traffic for the sector and presents to the Air Force a pictorial display of the air situation. If need be, the computer can guide a BOMARC missile to a target for certain interception.

COUNSELING TO DEVELOP STRONG LEADERS. "My most challenging duty as a SAGE Group Manager? Helping the men in my group advance and develop," replies Dick Brani. "One way I do this is by periodically rotating my men so that they become familiar with all phases of large-scale computer operation. But the most effective way is through counseling—just sitting down with a man and discussing his progress, his prospects, his career goals. IBM encourages frequent and intensive counseling. By this method the Company finds and develops the strong leaders it needs to stay at the head of its field."

SAGE PROGRAM STILL GROWING. "My future? I can advance to still more important responsibilities in SAGE field engineering," says Dick Brani. "SAGE has grown tremendously since its inception a few years ago, and it's still growing rapidly. Or, I can move into major spots in education, personnel, management, development engineering—or nearly any activity you can name. My future at IBM is limited only by my ability as an individual."

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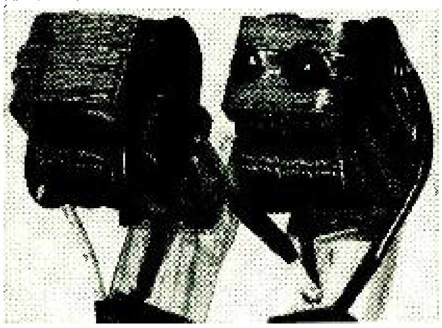
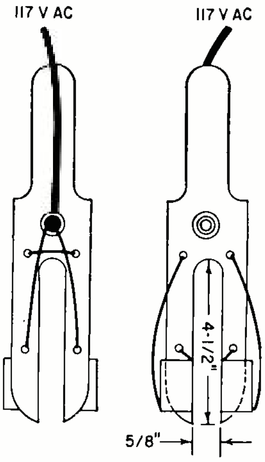
BULK ERASER FOR TAPE

An excellent bulk eraser for recording tape can be made from the coils from a discarded magnetic sander or other vibrating type tool. Just reverse the connections to one coil so that when they face each other a strong magnetic field is produced.

The coils are mounted on a fork made of any light wood (see diagram).

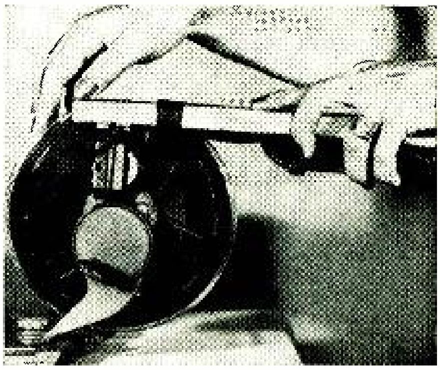




Above—Coils mounted on wooden fork.

Left—Parts layout, wiring arrangement.

Below—Eraser used to clear 7-inch reel of standard magnetic tape.



The fork's slot is ⅝ inch wide and 4½ inches deep to handle 7-inch reels. The leads from the coils are fed through holes bored in the fork, to keep them from obstructing the slot. A switch mounted at the base of the fork is convenient, but not necessary.

A simple stand to support a 5/16-inch pin horizontally 5 or 6 inches above the base or any home movie film rewind holds the reel while erasing.

This eraser does a remarkably clean job on a 7-inch reel in about 30 seconds, and is very convenient to handle and store—*Herbert C. McKay*

using AUDIO TRANSFORMERS

We have all seen and used audio transformers, but how many of us know how to modify their frequency response to suit our needs?

By HERBERT RAVENSWOOD

IN a previous article ("Design Calculations for R-C-Coupled Amplifiers," RADIO-ELECTRONICS, October, 1957), a number of fallacies that often crop up were uncovered and the correct procedure was outlined. As an audio transformer is a much more complicated device than a simple R-C coupling network, it would seem that the possibilities of getting confused are much greater. Therefore, it is surprising to find that, although detailed prediction with audio transformers is not as simple a matter as in R-C-coupled circuits, it is not too difficult to understand them correctly.

The principal thing is to understand the significance of the equivalent circuits which the transformer introduces and how we can work around them to get the results we need. Let's take each of the common kinds of audio transformers in turn and consider the factors that control its performance.

Input transformers

The practical circuit of an input transformer is shown in Fig. 1, together with the necessary equivalent circuits for estimating behavior at both ends of its frequency response. To calculate its precise performance, the electrical properties of the transformer, such as primary inductance, leakage inductance and various capacitances, as well as winding resistance and core losses, should be known in detail.

But in practice, a knowledge of the way circuit constants react with these electrical properties of the transformer is enough to permit adjusting the performance as required, once an initial check has been taken on the performance in any particular circuit. Anyway, most transformer manufacturers do not oblige us with these electrical properties so we *could* make the accurate calculation, and we have to be content with this approach to getting the correct performance.

At the low-frequency end, the transformer's primary inductance acts as a shunt reactance to the source resistance combined with the load resistance. The source resistance may be some kind of microphone or pickup, or a line from another amplifier. In each of these cases the source impedance does look like *some* value of resistance.

In the last case the input transformer is working from a line and the impedance that we are concerned with is what is connected to the other end of the line. This means that the source impedance may not necessarily be the nominal value quoted. Usually line impedances are quoted as 250, 500 or 600 ohms. But, when an amplifier has an output impedance quoted as 600 ohms, this does not necessarily mean that the impedance looking back from the output terminals is 600 ohms. What the rating means is that the amplifier will give its correct performance *when it is loaded externally by 600 ohms.*

This is also true of an input transformer. It will give its correct performance when a 600-ohm source is connected to it. With a 600-ohm output it may have a source impedance, looking back into the amplifier, of 60 ohms—assuming a damping factor of 10. If such an output is connected by a line to a 600-ohm input, the 600-ohm input will not be terminated by a 600-ohm source but by a 60-ohm source, and performance may not be as specified.

In addition to the source impedance or resistance, the transformer is also loaded on its secondary if a grid resistor is connected in parallel with it. The total loading effect can be calculated by dividing the grid resistor across the secondary by the square of the stepup turns ratio and then considering this equivalent resistor as being in parallel with the input resistance.

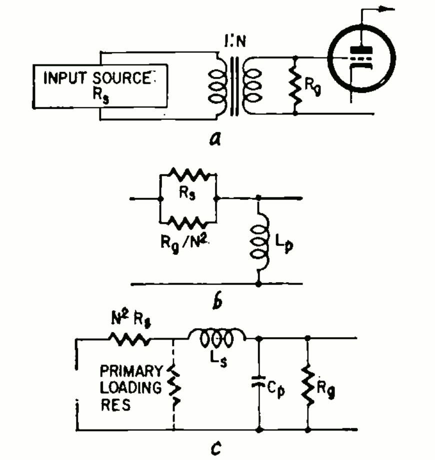


Fig. 1-a—Practical circuit of an input transformer; b—equivalent circuit for low-frequency response; c—equivalent circuit for high-frequency response. Dashed resistor shows equivalent position of a resistance connected across the primary winding.

Suppose, for example, the stepup ratio of the transformer is 10 to 1 and the grid resistor is 220,000 ohms. The 220,000 ohms divided by 100 gives an effective parallel resistance on the primary of 2,200 ohms. If the source resistance is actually 600 ohms, the equivalent resistance that the primary inductance is shunting will be 600 ohms in parallel with 2,200 ohms, or about 470 ohms. The 3-db point, in this instance, appears where the reactance of the primary inductance is equal to 470 ohms.

In practice, the primary inductance changes with frequency and signal level, so the response is not constant nor does it follow a fixed rolloff shaping.

A convenient way to make adjustments is based on the 2-to-1 step sequence. This is a series of db-loss figures that can easily be memorized and used as a basis for estimating how much the circuit values should be changed to effect a given improvement in the low-frequency response.

When reactance is 4 times the circuit resistance, the loss is 0.25 db. When reactance falls to twice the value of the circuit resistance, the loss is 1 db. When reactance and resistance are equal, it is the well-known figure of 3 db. When reactance falls to half this value, the loss increases to 7 db, while at a quarter of the 3-db value it rises to 12 db. This sequence, covering a change in reactance over a ratio of 16 to 1 or alternatively a corresponding change in associated circuit resistances, covers a sufficient range for all practical response estimates.

To illustrate this method of estimating response, suppose an input transformer working with circuit resistances that calculate out to an effective parallel value of 600 ohms on the primary shows a loss of 3 db at 20 cycles. If the circuit resistance can be reduced to a quarter of this value, or 150 ohms, the loss at 20 cycles will be only 0.25 db.

High-frequency calculation

The high-frequency response is a little more complicated than the low end. The leakage inductance of the transformer, together with the secondary capacitance combined with grid input capacitance and stray capacitances, contribute to the normal high-frequency response. Sometimes, besides these simple and essential components there is some interwinding capacitance —capacitance between points on the primary and points on the secondary winding. Audio transformers are usually designed so there is no such capacitance or it is connected in such a way that the primary-to-secondary capacitance cannot affect the transformer's frequency response. We will return to this point later as it is a complication and we want to deal with the simple circuit first.

The thing that seems to cause the most confusion in figuring out the high-frequency response of a transformer and determining how to improve its performance, is an understanding of just what leakage inductance is.

A transformer's primary inductance is set up by the magnetic field induced in the core by the current in its primary. From the viewpoint of this simple primary inductance, the magnetic field wraps itself completely around both windings. Because the magnetic material which forms the core has a very high permeability—up in the thousands, or tens of thousands —the magnetic field in the core exceeds that in the air space surrounding the windings by many thousand times, and the voltages generated in both windings are to all intents and purposes proportional to the turns in the windings. This means that, at any given operating condition for the transformer, the primary inductance will bear a relation to the inductance of the secondary proportional to the turns ratio squared. This is why it is immaterial whether we consider the low-frequency response from the primary or secondary side, because we can either consider the primary inductance and transform the secondary impedances back to the primary or vice versa. The conclusion will be exactly the same although different numbers are used.

Although the magnetic field in the core is so large that it completely swamps the magnetic field in the air surrounding the windings *at low frequencies* so they do not contribute any measurable component to the primary inductance, the wide range of frequencies over which an audio transformer operates means that the small field between the windings *can* have some effect at the high-frequency end of the range.

At this end of the range we have to

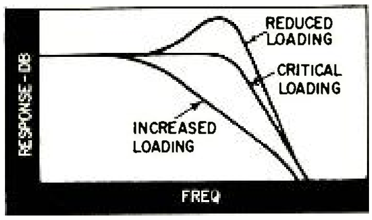


Fig. 2—Variations of an audio transformer's high-frequency response with the effective loading by circuit resistance values, not considering interwinding capacitance.

consider that, although the great bulk of the magnetic field is concentrated in the core, the air space surrounding each winding will still have exactly the same magnetic field that there would be if the same current circulated in the winding without the presence of a magnetic core. This is true for both primary and secondary windings. The current in each of these windings will set up a magnetic field around that winding only.

Some of this leakage field gets down between the two windings and some of it passes through the middle of each of them. But the net result is that *some of the magnetic field induces voltage in one winding but not in the other,* thus allowing a voltage difference from the ideal calculated by the turns ratio squared, between the two windings. As this voltage difference is generated by a changing magnetic field, induced in turn by the current in the windings, it has all the properties of an inductance.

But notice that it is a voltage *difference.* If the transformer had a 1-to-1 ratio so the same voltage would be on both windings, at low frequencies we could regard the transformer as a direct ac connection from one side to the other. But at the high-frequency end of the range, there can be an appreciable difference in voltage due to the leakage field. This means that the direct connection is no longer effective, but it is as if there is a series inductance between primary and secondary. This explains why leakage inductance can be regarded as a series inductance instead of a shunt inductance.

Now, when we take the equivalent circuit for the high-frequency end and rearrange it somewhat, we can see that it reduces to a resonant circuit in which the source resistance connected to the primary is a series loading resistance in the tuned circuit, while the shunt resistance connected across the secondary is a parallel loading resistance. This means that reducing the secondary shunt resistance will load down the circuit, reducing any tendency to peak, while increasing the primary source resistance will have the same effect. Alternatively, reducing the primary source resistance will increase the tendency to peak.

From this we can see that connecting a resistance across the primary will raise the high-frequency response, while connecting it across the secondary will drop the high-frequency response. This fact can prove quite useful in juggling the response at both ends so we get the required combined overall response.

Fig. 2 shows a typical series of response curves for different degrees of loading. In this we have not distinguished between loading effected by increasing the primary source resistance or by adding additional shunt resistance across the secondary. Under some circumstances this choice will make a little difference in the shape of the response—shifting the peak frequency. But this is a complicated matter to calculate precisely and it is better to leave it out of the present discussion.

Line-to-grid once again

Let's go back to our line-to-grid transformer that had a 3-db loss at 20 cycles when the source resistance was 600 ohms. Reducing the primary resistance to 150 ohms—easily achieved by some suitable matching pad—might cause a peak at the high-frequency end

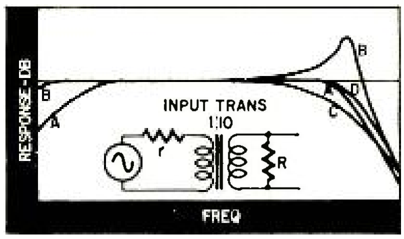
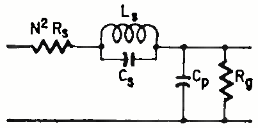


Fig. 3—Adjusting the response of an input transformer by changing circuit values. R and r represent basic circuit values and not actual resistances.

Curve	*r*	*R*
AA	600Ω	infinity
BB	150Ω	infinity
BC	300Ω	30,000Ω
BD	200Ω	60,000Ω

because the resonant circuit consisting of the leakage inductance and secondary capacitance would be insufficiently damped. Assuming we have a 10-to-1 stepup ratio and that originally no secondary grid resistance was connected, we might compromise by using a 300-ohm resistor on the primary, together with a 30,000-ohm resistor on the secondary. This will transfer back to the primary as another 300 ohms for the bass response effect, and the result at this end will be the same as a total circuit resistance of 150 ohms. It will also load down the high frequencies instead of causing too much peak. Maybe it will load the high frequencies down too much. If this happens, maybe 200 ohms as a primary source resistance, together with 60,000 ohms on the secondary, would give a satisfactory response.

A possible set of response curves for these conditions is shown in Fig. 3. These should not be taken to be indicative of a response for any particular audio input transformer. They just show the way adjustments may be made by using different combinations of circuit resistance.



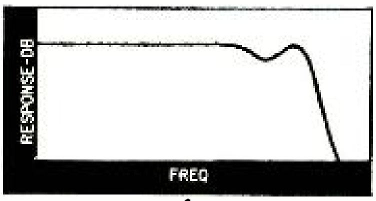


Fig. 4-a—Equivalent circuit of an input or interstage transformer for high-frequency response when interwinding capacitance interacts with leakage inductance as well as secondary winding capacitance; b—the kind of response caused by circuit a.

Now let's consider what interwinding capacitance can do. If the primary impedance is low, say less than 600 ohms, the whole primary may be regarded as effectively grounded in comparison to the high secondary impedance. This means that at any frequency within the audio range, the capacitance between primary and secondary may be regarded merely as contributing to the total effective secondary capacitance. On the other hand, if the primary impedance is relatively high, say 600 ohms or higher, interwinding capacitance cannot necessarily be ignored.

As mentioned earlier, the safest way is to arrange that the interwinding capacitance has no effect on the response. This is done by grounding (ac-wise) the parts of each layer adjacent to one another. Now, any capacitance between primary and secondary is virtually between two points both at ground potential and, as there is no audio voltage on either of them, there cannot be any transfer across this capacitance.

If this precaution is not followed, there will be some capacitive transfer between primary and secondary. At the high frequencies, the phase angle of the currents passing through this transfer capacitance may oppose the phase angle set up by the leakage inductance in the regular inductive transfer. This means that we have a virtual series wavetrap circuit without an equivalent network, as shown in Fig. 4. The result of this is a response with a dip in it. However, some ways of connecting the windings will result in a different phase relation so the current due to the normal transfer, with its leakage inductance, is additive to the capacitance transfer circuit. The effect is exactly similar to a change in the values of the effective leakage inductance and shunt capacitance. The shape of the resulting response will be similar to that already discussed, but as if the transformer electrical constants were changed slightly. But we do not know what the constants are supposed to be (the manufacturer does not publish them).

Interstage transformers

These transformers are no longer used as much as they were in the earlier days of audio, but they sometimes form a useful phase splitter because under some circumstances they provide better balance and less distortion than tube type phase splitters. This may not be generally recognized, but it is true.

For output stages where power is required to drive the grid of the output tubes, an interstage transformer (more commonly called a driver transformer) is almost a necessity (although there are circuits that *can* dispense with it). However, performance of a driver transformer requires taking into account the effect of grid current through the windings. This will be discussed in a further article because there is not enough space here.

Some variations in the catalog way

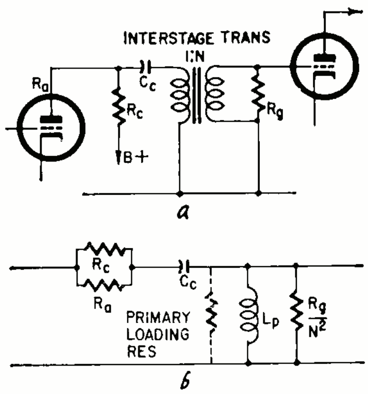


Fig. 5—A parallel-fed interstage or driver transformer will have different low-frequency parameters than the input transformer of Fig. 1. Note the different effect of the primary loading resistor, shown dotted in (b), compared with its effect on high-frequency response shown in Fig. 1-c.

of listing interstage transformers should be clarified before going further. In the early days, the turns ratio of a transformer was expressed to show the electrical "advantage" gained by putting it in circuit. Thus "3-to-1" signified that the transformer would deliver three times the voltage developed at the preceding stage's plate to the following stage grid. As long as interstage transformers were used only to give step*up*, there was no confusion.

Then came power drive, with the use of step*down* drive (or interstage) transformers to provide the required low source impedance for the output stage grids. Logically the ratio is expressed with the number representing the primary before that for the secondary. Thus 1.5-to-1 logically means the primary has one and a half times as many turns as the secondary. But, according to the earlier school, this could also mean a 1.5-to-1 stepup. So, in the interests of consistency, the more modern way of listing an interstage stepup transformer would be: 1:3.

So it happens that we may find some lists showing 3-to-1 and others 1-to-3, for the same basic product. This is not all. It was recognized that a mere statement of ratio was not enough. A microphone-to-line transformer and a plate-to-grid interstage might each have a 1-to-3 stepup ratio, but they are far from interchangeable because they use quite different numbers of actual turns to accommodate radically different impedances. So the next step, now quite widely used, is to list windings by impedance ratings.

For example, using this method, our original 3-to-1 interstage, which can also be listed as a 1-to-3 (more logically the latter), can now appear with the primary listed as impedance 10,000 ohms, secondary 90,000 ohms. This is intended to convey that the primary is intended to work in a 10,000-ohm plate circuit. It does not indicate that the secondary should be connected to a resistance of 90,000 ohms, but that the transformer will make the 10,000 ohms source, due to the primary-connected plate impedance, "look" like 90,000 ohms at its secondary terminals.

This is because the secondary voltage will be three times the primary voltage, while any secondary current will require a corresponding primary current of three times the magnitude. Thus the transfer changes effective impedance by $3 \times 3 = 9$ times.

The interstage transformer which does not have to handle power, but is merely a voltage transfer device, is essentially similar to an input transformer except that it may have to handle somewhat higher levels. Also, a good interstage transformer is parallel-fed, to avoid passing a polarizing current through its primary winding. The circuit of the transformer we are considering is illustrated in Fig. 5.

The equivalent circuit reduces to a resonant circuit consisting of the coupling capacitor and the primary inductance. The source resistance, made up of the ac resistance R_a of the preceding tube in conjunction with the plate coupling resistance R_c as a parallel combination, appears as series damping. The secondary load resistance R_g, which is reflected through the transformer turns ratio squared, acts as shunt damping. Notice in this case that, if a resistance were connected across the primary instead of the secondary, it will still have the same effect on the low-frequency resonant circuit because it still acts as shunt damping across the effective primary inductance.

Thus we have in this type of circuit another way to adjust the high-frequency and low-frequency response independently so we can get the best combined overall response. A resistance connected in parallel with the secondary will load down both ends of the frequency response. A resistance connected in parallel with the primary will lift the high-frequency response and load down the low-frequency response.

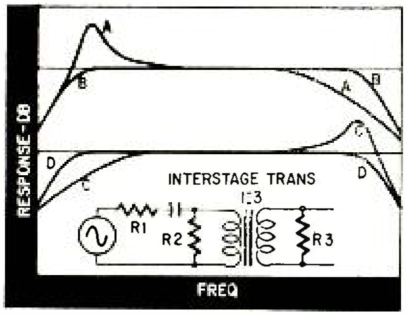


Fig. 6—The method adopted for flattening the overall response in two interstage-coupling transformer circuits.

Curve	*Transformer*	*R1*	*R2*	*R3*
AA	1	6,500Ω	infinity	470,000Ω
BB	1	6,500Ω	15,000Ω	470,000Ω
CC	2	7,700Ω	infinity	1 megohm
DD	2	4,400Ω	infinity	220,000Ω

Note that in each case R1 is the equivalent of R_p and R_c, of Fig. 5-a, in parallel.

This takes care of quite a wide range of variations, but suppose we happen to want to lift the low-frequency response and load down the highs. At first sight it seems we do not have a combination that will produce this effect. But in practice this is not difficult to achieve. The approach is to reduce the source resistance on the input side to coupling capacitor C_c, by shunting down the plate coupling resistor or altering the operating conditions of the tube so its effective ac resistance is lower. In doing this be careful not to run into overload. This will lift *both* ends of the response somewhat. Now, by loading the secondary side of the transformer the loading effect on the high-frequency response will usually act more rapidly than it does on the low-frequency response. In this way it is usually possible to lift the low-frequency response and pull down the high-frequency response. If this method does not work, the only alternative is to try a different value for the coupling capacitor, or a different transformer. Fig. 6 shows response curves with different combinations of resistance connected in the circuit of Fig. 5.

Output transformers

This is different from the other transformers we have considered so far in that it uses a stepdown instead of stepup ratio. The primary is the high-impedance winding, while the secondary operates at low impedance. Normally, modern output transformers are direct-coupled because they use push-pull circuits, and the only components in the primary circuit contributing to low-frequency response are the plate resistance and the transformer's primary inductance.

The capacitance effective for the high-frequency rolloff is the primary capacitance, and the resistance providing series loading for the effective high-frequency resonant circuit is the load resistance. The resistance providing shunt loading is the ac resistance of the tubes. This is just the reverse of the input and interstage transformer. But the response follows a similar arrangement and Fig. 7 shows the actual circuits together with the equivalent circuits for low-frequency and high-frequency rolloff, while Fig. 8 shows the response produced by various values of ac and load resistance.

Because of this functional transposition of the important circuit elements, according to whether a transformer is stepup or stepdown, it is customary to use symbols that can be considered as related to the high- and low-impedance windings, rather than to primary and secondary. This makes formulas and charts more universally applicable. Thus C_p is the winding capacitance of the high-impedance winding—secondary of a stepup, primary of a stepdown. The inductance labeled L_p may be primary or secondary, but it is the "primary" inductance of the transformer—that due to the magnetization of the core.

Leakage inductance, which is due to magnetic field leaking *between* windings, not through the core, is given the symbol L_s. This is a function of the physical spacing between the *two* coils (primary and secondary) and may be given a value in terms of either one, according to which circuit is used as a reference for all the impedances associated with the transformer.

Similarly C_s, occupying a similar circuit position to L_s, represents *equivalent* interwinding capacitance. This is not any capacitance you can measure on a capacitance bridge or meter, but is a measure of the effective capacitive transfer between windings due to the voltage distribution dependent on the external connections (what part of each winding is grounded). In a well-designed, correctly connected transformer, the quantity C_s is effectively eliminated.

In practice, of course, the load resistance that can be used and the ac resistance that appears are determined by the amplifier's specification, and it is not usually possible to adjust these very far without departing completely from the operating specification in other aspects. However, the effective ac resistance of the tubes is controlled by any feedback that is taken from the plate circuit to some earlier stage in the amplifier, and this effectively modifies the apparent frequency response of the transformer as well as probably having an effect on the amplifier's frequency response due to the feedback over the amplifier circuits.

Space has run out on this discussion of audio coupling arrangements and we are left with some points that still need discussion: why frequency response changes with level, and how to control this effect; the overall effect of feedback on the frequency response of different kinds of circuit, and the question of high-frequency stability in different kinds of tube coupling circuits. A way of thinking this thing out, called the interaction concept, helps considerably in analyzing the situation and estimating a suitable arrangement. These things will be discussed in a future article. END

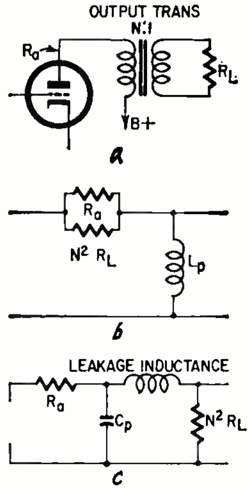


Fig. 7—Output transformer: a—practical circuit; b—low-frequency parameters; c—high-frequency parameters. For simplicity, only a single-ended transformer is shown, but a push-pull type has precisely similar equivalents.

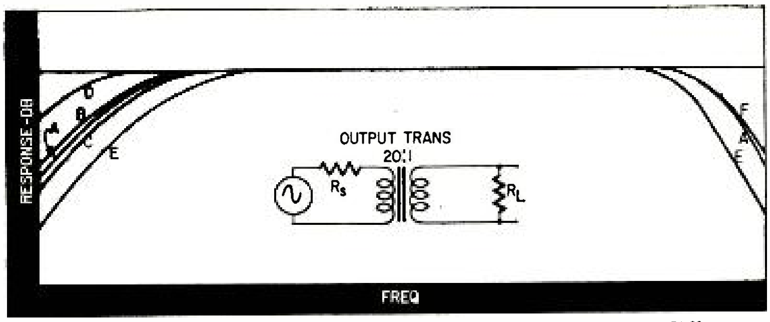


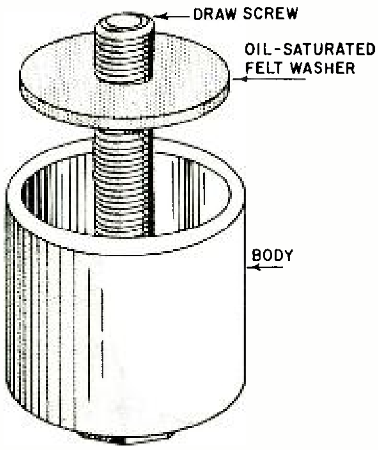
Fig. 8—Variations in response of an output transformer with different values of R_s and R_L. (R_s is the effective value of R_a in Fig. 7-a, which may be modified due to feedback.) These responses represent only the transformer-circuit response and do not take into account other possible feedback effects.

Curve	R_s	R_L
AA	1,000Ω	10Ω
BE	1,000Ω	5Ω
CF	1,000Ω	20Ω
DF	500Ω	10Ω
EE	2,000Ω	10Ω

CHASSIS-PUNCH CARE

To the electronics builder, a chassis punch is probably as useful as his soldering gun or his own two hands. And like most all other shop tools, a chassis punch requires a certain amount of care if it is to lead a long useful life.

To protect my punches I cut felt



washers from an old felt hat, saturate each with oil and slip one over each draw screw as shown. The rest of the punch is assembled as used just as before. The oil keeps the parts lubricated, makes the punch work easier, and deters rust. A chassis punch is relatively expensive, so I give mine the care they so rightly deserve.—*John A. Comstock*

SPAGHETTI INSULATES SOLDER

When I have to solder live electric wires, I avoid the possibility of getting a shock when the solder touches the joint by insulating it with a length of spaghetti. By slipping the insulation over the solder, I avoid the unpleasant experience of receiving an unnecessary jolt.—*John Abram*

PLUG ADAPTER

With the increasing popularity of miniature mike connectors, I find an adapter is needed to connect a standard phono plug quickly and easily to a miniature mike jack.

The photo shows the extreme simplicity of the adapter. It is merely a miniature mike connector with the setscrew and cord protecting spring removed. The miniature mike connector fits on

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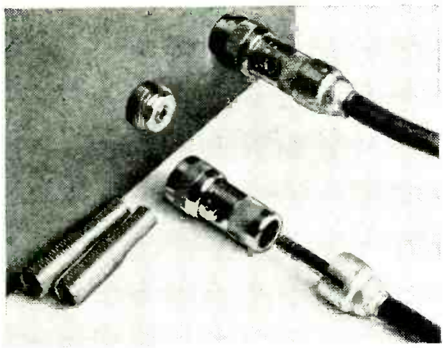


the miniature mike chassis unit in the usual manner and the standard phono pin plugs onto the end of the mike connector.

A standard phono pin plug makes a snug fit on the end of a miniature mike connector. When you push the phono plug onto the end of the mike connector, the pin on the phono plug contacts the eyelet in the front end of the mike connector. This makes a good temporary connection as long as you don't pull too hard on the phono cord.

The miniature mike chassis shown in the photo is a Switchcraft *Mini-Con* 5501MP. The miniature mike connector is a Switchcraft *Mini-Con* 5501F.—*Art Trauffer*

RENEW PANEL MARKINGS

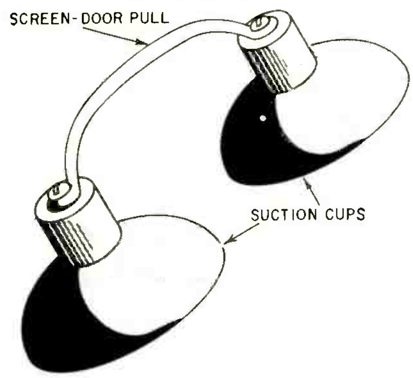
The depressed markings used on the Simpson 260 and Hickok 455 multimeters are typical of many instrument panels. These markings can be easily restored to a brand-new appearance.

Buy a china marking pencil. They come in several colors. Red and white are best for electronic instruments.

Warm the instrument panel slightly under a 100-watt electric lamp and rub the pencil over the panel markings to fill the letters. Rub off any excess on the panel with a piece of tissue paper. This technique also works on engraved name plates.—*Edwin Bohr*

MASK-REMOVAL TOOL

Do you carry a plumber's force cup in your toolbox to ease the removal of a TV's safety mask? Many technicians



do. A force cup works well, but it wastes a lot of valuable space in your toolbox. For a smaller unit, try the simple gadget shown in the drawing. It's just a couple of car-rack suction cups attached to a screen-door handle.
—*Clyde A. Compton* END

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new PATENTS

SQUELCHED CARRIER CURRENT

Patent No. 2,632,812

John R. Cooney, Waldoboro, Me.

In carrier-current signaling, messages are carried along power lines. This system includes a squelch. Receive-transmit switch S2 is shown in receive position. Of the two *transmit* positions, one is equipped with a spring return for momentary use.

Signals from the line pass through C1 and appear across transformer T1's primary. The lower secondary is grounded during *receive* and V1 acts as a diode detector. Potentiometer R1

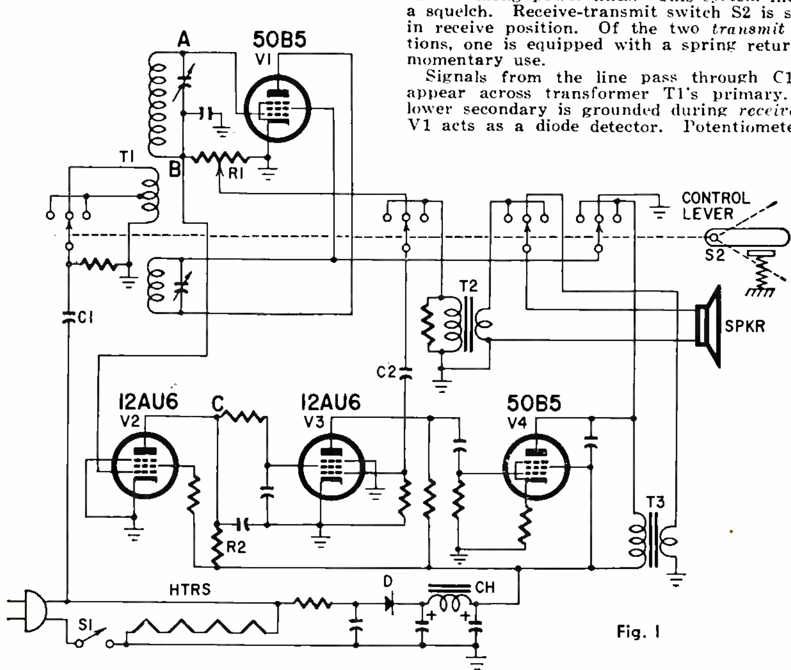
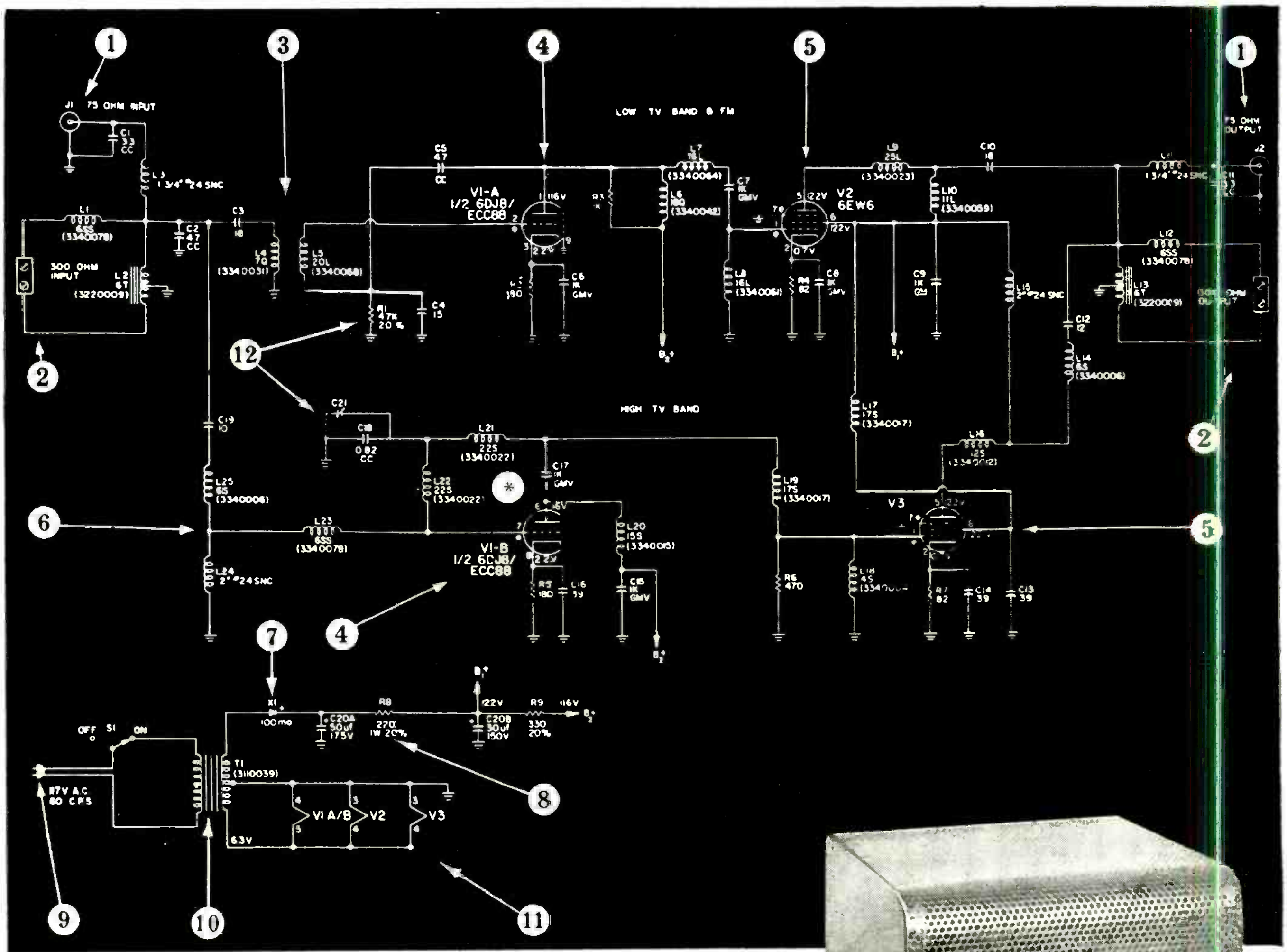


Fig. 1

the secret's in the circuit!



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*U. S. Patent 2,761,023—triode neutralization circuit

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is the volume control. With no signal, point B is at ground potential and there is no bias on V2. It conducts, generating a large drop across R2 to lower V3's screen voltage. The tube blocks and mutes the speaker. A signal makes B negative to block V2. Full screen voltage appears at V3 and the signal is heard in the speaker.

When transmitting, the speaker acts as microphone. The audio goes through T2, C2 and V3, V4. T3's primary is the modulation choke. V1 oscillates because of feedback between upper and lower secondaries of T1.

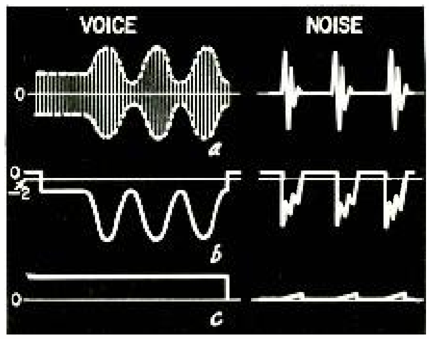


Fig. 2

Fig. 2 shows why the circuit can distinguish between voice and noise. Noise pulses are momentary and decay rapidly. During noise, B goes negative for short intervals only, so V2 conducts to some extent. The waveforms of Fig. 2 are shown for points A, B, C.

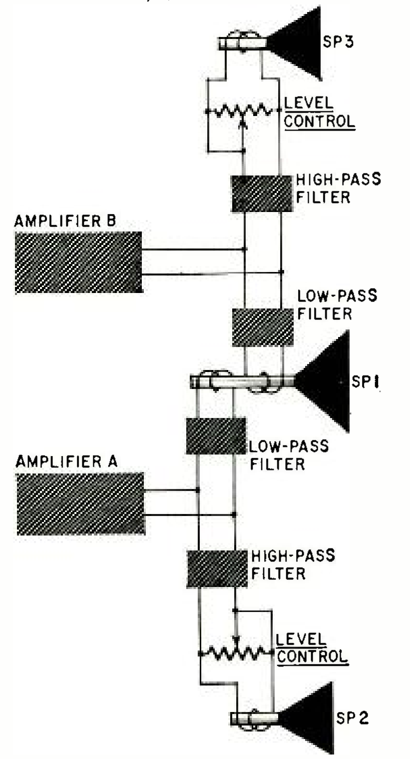
SIMPLIFIED STEREO

Patent No. 2,904,632

Sidney E. Levy, White Plains, N. Y. (Assigned to University Loudspeakers, Inc., White Plains, N. Y.)

Most stereo listeners have noticed that low frequencies are not directional. It is difficult—in a room of ordinary size—to determine the direction from which they come. It is therefore sufficient to use a *single* low-frequency speaker or woofer. Treble notes are more directional, so two tweeters must be used for stereo.

In the diagram, SP1 is the woofer. It is



wound with two voice coils, one for each amplifier. Note the low-pass filters.

The tweeters, SP2 and SP3, are energized through high-pass filters, each reproducer being connected to a separate amplifier.

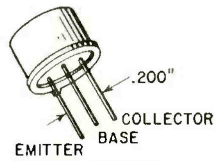
This produces a stereo system using only a single woofer. Since these speakers are much larger and more expensive than tweeters, the saving is considerable. (The system has been commercialized under the trade name *Trimensional.*) END

NEW TUBES and SEMI-CONDUCTORS

BUT for a couple of transistors and group of diode rectifiers, vacuum tubes rule this month's column. There are octal and 9-pin miniature vertical amplifiers and oscillators; and a couple of 23-inch picture tubes.

2N337, 2N338

Two high-frequency silicon n-p-n transistors that can be used as af or rf amplifiers or in high-speed switching



2N337, 2N338

circuits, are grown-junction devices with a diffused base. Both are suitable for insertion in printed boards by automatic equipment.

Maximum ratings of these G-E transistors at 25°C are:

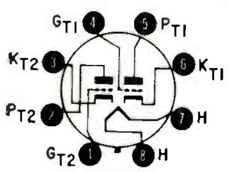
V_{CBO}	45
V_{EBO}	1
I_C (ma)	20
P_C (mw)	125

Electrical characteristics at 25°C are:

	2N337	*2N338*
h_{fe} (current transfer ratio) V_{CB} = 20, I_E = 1 ma, f = 1 kc)	55	99
f_{ab} (alpha cutoff frequency) (V_{CB} = 20, I_E = 1 ma)	30 mc	45 mc
h_{FE} (Common-emitter current gain) (V_{CE} = 5, I_C = 10 ma, f = 1 kc)	35	75

10EG7

This double-triode in an octal base has dissimilar sections. A medium-mu section is intended for use as a vertical deflection oscillator while the second



10EG7

section has a low mu and is intended for use as a vertical deflection amplifier. The tube has a 9.7-volt heater rated at 600 ma. It has an 11-second controlled warmup for use in TV sets using series heater strings.

Design maximum ratings of this Sylvania tube are:

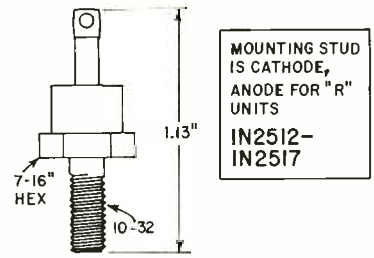
	Osc Section	Ampl Section
V_P	330	330
V_P (pos pulse)	—	1,500
V_G (neg pulse)	400	250
P_P (watts)	1.5	10
I_K (av ma)	22	50
(peak ma)	77	175
R_G (self-bias) (megohms)	2.2	2.2

Average characteristics are:

V_P	250	150
V_{G1}	−11	−17.5
I_P (ma)	5.5	45
g_m (μmhos)	2,000	7,500
μ	17.5	6.0
R_P (ohms approx)	8,750	800

1N2512, 13, 14, 15, 16, 17

These medium-current diffused-silicon rectifiers are designed to operate over ambient temperatures in the range of −65 to 165°C. The series is particularly suited to rectifier applications where high inverse voltages, high forward conductance, very low leakage current and high rectification efficiency are required. Units with reverse polarity (anode to stud) carry suffix R.



Maximum ratings of these Raytheon diodes are:

	1N2512	-13	-14	-15	-16	-17
PIV	100	200	300	400	500	600
$I_{av\ rect}$ (30°C) (amps)	4	4	4	4	4	4
I_{surge} (1/120 sec) (amps)	30	30	30	30	30	30
$I_{rev\ leak}$ (μa)	2	2	2	2	2	2

23CP4, 23EP4

Two 110° rectangular glass picture tubes whose bi-panel construction eliminates the need for a safety-glass window in the receiver. These RCA tubes use an envelope that is not much larger than conventional 21-inch 110° tubes, but provides a larger picture that has nearly straight sides and corners that are only slightly rounded.

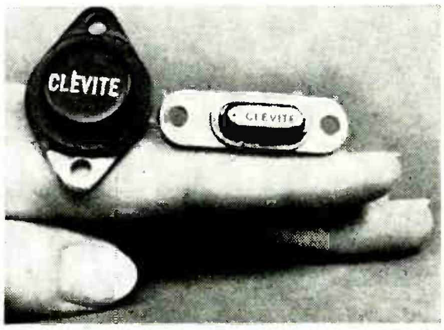
Identical in overall dimensions, the two tubes differ mainly in the type of electron gun used. The 23CP4 has a regular type of straight gun while the 23EP4 has a straight gun which operates at low G2 voltages in cathode drive circuits. Both types use magnetic deflection and low-voltage electrostatic focus.

The bi-panel construction provides an integral protective panel. The panel is sealed to the face of the tube. It eliminates air separation between the picture tube and the protective window. This improves contrast by reducing reflections and eliminates the need for a dust seal.

Both tubes have aluminized screens, a 1⅛-inch neck and a glass-button 8-pin base.

Half-sized transistors

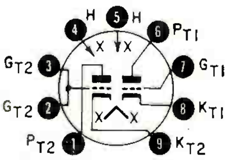
Power transistors, only half the size and weight of present versions, have been developed by Clevite. They claim their new transistors will facilitate the



introduction of portable, battery-powered hi-fi stereo equipment. The new units, named Spacesavers, are available in eight 3-amp switching units. Other types will become available shortly.

6DR7, 10DR7, 13DR7

A series of 9-pin miniature double triodes with dissimilar sections—a hi-mu section for use as a vertical deflec-



6DR7, 10DR7, 13DR7

tion oscillator and a low-mu section for use as a vertical deflection amplifier. The 6DR7 has a 6.3-volt 900-ma heater, the 10DR7 a 9.7-volt 600-ma heater, and the 13DR7's heater is rated at 13 volts, 450 ma.

Average characteristics of this series of Sylvania tubes are:

	Osc section	*Ampl Section*
V_P	250	150
V_{G1}	−3	−17.5
I_P (ma)	1.4	35
g_m (μmhos)	1,600	6,500
μ	68	6
R_P (approx ohms)	40,000	925

Heats sinks and mounting clips

Two more manufacturers are turning out heat sinks and mounting clips for transistor applications. Selling them for industrial and OEM use, the Industrial Division of the Birtcher Corp. produces a line of beryllium transistor clips that cover almost every transistor case. They also make a line of heat sinks for power transistors.

Another firm, Monadnock Mills, makes a group of anodized aluminum insulators wafers for use with power transistors. These units insulate power transistors from a chassis, without destroying the heat-sink function of the chassis. END

Technotes

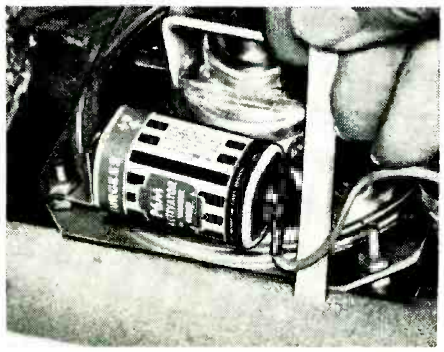
ZENITH CHASSIS 16Z21

Symptom: Sudden loss of raster, odor similar to burning transformer.

Cure: Check for a shorted 12DQ6-GT horizontal output tube. In several cases the customer was able to turn the set off quickly enough to save the flyback. Check the flyback carefully to be sure that it has not overheated enough to cause future trouble. Fusing the transformer with a 0.25-amp slow-blow fuse minimizes damage caused by shorted 12DQ6's.—*John B. Ledbetter*

SHORTED-BATTERY CHECK

Some transistor radios have one battery terminal at chassis potential, while the other terminal with flexible lead is located very close to the chassis.



It is easy to ground this second terminal accidentally to the chassis and end up with a dead battery. Make sure the lead shown is as far away from the chassis as possible.—*Harry Leeper*

CBS CHASSIS 1021-2

A number of these sets develop compression at the top and bottom of the raster. All components related to the vertical sweep section were checked and double-checked. Tube substitution was tried without effect.

While attempting to adjust the height

and linearity controls, we noticed that they were fully advanced. All other settings gave abnormal compression at the top and bottom of the raster. Finally we decided to replace the 6AH4, used

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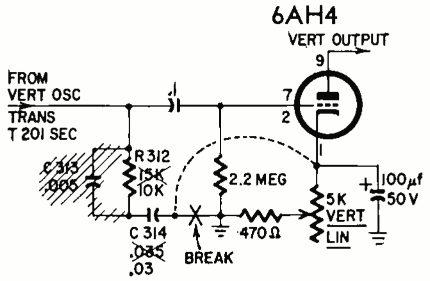
as a vertical output tube, with a 6V6-GT. The following socket changes are required:

The blue and black leads connected to pin 5 were disconnected and connected to pins 3 and 4. A jumper was installed between pins 1 and 5 for the grid connection. (Pins 3 and 4 may have to be connected through a 68-ohm resistor to isolate the screen from the plate.) This modification solved the problem and resulted in perfect control over vertical linearity and size.—*Walter Fernald*

(Many technicians do not like to change tubes or tube sockets in a re-



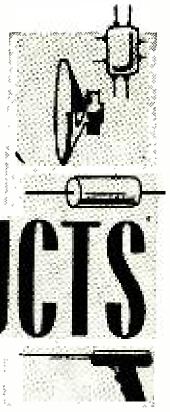
ceiver. They know the difficulty involved in making the change and during future servicing. A simpler modification has been suggested and is said to give good results. Replace C313, R312 and C314 with a series combination consisting of a 10,000-ohm ½-watt resistor and a .03-µf 600-volt capacitor. The capacitor connects at the junction of R310, C315 and the secondary of T201 (see diagram). The resistor returns to the cathode of the vertical output tube (V19, 6AH4) rather than to ground. —*Editor*)

MOTOROLA 17P3-1

Complaint: Intermittent vertical jitter with occasional 2-inch reduction in height.

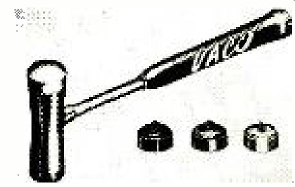
Cure: After all regular causes of this fault checked out OK, we were desperate. Grasping at straws, we replaced the 17CFP4 picture tube. This cured the set. Apparently there was an intermittent breakdown between the final screen and the anode or control grid.—*Barrie W. McClintock* END

new PRODUCTS

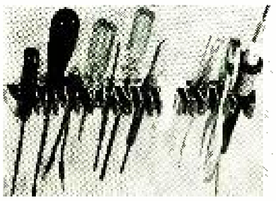


METALLIZED - PAPER CAPACITOR line has excellent humidity resistance. *Type P8292ZN* units have high-temperature solid impregnant, plastic case. Complete line of sizes, voltages and capacitances for all applications—**Aerovox Corp.,** New Bedford, Mass.

SOFT-FACE HAMMER has 3 interchangeable screw-in tips.



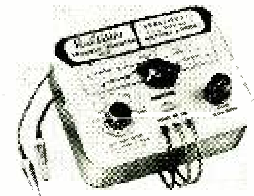
Shot-loaded head prevents rebound, adds 30% more power to drive. Includes medium, tough and extra tough (Nylon) tips that are chip-proof, mushroom-proof. Won't mar delicate surfaces.—**Vaco Products Co.,** 317 East Ontario St., Chicago 11, Ill.



WORKBENCH TOOL HOLDER *model 9525* holds tools of all sizes and types such as tweezers, soldering irons, hammers and probes. Snap-in, snap-out feature provides unusual versatility.—**G-C Electronics Co.,** 400 South Wyman St., Rockford, Ill.

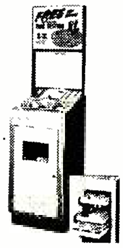
PRECISION SWITCH series from 1-pole 10-position to 5-pole 2-position. *Series BJ* switch ½ inch in diameter and depth. Capacity 350 ma at 100 vdc, breakdown voltage 1,000 rms. Current capacity 4 amps. — **Clarostat Mfg. Co.,** Dover, N. H.

RECTIFIER SUBSTITUTION BOX checks selenium, silicon rectifiers, single and dual diodes by direct substitution. *Rectifier Troubleshooter RS-106* has con-

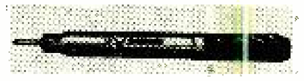


trols to select proper value of unit being tested. Box protected by ½-amp slow-blow fuse.—**Sencore,** Addison 2, Ill.

SELF-SERVICE TESTER has multi-color 7½-inch meter. *Model 201* tests over 800 tube types (provision for future types), 6- and 12-volt vibrators, pin straighteners on panel. 2 settings check tubes in about 10



seconds. Counter model also.—**Mercury Electronics Corp.,** 77 Searing Ave., Mineola, N.Y.



SIGNAL INJECTOR size of pen has frequency range from mid-audio to radio frequencies (in harmonics). Transistorized *Mosquito* can be coupled to inductive circuits without leads. Weighs about 1 oz.—**Don Bosco Electronics, Inc.,** 56 Route 10, Hanover, N. J.

PRECISION ATTENUATORS remain accurately calibrated regardless of temperature, humidity or aging. *Model 372* in 6 waveguide sizes from 2.5 to 18

kmc. Low SWR, 1.05 to 1. Nominal attenuations of 10 or 20 db.—**Hewlett-Packard Co.,** 275 Page Mill Rd., Palo Alto, Calif.

SURFACE - TEMPERATURE PROBE *G312*. Fast-reacting

thermistor bead mounted on aluminum disc 0.25 x .005 inch. Supplied with 48-inch Teflon-insulated ribbon wire. Can be cemented, taped or held onto any surface.—**Fenwal Electronics, Inc.,** 51 Mellen St., Framingham, Mass.

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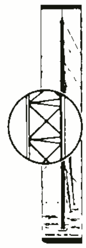
CITIZENS-BAND TRANSCEIVER *model TR-800.* 5-channel transmitter, 22-channel receiver. Audio output 3 watts, input power 5 watts. Comes

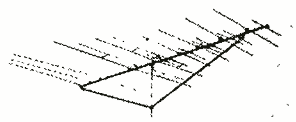
with microphone, 1 crystal. 6- and 12-volt power packs available for mobile use.—**United Scientific Laboratories, Inc.,** 35-15 37th Ave., Long Island City 1, N. Y.

HEAVY-DUTY TOWER suitable for heights to 450 feet when guyed every 50 feet. *No. 45* tower sections 10 feet long,



18-inch triangular pattern, hot-dipped galvanized. Tower sections interchangeable with *No. 40* tower.—**Rohn Mfg. Co.,** 116 Limestone, Bellevue, Peoria, Ill.

PREASSEMBLED ANTENNAS of broad-band design.



Foreshortened center-loaded elements similar to antennas in JFD *Banshee* line. 9 to 18 ele-elements, in both gold-anodized and natural aluminum models. *Booster Paks* can be added to increase 9- and 11-element units to 15- and 18-element arrays, respectively.—**JFD Electronics Corp.,** 6101 Sixteenth Ave., Brooklyn 4, N. Y.

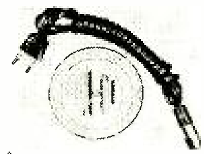
TWO-SET COUPLER *model A-102* provides 10–20-db isola-

tion for TV or FM sets. Mounted outdoors or indoors. Loss 3.5 db. No-strip terminals.—**Blonder-Tongue Laboratories, Inc.,** 9 Alling St., Newark 2, N. J.

RECORD LIFE SAVER *model RLS-101* indicates when to in-

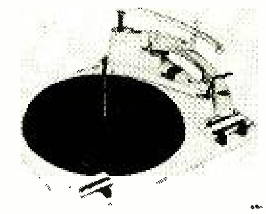
spect your stylus under microscope. Exposes light-sensitive paper to shielded bulb that goes on whenever power is applied to turntable motor. — **Premier Electronics, Inc.** 341 Manida St., New York 59, N. Y.

TURNTABLE TIMING LAMP simplifies checking turntable speed. Place strobe-disc on turntable, hold lamp over correct row of dots on disc. Speed cor-



rect when dots stand still. *Strobolamp (part No. 699)* comes with disc and 6-foot cord. Plugs into 117-volt ac outlet.—**Switchcraft, Inc.,** 5555 N. Elston Ave., Chicago 30, Ill.

FOUR-SPEED CHANGER *model RC210* may be used man-



ually. Mixes 10- and 12-inch records of same speed. 45-rpm spindle available. Plug-in head. Changer may be started and stopped without rejecting record being played. — **Garrard Sales Corp.,** 80 Shore Rd., Port Washington. N. Y.

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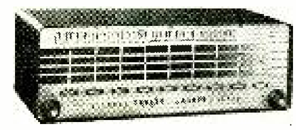

amplified or attenuated 14 db from 0-gain position. Helps kill feedback howl in PA systems. Adjusts response curve of hi-fi systems.—**Blonder-Tongue Laboratories, Inc.,** 9 Alling St., Newark 2, N. J.

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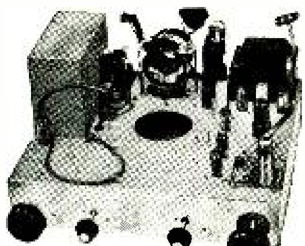

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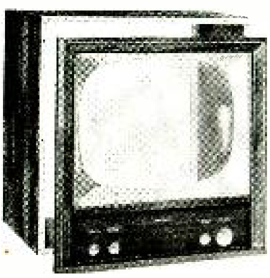

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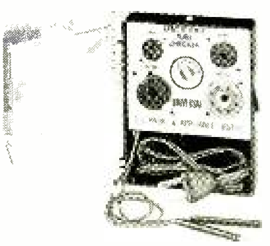

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- ☐ 35 – MICA COND. 20-2200 mmf & 15-2400 mmf $1
- ☐ 35 – MICA COND. 20-3300 mmf & 15-4700 mmf $1
- ☐ 35 – MICA COND. 20-6800 mmf & 15-10000 mmf $1
- ☐ 35 – CERAMIC COND. 20-5 mmf & 15-10 mmf $1
- ☐ 35 – CERAMIC COND. 20-25 mmf & 15-47 mmf $1
- ☐ 35 – CERAMIC COND. 20-56 mmf & 15-82 mmf $1
- ☐ 35 – CERAMIC COND. 20-100 mmf & 15-150 mmf...$1
- ☐ 35 – CERAMIC COND. 20-270 mmf & 15-470 mmf...$1
- ☐ 35 – CERAMIC COND. 20-1000 mmf & 15-1500 mmf. .$1
- ☐ 35 – CERAMIC COND. 20-2000 mmf & 15-5000 mmf. .$1
- ☐ 50 – 100KΩ ½ WATT RESISTORS 5%.........$1
- ☐ 50 – 470KΩ ½ WATT RESISTORS 10%.......$1
- ☐ 10 – ASST. WIREW'ND RES. 5, 10, 20 watt...$1
- ☐ 3 – AUDIO OUTPUT TRANS. 50L6 type $1
- ☐ 3 – AUDIO OUTPUT TRANS. 6K6 or 6V6 type ..$1
- ☐ 3 – I.F. COIL TRANSFORMERS 456 kc $1
- ☐ 3 – I.F. COIL TRANSFORMERS 10.7 mc FM ..$1
- ☐ 4 – OVAL LOOP ANTENNAS ass't hi-gain types .$1
- ☐ 3 – LOOPSTICK ANT. new ferrite adjustable $1
- ☐ 12 – RADIO OSCILLATOR COILS 456 kc $1
- ☐ 3 – ½ MEG VOLUME CONTROLS with switch. .$1
- ☐ 5 – 50K VOLUME CONTROLS less switch $1
- ☐ 10 – SURE GRIP ALLIGATOR CLIPS..........$1
- ☐ 1 – GOLD GRILLE CLOTH 11"x14" or 12"x18".$1
- ☐ 5 – SETS SPEAKER PLUGS wired $1
- ☐ 10 – SETS PHONO PLUGS and PIN JACKS..$1
- ☐ 2 – $2.50 SAPPHIRE NEEDLES 10,000 plays .$1
- ☐ 5 – DIODE CRYSTALS 2—IN21 2—IN22 1—IN34..$1
- ☐ 3 – DIODE CRYSTALS 1—IN60, 1—IN64 1—IN69 .$1
- ☐ 2 – SELENIUM RECTIFIERS 1—65ma & 1—100 ma $1
- ☐ 15 – ASST. TV COILS sync, peaking, width, etc. .$1
- ☐ 5 – TV CRT. SOCKETS with 18" leads.......$1
- ☐ 5 – HI-VOLT. ANODE LEADS with 18" leads....$1
- ☐ 10 – TV CARTWHEEL CONDENSERS 10kv $1
- ☐ 1 – LB. SPOOL ROSIN CORE SOLDER 40/60 ..$1
- ☐ $15 – "JACKPOT" TELEVISION PARTS $1

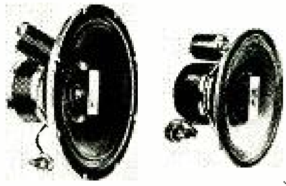
HANDY WAY TO ORDER—Simply tear out advertisement and pencil mark items wanted (X in square is sufficient); enclose with money order or check. You will receive a new copy of this ad for re-orders.

ON SMALL ORDERS—Include stamps for postage, excess will be refunded. Larger orders shipped express collect.

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

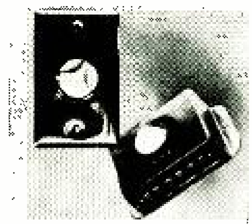
TELEPHONE COrtlandt 7-2359

TWO-WAY SPEAKER made in Britain. Horn tweeter, mid-range radiator and L-pad high-frequency control. 12-inch *model KN-812A* with 3½-lb magnet,



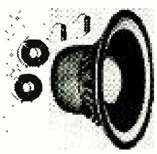
30 to 20,000 cycles. 15-inch *model KN-815A* with 6¼-lb magnet, 20 to 20,000 cycles.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

SPEAKER-SELECTOR switch, stereo or monophonic, has circuitry that matches impedances. Stereo control *No. 30-388* is wall-plate



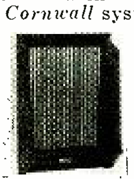
type, also monophonic types, wall-plate or surface mounting. Housings brushed brass.—**Audiotex Mfg. Co.**, Dept. FR, 3225 Exposition Pl., Los Angeles, Calif.

DUAL VOICE-COIL stereo woofers for 3-channel system. 8-inch *SK-139* and 12-inch *SK-133* both have 2-inch voice coils, 2-lb magnets. 350-cycle crossover network *KT-161* lets you



combine bass from 2 channels in 1 woofer.—**Lafayette Radio**, 165-08 Liberty, Jamaica 33, N.Y.

LOUDSPEAKER SYSTEM designed for corner placement can also be used in non-corner locations. *Cornwall* system has 3



drivers. Occupies 7 cubic feet. Smooth bass response to 35 cycles. Useful as second- or third-channel speaker in stereo systems.—**Klipsch and Assoc., Inc.**, Hope, Ark.

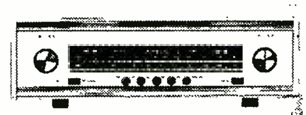
CONE TWEETER *No. A35T*. Response 3,000 to 18,000 cycles. Having sealed acoustic rear chamber, this direct radiator requires no horn. Built-in 4-μf

capacitor, 2.5-oz magnet housed in heavy yoke. No other network components necessary. Power capacity 25 watts.—**Audax, Inc.**, Div. of **Rek-O-Kut Co., Inc.**, 38-19 108th St., Corona 68, N.Y.

MAGNETIC STEREO CARTRIDGE. Extremely high vertical compliance and high output (30 mv per channel). *Model AG3400:* flat response from 50 to

18,000 cycles. Stylus pressure 3 to 5 grams. Mu-metal shielded throughout. Channel separation better than 22 db at 1,000 cycles.—**North American Philips Co., High Fidelity Products Div.**, 230 Duffy, Hicksville, N.Y.

STEREO TUNER. Separate FM—AM reception and adapter for FM multiplex. *Model S-2200* has 2 tuning indicator lights to insure accurate tuning. High-Q



bridged-T whistle filter for AM, 0.95-μv sensitivity for 20-db quieting of FM. Interchannel hush (squelch) eliminates "hash" between FM stations.—**Sherwood Electronic Laboratories, Inc.**, 4300 N. California Ave., Chicago 18, Ill.

STEREO AMPLIFIER *model AM-150*. Response 50 to 12,000 cycles. 6 tubes, ac-dc circuit. Dual 8-ohm output, for use with

high-output crystal or ceramic stereo cartridge. 3 controls, sand-gold finish with contrasting black.—**Olson Radio Corp.**, 260 S. Forge St., Akron 8, Ohio.

MATCHED MICROPHONES for stereo taping in 2 types. Paired *Ceramikes* acoustically matched within 2 db. 1-piece die-cast metal case contains

rugged rubber-encased ceramic transducer. *CM-T10:* 50–13,000-cycle response at −62-db level. More sensitive *CM-T11:* response 50–8,000 cycles at −55 db. Table stands are also available.—**Sonotone Corp.**, Elmsford, N.Y.

END

All specifications on these pages from manufacturers' data.

STOP BUYING TUBES IN THE DARK

BRAND NEW TUBES

Each Tube Individually and Attractively Boxed! You Can Rely On Rad-Tel's Speedy One Day Service!

All Rad-Tel's First Quality! Guaranteed One Full Year!

NOT USED NOT PULLED OUT OF OLD SETS

better than 70% off

Qty.	Type	Price	Qty.	Type	Price
	0Z4M	.79		4BZ6	.58
	1AX2	.62		4BZ7	.96
	1B3GT	.79		4CB6	.59
	1DN5	.55		4CS6	.61
	1G3	.73		4DE6	.62
	1J3	.73		4DK6	.60
	1K3	.73		4DT6	.55
	1L6	1.05		5AM8	.79
	1LA6	.69		5AN8	.86
	1LC6	.79		5AQ5	.52
	1LN5	.59		5AT8	.80
	1R5	.62		5BK7A	.82
	1S5	.51		5BQ7	.97
	1T4	.58		5BR8	.79
	1U4	.57		5CG8	.76
	1U5	.50		5CL8	.76
	1X2B	.82		5EA8	.80
	2AF4	.96		5EU8	.80
	2BN4	.60		5J6	.68
	2CY5	.71		5T8	.81
	3AL5	.42		5U4	.60
	3AU6	.51		5U8	.81
	3AV6	.41		5V6	.56
	3BA6	.51		5X8	.78
	3BC5	.54		5Y3	.46
	3BE6	.52		6AB4	.46
	3BN4	.63		6AC7	.96
	3BN6	.76		6AF3	.73
	3BU8	.78		6AF4	.97
	3BY6	.55		6AG5	.65
	3BZ6	.55		6AH6	.99
	3CB6	.54		6AK5	.95
	3CF6	.60		6AL5	.47
	3CS6	.52		6AM8	.78
	3CY5	.71		6AN4	.95
	3DE6	.62		6AN8	.85
	3DK6	.60		6AQ5	.50
	3DT6	.50		6AR5	.55
	3Q5	.80		6AS5	.60
	3S4	.61		6AT6	.43
	3V4	.58		6AT8	.79
	4AU6	.54		6AU4	.82
	4BA6	.51		6AU6	.50
	4BC5	.56		6AU7	.61
	4BC8	.96		6AU8	.87
	4BE6	.54		6AV6	.40
	4BN6	.75		6AW8	.89
	4BQ7	.96		6AX4	.65
	4BS8	.98		6AX7	.64
	4BU8	.71		6BA6	.49

Qty.	Type	Price	Qty.	Type	Price
	6BC5	.54		6J6	.67
	6BC7	.94		6K6	.58
	6BC8	.97		6S4	.48
	6BD6	.51		6SA7GT	.76
	6BE6	.55		6SK7GT	.74
	6BF6	.44		6SL7	.80
	6BG6	1.66		6SN7	.65
	6BH6	.65		6SQ7	.73
	6BH8	.87		6T4	.99
	6BJ6	.62		6T8	.80
	6BK5	.80		6U8	.78
	6BK7	.85		6V6GT	.54
	6BL7	1.00		6W4	.57
	6BN4	.57		6W6	.69
	6BN6	.74		6X4	.39
	6BQ5	.65		6X5GT	.53
	6BQ6GT	1.05		6X8	.77
	6BQ7	.95		7AU7	.61
	6BR8	.78		7A8	.68
	6BS8	.90		7B6	.69
	6BU8	.70		7Y4	.69
	6BY6	.54		8AU8	.83
	6BZ6	.54		8AW8	.93
	6BZ7	.97		8BQ5	.60
	6C4	.43		8CG7	.62
	6CB6	.54		8CM7	.68
	6CD6	1.42		8CN7	.97
	6CF6	.64		8CX8	.93
	6CG7	.60		8EB8	.94
	6CG8	.77		10DA7	.71
	6CM7	.66		11CY7	.75
	6CN7	.65		12A4	.60
	6CR6	.51		12AB5	.55
	6CS6	.57		12AC6	.49
	6CU5	.58		12AD6	.57
	6CU6	1.08		12AE6	.43
	6CY5	.70		12AF3	.73
	6CY7	.71		12AF6	.49
	6DA4	.68		12AJ6	.46
	6DB5	.69		12AL5	.45
	6DE6	.58		12AL8	.95
	6DG6	.59		12AQ5	.52
	6DQ6	1.10		12AT6	.43
	6DT5	.76		12AT7	.76
	6DT6	.53		12AU6	.50
	6EU8	.79		12AU7	.60
	6EA8	.79		12AV5	.97
	6EB8	.94		12AV6	.41
	6H6GT	.58		12AV7	.75
	6J5GT	.51		12AX4	.67

Qty.	Type	Price	Qty.	Type	Price
	12AX7	.63		12SQ7M	.73
	12AZ7	.86		12U7	.62
	12B4	.63		12V6GT	.53
	12BA6	.50		12W6	.69
	12BD6	.50		12X4	.38
	12BE6	.53		17AX4	.67
	12BF6	.44		17BQ6	1.09
	12BH7	.73		17C5	.58
	12BK5	.70		17CA5	.62
	12BL6	.56		17D4	.69
	12BQ6	1.06		17DQ6	1.06
	12BY7	.74		17L6	.58
	12BZ7	.75		17W6	.70
	12C5	.56		19AU4	.83
	12CA5	.59		19BG6	1.39
	12CN5	.56		19T8	.80
	12CR6	.54		21EX6	1.49
	12CU5	.58		25AJ4	.87
	12CU6	1.06		25BQ6	1.11
	12CX6	.54		25C5	.53
	12DB5	.69		25CA5	.59
	12DE8	.75		25CD6	1.44
	12DL8	.85		25CU6	1.11
	12DM7	.67		25DN6	1.42
	12DQ6	1.04		25EH5	.55
	12DS7	.79		25L6	.57
	12DZ6	.56		25W4	.68
	12EL6	.50		25Z6	.66
	12EG6	.54		35C5	.51
	12EK6	.56		35L6	.57
	12EZ6	.53		35W4	.52
	12F5	.66		35Z5GT	.60
	12F8	.66		50B5	.60
	12FM6	.45		50C5	.53
	12K5	.65		50DC4	.37
	12SA7M	.86		50EH5	.55
	12SK7GT	.74		50L6	.61
	12SN7	.67		117Z3	.61

TRANSISTOR 2N215
PNP GENERAL PURPOSE
A.F. AMP

39¢ ea. In Lots of 10
45¢ ea. single

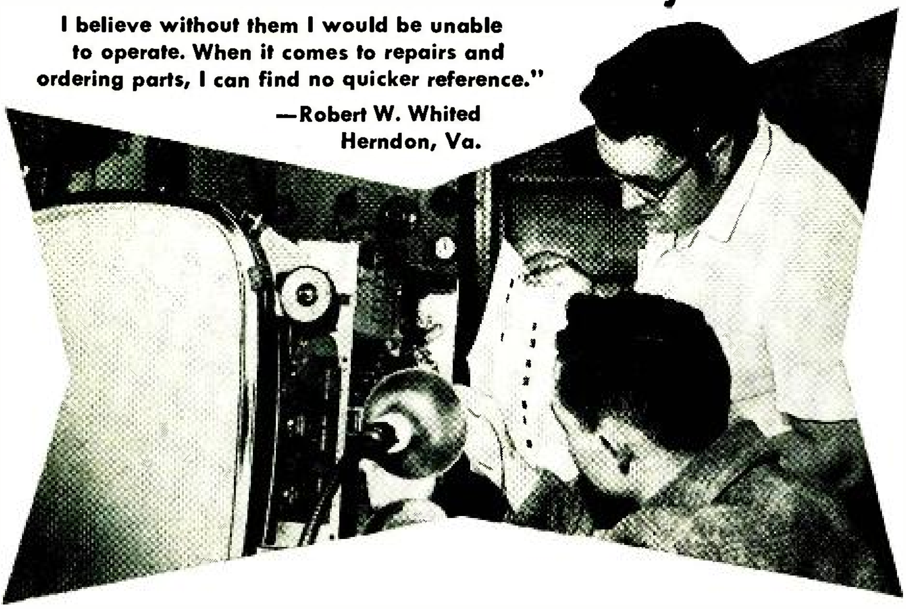
Send For Free Trouble Shooter Guide And New Tube & Parts Catalog.

Not Affiliated With Any Other Mail Order Tube Company.

RAD-TEL TUBE CO.

55 Chambers Street
Newark 5, N. J.
DEPT. RE 460

TERMS: 25% deposit must accompany all orders — balance C.O.D. $1 HANDLING CHARGE FOR ORDERS UNDER $5
Subject to prior sale. Please add postage. No C.O.D.'s outside continental U.S.A.



TECHNICIANS' NEWS

AGAINST FACTORY SERVICE

The National Appliance & Radio–TV Dealers (NARDA) is against factory service, according to the Television Service Association of Michigan. The Executive Committee of NARDA says "the members feel that such a policy deprives the consuming public of the right of free choice of agencies to service its appliances and may tend to create a monopoly."

Frank J. Moch, executive director for the National Alliance of TV & Electronic Service Associations, warns technicians that company service warranties are a serious threat to their businesses. Several manufacturers, according to Moch, stated that competition will probably force them to include service warranties with their sets. He urges all technicians to "among other things write to their Senators and Representatives demanding legislation to prevent factories from killing off independent service."

SALES TAX INVESTIGATION

The *Vanguard*, official publication of the Tri-State Council of TV Service Associations (Pennsylvania, Delaware, New Jersey), reports that 37 names were submitted to the State Sales Tax Department of Pennsylvania for investigation. The state has a law that requires retailers to collect sales tax on TV servicing. The Pennsylvania association asked their members to submit the names of any "illegitimates" who were doing business without paying taxes to the Tax Department.

NO LAW BROKEN?

An Alexandria, Va., judge dismissed fraud charges against the owner of a service shop who charged a policewoman $37.20 for a new fuse and tube. The owner of a nearby service shop said he charges $2.10 for the tube and 20c for the fuse. The judge said:

"I don't think any law has been broken. It's a sickening story that people can be fleeced like this. A dirtier trick I've never heard of. It's a shame something can't be done to break it up."

TV SAFETY GROUP

The Empire State Federation of Electronic Technicians associations has created a committee to investigate safety problems in modern TV receivers. Designating the program "Operation TV Safety," ESFETA asks that technicians:

Keep children and customers at a safe distance while servicing sets.

Do not defeat electrical interlocks.

Replace cabinet back after servicing.

Check antenna installations for dangers such as grounding, nearness to power lines and rusted or improper mounting.

Check potential between metal cabinets and ground for dangerous voltages.

Watch out for shock hazards.

Why Aren't You on the List?

RADIO-ELECTRONICS is publishing a list of all of the *known* television service associations in North America. Every now and then some association will write in and ask us why it has not been listed. *We can list you only if we know about you.* We have had difficulty in getting the names and addresses of associations. In spite of numerous letters, we have not been able to get any information from a number of states known to have service organizations. These include Arkansas, Connecticut, Florida, Minnesota, Missouri, New Hampshire, Oklahoma, Rhode Island and Texas. Word from these states is anxiously awaited.

If your association has not been listed or if you know of any that have not been listed, let us know about it. Send a postcard with the name and address of president or secretary to: Associations Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York 11, N. Y.

MASSACHUSETTS

ELECTRONIC TECHNICIANS GUILD OF MASSACHUSETTS (ETG)
Leonard Smith, Secretary
Box 176
Newtonville 60, Mass.

GREATER BOSTON CHAPTER, ETG
James H. Kelley, Secretary
236 Main St.
Woburn

BROCKTON CHAPTER, ETG
Albert Kazukonis, President
743 N. Main St.
Brockton

FALL RIVER CHAPTER, ETG
Henry Nadeau, President
The Lane
Assonet

LAWRENCE CHAPTER, ETG
Donald Baron, President
118 Essex St.
Lawrence

LOWELL CHAPTER, ETG
Al Nickerson
38 Ledge Road
N. Chelmsford

NORTH SHORE CHAPTER ETG
Robert Pelletier
43 High St.
Danvers

SOUTH SHORE CHAPTER, ETG
George Toma, Secretary
Broad St.
East Weymouth

SUBURBAN CHAPTER, ETG
Gilbert P. Clark, Secretary
845 Washington St.
Newtonville 60

RADIO AND TELEVISION TECHNICIANS GUILD OF GREATER NEW BEDFORD
J. L. Shepley, Secretary
110 Topham Street
New Bedford

WORCESTER COUNTY ASSOCIATION OF TELEVISION TECHNICIANS (WCATT)
Warren Pease, President
Ponakin Road
Lancaster

PENNSYLVANIA

RADIO AND TELEVISION SERVICEMEN'S ASSOCIATION OF PITTSBURGH
Tom Ging, Secretary
3239 Ashlyn Avenue
Pittsburgh 4, Pa.

ETG ON TV?

The Electronic Technicians Guild of Mass., Boston Chapter, announces a tentative plan to appear on WHDH-TV's Dateline Boston program (channel 5) about the first week in June. It will be a demonstration type program featuring TV service techniques and tips.

ACTRA OFFICERS

The Alameda County Television & Radio Association installed officers for 1960. They are: Claire W. Lanam, president; Stephen L. Strong, first vice president; Frank Lozano, second vice president; John A. Edwards, treasurer; Melvin J. Dumolt, representative to the California State Electronics Association. Directors are Lewis E. Hall, Roy E. Brown, L. M. Bacon, Allan Crawford, William R. Howard, Roy Pine, Norman W. James, Hal McGee, Milton M. Siegel, Sam Ditto and Dick Soone.

FTRSA ELECTS OFFICERS

The Federation of Television–Radio Service Associations of Pennsylvania Inc. elected and installed its 1960 officers: Wayne E. Prather, president; Charles Ross, vice president; John Ruch, recording secretary; L. B. Smith, financial secretary; Leon J. Helk, corresponding secretary.

RATE INCREASE

Service shops in the Santa Clara area plan to raise their rates as much as 15%. Russell J. Hamm, president of the Radio–TV Association of Santa Clara Valley (Calif.) said that rates in the San Francisco area were about 15% higher than the Santa Clara area. Mr. Hamm said that the increased time spent on servicing printed circuits and the $3-an-hour wage rate make the change necessary.

LICENSE COMMISSION

A Board of Commissioners was appointed to administer the Kansas City Television and Electronics Service License Ordinance. The men appointed are: C. L. Foster, Avery Fouts, Don Ellis, Don Day and John Gardner. All five are connected with electronics, three being active members of the servicing industry.

The commission has to examine and license all men who service or expect to service television or related electronic equipment.

TUBE-CHECKER PROBLEMS?

TSA (Iowa) *Beacon* advises, "Don't look for any immediate solution to the tube-checker problem. Do keep your eyes and ears open and if you see a tester (in a drugstore) in your area, see what brand of tubes he is selling.

"Find out if the customer can return a tube if it does not help the trouble. Keep track of the operation to see if it is legitimate. If off-brand tubes are sold, report it to your NATESA director. NATESA has a wad of information on these things and the picture is starting to clear up."

ARTSNY ENCOURAGES WIVES

The Associated Radio–Television Servicemen of New York (City) featured a novel event at their recent annual dinner dance and installation of officers. A beautiful jewel box was presented to Mollie Goldfarb, wife of Phil Goldfarb, treasurer and long-time active member, and to Elsie La Presti, wife of Peter La Presti who during the past year was corresponding secretary. The presentation was in appre-

ARTSNY president Ed Eisen presents jewel cases to Mrs. La Presti (left) and Mrs. Goldfarb, in recognition of their services to the Association.

ciation of their assistance to and encouragement of their husbands in association work.

The affair, held in Brooklyn's Farragut Inn, was well attended, nearly 40 persons being present. There was no formal program—though short addresses were made by some of the officials—and social activities were carried on till after 1 a.m.

BBB TO CHECK

Aaron A. Knopf, general chairman of the organizing committee of the Long Island Better Business Bureau, reports that a special effort will be made during the coming year to improve advertising and selling practices among television sales and servicing firms in Nassau and Suffolk counties (New York), according to *Guild News* of the Radio Television Guild of Long Island. A considerable number of complaints were made last year to local district attorneys and the New York City Better Business Bureau the *Guild News* states. The Long Island BBB will distribute pamphlets designed to educate the public about industry practice, and make daily checks on advertising and selling practices in an attempt to stamp out unfair competitive tactics.

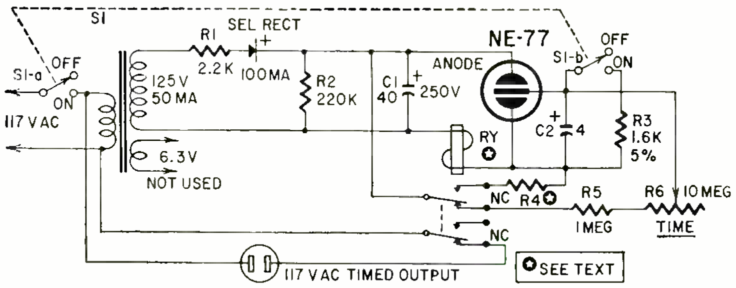
GROUP LISTS WHOLESALERS

The *Newsletter* of the Independent TV Service Dealers Association of Los Angeles County is listing "ITVSDA-Approved Jobbers"—"These wholesalers have given ITVSDA assurance in writing that they do not make a practice of selling to anyone other than holders of valid resale permits and industrial accounts." Jobbers who follow such a policy are urged to send the Association a letter to that effect so that his name can be added to this list. The names will continue to be listed in each issue, pending verified complaints against anyone so listed. END

NOTEWORTHY CIRCUITS

DARKROOM TIMER

This darkroom timer makes use of that miniature glow lamp, the NE-77. The advantages of this timer over most others are those that the NE-77 has in almost any circuit—small size and low cost.



The NE-77 is a three-electrode neon lamp that acts like a cold-cathode thyratron. (See "New Neon Bulb Acts Like a Thyratron," RADIO-ELECTRONICS, October, 1958.) The red dot on its tiny glass envelope identifies its anode.

The values for C2 and R6 may be any combination that will allow the maximum timing period desired. Those shown in the diagram allow a timing period ranging from 4 to 40 seconds.

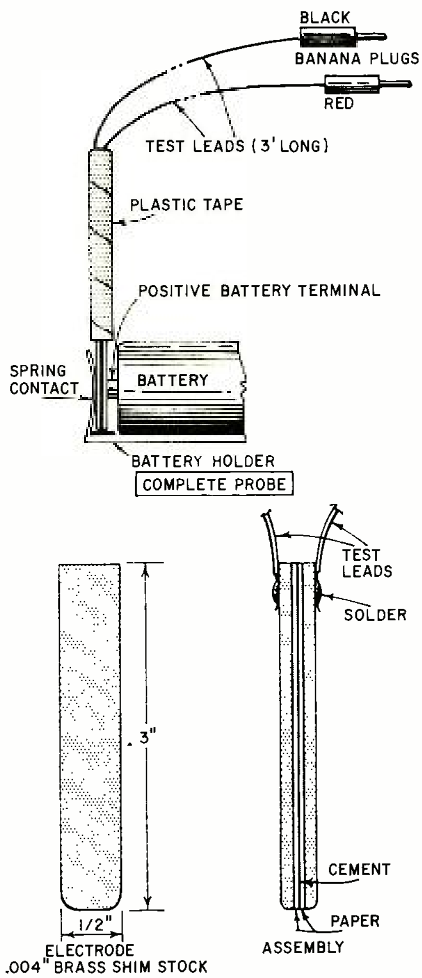
A comparatively inexpensive relay that works very well in this circuit is a Potter & Brumfield 24-volt DC DPDT type GA11D, but almost any relay may be used that has DPDT contacts and a coil resistance of 200 ohms or more.

Resistor R4's value depends on the relay used and should pass a current equal to approximately 30% of the relay operating current. The wattage of R1 and R4 depends on the amount of relay hold current used. All other resistors are ½ watt.

To operate the timer, turn TIME control R6 to the desired time and throw S1 to ON. This slowly allows capacitor C2 to charge. The speed at which this charging takes place depends on the setting of R6. When the voltage across C2 reaches the triggering voltage of the NE-77, the lamp fires, causing C1 to discharge through the relay. The relay closes, disconnecting the 117-volt line from the output receptacle, at the same time closing the normally open contacts that connect the holding current to the relay. Throwing S1 to OFF lets the relay return to its normal state and at the same time places R3 across capacitor C2, insuring its complete discharge. This sets up the timer for the next timing period.—*James Martin*

BATTERY-CURRENT PROBE

Measuring battery current drain in transistor portable radios is a simple but effective way to detect abnormally high- or low-resistance paths in the circuitry. If the normal operating battery drain is known, and the measured current is higher or lower than this value,



the technician knows whether to look for a shorted or an open circuit element. Shorts and opens appear frequently in transistors. In fact, the majority of failures in transistors are shorts and opens. Therefore, the battery-current test has proved very useful.

This handy battery-current probe has been a time and temper saver for this test. It slips easily between the battery and the contact of the battery holder or between batteries in series. This eliminates removing batteries and frustrating attempts to connect test leads to them. The test may be made as easily as a voltage measurement, without disconnecting any receiver circuits.

The probe consists of two thin metal plates, electrically insulated and connected to the input of a suitable milliammeter or multimeter by convenient lengths of test lead.

The electrodes are cut from 4-mil brass shim stock and tin-dipped. Test leads are soldered to one end of each plate. The other ends of the test leads are terminated with banana plugs. The brass plates are insulated with paper and cemented together with epoxy resin. The positive electrode is identified by a dab of red paint. The upper end of the probe was wrapped with enough plastic electrical tape to make a comfortable handle.—*Dale F. Betz* END

50 Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

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

In April, 1910, *Modern Electrics*

Policing the Ether, by James M. Murdock.

French Wireless Cars.

Calculation of Condenser Capacity, by H. W. Secor.

New Duddell Oscillator.

Curious Frequency Meter.

Variometer for Amateurs, by M. H. Hammerly.

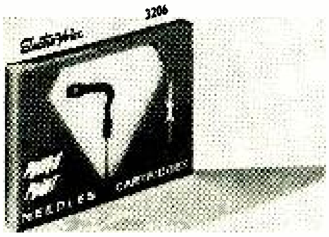
How to Receive and Transmit at the Same Time, by Hallam Anderson.

The Duplex Aerial.

"It's a remote-control for my TV. I shut off the set at home so my wife can start preparing dinner."

BUSINESS and PEOPLE

Electro-Voice, Inc., Buchanan, Mich., is packaging its replacement phonograph needles in styrene plastic containers which display the individual needles through a transparent window. The company is also marketing its



matched microphones for public address and home stereo recording systems in pairs at no extra cost. The paired microphones are carefully balanced within close tolerances.

Centralab, Milwaukee, Wis., has redesigned and simplified all its stock product packages. The number of pack-

age sizes and shapes has been reduced by more than 50%, with many of the bothersome smaller sizes being eliminated.

Standard Coil Products Co., Melrose Park, Ill., now has its TV tuner replacements listed in Howard W. Sams Photofact folder service, thus becoming the first TV tuner manufacturer to partici-

pate in the service. Standard Coil's distributor sales manager A. H. (Buzz) Forbes is shown behind the stack of the tuner specifications prepared for the Photofact service.

Cornell-Dubilier Electric Corp., South Plainfield, N. J., is using a unique 30-30 promotion to dramatize its aim to get sales action on its new Electomite miniaturized electrolytic capacitors.

Winchester 30-30 repeating carbines will be awarded to outstanding distributors during the campaign. Ray Leary, C-D general sales director, is shown "covering" the capacitor market with a 30-30, as Bill Schoneberger (left), sales manager, and Bob Riegel, merchandising manager, look on.

Matthew L. Devine (left), has been elected president of Amphenol-Borg Electronics Corp., Broadview, Ill., suc-

ceeding **Arthur J. Schmitt,** (right), who will continue as chairman of the board and chief executive officer. **George W. Borg** remains chairman of the executive committee. Devine had been on the board of directors since April, 1956, and is also a member of the executive committee. He had been a partner of Cresap, McCormick & Paget, management consultants.

R. Fred Meinicke (right), has been appointed sales manager of the Amphenol Distributor Div. He has been with the company since 1950 in various distributor sales positions.

Perma-Power, Chicago, designed a new 12-pack dispenser carton for its TV tube brighteners.

Hermon H. Scott, president of H. H. Scott, Inc., was elected chairman of the board of directors of the Institute of High Fidelity Manufacturers.

Ray V. Pepe, James B. Lansing Sound, Inc., was elected vice president and director, and will act as president until the special election to fill the vacancy. **Saul Marantz,** Marantz Co., and **Donald Plunkett,** Fairchild Recording Equipment Corp., were named to the board of directors. **Raymond E. Ward**, Shure Brothers, was also elected to the board, but with qualification depending on the election of the president.

Robert Wolfe has been named sales manager of the new Centralab Variable Resistor Sales Div., Milwaukee, Wis. He is well known in the electronics industry and was most recently with *Electronics World* magazine.

Oden F. Jester joined the sales division of Shure Brothers, Inc., Evanston, Ill., to handle special assignments. He was formerly with Standard Coil Products Co., Inc., Thordarson-Meissner, and Utah Radio & Electronic Corp., among others.

John W. (Jack) Merritt is back as distributor sales manager of Howard W. Sams & Co., Indianapolis. He had been co-ordinating the marketing-advertising department activities of Bobbs Merrill Co., Inc., and other associated Sams subsidiaries. **Tom Surber** will continue as assistant sales manager.

Francis J. Chamberlain is the new general sales manager of Clarostat Manufacturing Co., Inc., Dover, N. H. He will head all sales and sales promotion activities of the company and its subsidiary, Campbell Industries. He has been acting sales manager since early last year.

Robert A. Donner joined Telectrosonic Corp., Long Island City, N. Y., subsidiary of Telectro Industries Corp., as sales manager. He comes from American Audion Corp., where he had been general sales manager.

Larry Epstein joined Bogen-Presto Div. of Siegler Corp., Paramus, N. J., as sales and merchandising manager on high-fidelity and professional equipment. He comes from United Audio Products, and was previously with University Loudspeakers and RCA International. END

ALL TUBES INDIVIDUALLY BOXED . . . UNCONDITIONALLY GUARANTEED ONE YEAR
SEND FOR FREE COMPLETE TUBE LIST & ORDER BLANK
INQUIRY PUTS YOU ON MAIL-LIST

TELTRON SMASHES PRICES on TUBES for '60!

GIFT OFFER
ONE 6BG6G tube will be shipped **FREE** with any $10.00 or more order accompanying this ad.

FREE $7.50 list value. Bonus box includes 3 6SN7 tubes & 25 assorted resistors & condensers with each order of $25.00 or more of receiving tubes and special purpose tubes only.

FREE EICO TUBE TESTER

By popular demand we are repeating this fabulous FREE GIVE-AWAY. You get this EICO tube tester kit #625K ABSOLUTELY FREE when you purchase $199.00 worth of receiving tubes from TELTRON within 60 days.

Tube tester may be purchased outright for $34.95 PREPAID. Send for FREE list of other EICO test equipment & HI FI components that we distribute.

PARTIAL LIST MOST OFTEN USED TUBES

OZ4	.45	6BA8	.49	9U8	.79
1B3GT	.62	6BC5	.48	10DE7	.49
1R5	.51	6BC8	.59	12AB5	.44
1S5	.43	6BE6	.46	12AF6	.44
1T4	.51	6BF5	.48	12AT6	.37
1U4	.51	6BG6G	1.18	12AT7	.71
1U5	.43	6BH6	.51	12AU6	.43
1X2	.62	6BJ6	.51	12AU7	.58
2AF4	1.02	6BK5	.75	12AV6	.42
2BN4	.55	6BK7	.78	12AV7	.73
3AU6	.43	6BL7GT	.78	12AX4GT	.60
3BC5	.58	6BN4	.44	12AX7	.61
3BN6	.90	6BN6	.90	12AZ7	.65
3BZ6	.45	6BQ6GT	.83	12B4	.52
3CB6	.51	6BQ7A	.85	12BA6	.46
3DT6	.51	6BY5G	.75	12BE6	.46
3V4	.48	6BZ6	.45	12BH7	.61
4BC8	.69	6BZ7	.95	12BQ6	.63
4BQ7	.75	6C4	.41	12BY7	.65
4CB6	.51	6CB6	.51	12CR6	.43
5AM8	.59	6CG6G	1.63	12CU6	.63
5AN8	.64	6CF6	.45	12DB5	.59
5AT8	.54	6CG7	.44	12DQ6	.63
5AV8	.54	6CH8	.54	12K5	.44
5BK7	.68	6CM7	.44	12SA7	.45
5J6	.61	6CS6	.45	12SK7	.45
5T8	.59	6CU6	.95	12SN7GT	.56
5U4G	.43	6DE6	.43	12SQ7	.38
5U4GA	.45	6DG6GT	.50	12V6GT	.43
5U4GB	.45	6DQ6	.89	12L6GT	.43
5U8	.59	6H6	.47	12W6GT	.43
5V4G	.49	6J5	.49	17DQ6	.68
5X8	.55	6J6	.61	19AU4	.60
5Y3GT	.30	6K6GT	.39	19BG6G	1.48
6AB4	.43	6S4	.41	25BQ6GT	.82
6AC7	.65	6SA7	.45	25CD6G	1.19
6AF4	1.02	6SC7	.54	25CU6	.82
6AG5	.52	6SK7	.45	25L6GT	.41
6AH6	.47	6SL7GT	.60	25W4GT	.43
6AL5	.43	6SN7GT	.60	25Z6GT	.36
6AM8	.59	6SQ7	.38	35B5	.48

Send for FREE complete list of most often used tube types.

NEW AND HARD TO GET TYPES PROMPT DELIVERY

1DN5	.60
1G3GT/1B3	.70
2CY5	.50
3AF4	1.02
4DE6	.55
4DT6	.59
5CQ8	.59
6BJ8	.64
6BQ5	.74
6CQ8	.59
6CX8	.64
6DS5	.69
8AW8	.75
8CX8	.90
11CY7	.74
12EK6	.59
17AX4GT	.50
17D4.50 50EH5	.59

APPROX. COST ANY TYPE EXCESS REFUNDED.

Obsolete, seldom used tubes. Immed. delivery.

1A6	.93	7B4	.44
1C5GT	.57	7B5	.41
1C7G	.39	7B8	.47
1F5	.39	7C5	.44
1H4G	.39	7F8	.77
1LA6	.66	7H7	.51
1LB4	.69	7N7	.52
1LH4	.66	7V7	.82
1LN5	.66	7Y4	.35
3LF4	.66	7Z4	.40
5T4	.59	12A8GT	.45
6A7	.59	12K7GT	.40
6A8	.40	12Q7GT	.48
6AB7/		12SF[illegible]	.57
1853	.60	14A7	.43
6AQ7GT	.60	14B6	.36
6AS7G	1.50	14Q7	.52
6D6	.59	27	.45
6F5GT	.44	35A5	.48
6F6	.42	35Y4	.35
6S7	.89	37	.59
6SB7Y	.50	39/44	.39
6SR7	.43	45	.55
6U5	.54	50A5	.48
6U7G	.40	50X6	.53
7A4/		56	.48
XXL	.47	71A	.65
7A6	.47	75	.44
7A8	.46	77	.55
7A7	.42	80	.40

Semiconductors for immediate delivery.

1N34	.49
1N38	.95
1N60	.34
1N66	.49
1N82A	1.00
1N253	4.25
1N256	19.95
1N295	.30
1N460A	4.60
1N1096	9.00
2N63	3.75
2N130A	2.75
2N329A	40.00
2N484	1.75
2N622	30.00
2N633	1.35

NEW PRICE SCHEDULE OF TELEVISION PICTURE TUBES
PICTURE GUARANTEED FOR ONE (1) YEAR

8DP4	*	17EP4	$13.25	21AVP4	$19.25
10ABP4	*	17CP4	17.25	21AWP4	18.75
10BP4	$ 7.95	17GP4	17.95	21EP4	17.25
12LP4	10.75	17HP4	16.49	21FP4	19.25
14BP4	11.75	17JP4	16.49	21MP4	21.25
14CP4	11.95	17LP4	17.45	21WP4	17.25
14QP4	13.25	17QP4	13.25	21XP4	18.75
14RP4	14.25	17TP4	16.49	21YP4	18.75
16AP4	16.45	17YP4	16.49	21ZP4	17.25
16CP4	12.49	19AP4	18.25	24ADP4	*
16DP4	11.99	20CP4	15.75	24AP4	*
16EP4	15.99	20DP5	15.75	24CP4	27.25
16GP4	15.99	20HP4	17.75	24DP4	28.75
16HP4	12.49	21ACP4	21.95	24TP4	*
16KP4	11.95	21ALP4	18.75	24VP4	*
16LP4	11.95	21AMP4	18.75	24YP4	*
16RP4	11.95	21AP4	21.25	24EP4	*
16TP4	11.95	21ATP4	19.25	27RP4	*
17ATP4	16.75	21AUP4	19.25		
17AVP4	15.75				

*Price upon request.

ALUMINIZED ON ANY TUBE. $4.00 EXTRA

All picture tubes require a deposit on your dud. Please add an additional $5.00 on tube sizes to 17". Add $7.00 on sizes 19", 20", 21" and 24"s. Your cash deposit will be refunded immediately upon receipt of your dud prepaid. Picture tubes are shipped promptly from our warehouse (the US continent and Canada only) F.O.B. Harrison, New Jersey.

Special-purpose, transmitting and industrial Tubes for immediate delivery.

OA2	.70	807	1.00
2A4G	.75	811A	3.25
2D21	.65	813	9.25
2E26	2.50	833A	40.00
2X2	.75	866A	1.00
5R4GY	1.00	2050	.85
6J4	1.00	5675	12.25
12A6	.60	5879	1.10
FG27	8.50	6146	3.85
HY69	1.75	6161	34.50

RECEIVING TUBE SPECIALS
6SN7GT A & B
Lots of 50...... $24.50
Lots of 100.... $14.50
6W4GT
Lots of 50...... $18.95
Lots of 100.... $14.95
12AU7 & A
Lots of 50...... $24.95
Lots of 100.... $17.95
6AU6 & A
Lots of 50...... $18.95
Lots of 100.... $14.95
6CB6 & A
Lots of 50...... $12.95
Lots of 100.... $11.95
Free Postage

HEAVY DUTY SOLDER GUN KIT. 135 w gun. Dual spotlight illum. work when gun on. INCL: wire soldering brush & aid to make tight twists, reopen old joints, lge. pkg. solder. Prepd., $4.99. 3 for $14.29.

FIBER FUSE CLIPS......15c ea.
12 for $1.65
PREPAID

RCA CHEATER CORDS
39c ea.
6 for $1.95
PREPAID

Complete Outdoor **ALL CHANNEL CONICAL ANT.** local/fringe areas. 8 elem. ant. with crossbar. 5' seamless mast (alum.). chimney mt. or 7" wall brkt. (state need) 8 standoffs. 50' 300 ohm wire. 3—$7.49. Imm. dl. FOB Harrison, N.J.

SWITCH-TYPE Indoor Antenna
Shipped postage paid. New 6 position switch for use on UHF. VHF and color sets. Attractively packaged $2.99. lots of 6 $2.49.

PARALLEL PICTURE TUBE BRIGHTENER 99c
Series type........ $1.39

AUTO VIBRATERS
6 Volt 4 Prong Universal $1.59
12 Volt 3 Prong Standard $1.79
12 Volt 4 Prong Standard $1.99

NEW LIBERAL TERMS: NO MINIMUM ORDER. FREE POSTAGE ON ALL TUBE & PARTS ORDERS OVER $5.00 IN U.S.A., APOs & TERRITORIES. 25% DEPOSIT REQUIRED ON CODs. PLEASE SEND APPROXIMATE POSTAGE ON CANADIAN AND FOREIGN SHIPMENTS. EXCESS WILL BE REFUNDED. All picture tubes and outdoor antennas shipped FOB Harrison, New Jersey.

TUBES LISTED MAY BE FACTORY SECONDS OR USED TUBES AND CLEARLY MARKED.

TELTRON ELECTRIC CO.

428 Harrison Ave. Harrison, N. J. Phone HUmboldt 4-9848
Dept. RE-4

OPPORTUNITY ADLETS

Rates—50c per word (including name, address and initials). Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for June issue must reach us before April 15, 1960.
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154 West 14 St., New York 11, N. Y.

HI-FI DOCTOR—will solve your hi-fi problems on the spot. Acoustic, Audio, Radio Engineer. Stereo Designing. Professional visits, day, evening. New York area. WILLIAM BOHN. Plaza 7-8569, weekdays.

DISCOUNTS UP TO 50% on Hi-Fi amplifiers, tuners, speakers, tape recorders, individual quotations only, no catalogs. CLASSIFIED HI-FI EXCHANGE, 2375 East 65th Street, Brooklyn 34, N.Y.

5-INCH TV Test CRT. Complete with adapter $3.95 post paid. CRYSTAL ELECTRONICS, 9507 101st Ave., Ozone Park, N.Y. HI 1-0700.

CAMERA Repairmen greatly needed! You can learn manufacturers' service methods at home, in your spare time! Free, big illustrated book tells how! Write today. NATIONAL CAMERA REPAIR SCHOOL, Dept. RE-2, Englewood, Colorado.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND TESTING equipment repaired. HAZELTON INSTRUMENT CO., 128 Liberty Street, New York, N.Y.

PROFESSIONAL ELECTRONIC PROJECTS — Organs, Timers, Computers, etc.—$1 each. List Free. PARKS, Box 1665, Seattle 55, Wash.

TUBES—PRICES SMASHED—Radio, TV & Picture Tubes from Authorized Distributor. Top Brands. Write for Free Catalog. RADIO HUT, 25 Highland Ave., Bridgeport, Conn.

APPLIANCE Parts—Supplies Wholesale. Catalogue 25c. SECO, 26 So. 20 St., Birmingham 3, Ala.

CLOCKS FOR RADIOS. Electric, Battery-Operated Clocks with alarm device and lighting contact specially built for radios. Working one year independently on flashlight dry cell. Sole producers SCHILD, watch factory, Le Chaux-de-Fonds, Switzerland.

DIAGRAMS FOR REPAIRING RADIOS $1. Television $2. Give make, model. DIAGRAM SERVICE, Box 672-RE, Hartford 1, Conn.

IF YOU HAVE A BACKGROUND IN ELECTRONICS, but are having trouble passing FCC Commercial Phone Exams, my 15 years' experience as Chief Instructor of Electronics School can help you over the hump, very inexpensive. Free Literature. Write SHOTGUN REVIEW, Dept. A, Box 10631, Jackson 9, Miss.

(*Continued on page 133*)

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.

1960 RADIO MANUAL of diagrams and service information on popular radio sets, auto radios, and stereo equipment. $2.50. Also available are individual diagrams and data on popular sets. Send 40¢ for radio diagrams, 75¢ for TV diagrams. Master Index of individual diagrams, 25¢.—**Supreme Publications**, 1760 Balsam Road, Highland Park, Ill.

REPLACEMENT STYLUS WALL CHART, 20 x 30 inches, shows manufacturer's cartridge number, shape of needle, needle number and list price.—**Duotone Co. Inc.**, Locust St., Keyport, N. J.

OHM'S LAW CALCULATOR, an old friend, is available with a second set of scales that solve parallel resistance problems. In plastic, $1.50. In cardboard, 25¢.—**Ohmite Manufacturing Co.**, 3603 Howard St., Skokie, Ill.

SIGNAL GUIDE listing the most common "10" signals, as used by taxi and other two-way mobile services, is available to class-D Citizens band operators. Send FCC call letters with your request.—**Vocaline Co.**, 10 Coulter St., Old Saybrook, Conn.

TELEVISION REPLACEMENT GUIDE lists transformers, yokes and chokes. This 129-page guide gives impedances, sizes, weights and diagrams of horizontal output transformers. *TV-60* is available from Triad distributors or from the manufacturer.—**Triad Transformer Corp.**, 4055 Redwood Ave., Venice, Calif.

FLIP-CHART KIT to bring the Seco model 107 tube tester up to date. Order part *No. FC3-260* from your distributor or write the manufacturer.—**Seco Electronic Manufacturing Co.**, 5015 Penn. Ave. S., Minneapolis, Minn. $2

TRI-AMP RECTIFIERS, selenium units which rectify through a p-n junction rather than a barrier layer, are described in a 4-page brochure, *Bulletin No. 287A*. Voltage ratings per cell are 26 to 33 (reverse rms voltage), current ratings 0.3 to 45 amp half-wave, 0.9 to 90 center tap and bridge.—**Radio Receptor Co., Inc.**, 240 Wythe Ave., Brooklyn 11, N. Y.

TIPS FOR SERVICEMEN are found in the third edition of *Stan Cor's Corner.* In the brochure are 38 short cuts, hints and gadgets. The subjects covered are tools, soldering, tool kits and even rear-seat speaker installations.—**Chicago-Standard Transformer Corp.,** 3501 W. Addison St., Chicago 18, Ill.

CARD-PUNCH DATA for testing over 1,000 tube types are contained in a 44-page booklet *Card Punch Data For Your WT-110A Automatic Electron Tube Tester.* It gives instructions on how to bring your RCA tube tester up to date on recent domestic and popular foreign tube types. It can be obtained from your distributor or by writing to the manufacturer.—**RCA Commercial Engineering,** 415 So. Fifth St., Harrison, N. J. $1

DIRECT-CURRENT SUPPLY of the motor–alternator–rectifier type is described in *Bulletin 59-P* (32 pages). Regulated output is extremely stable regardless of line-voltage fluctuations. —**Electric Specialty Co.,** 211 South St., Stamford, Conn., Att. L. Sullivan.

LABORATORY STANDARD METERS and associated transformers are given detailed treatment in a 23-page color brochure *World Standards.* Also included is a data section including correction curves for use with transformers. — **Weston Instruments Div., Daystrom Inc.,** 614 Frelinghuysen Ave., Newark 12, N. J.

COMPUTER-GRADE CAPACITORS of the electrolytic type are described in a 4-page folder. Performance characteristics, dimensions and a table of stock values are given in *QE Bulletin NPJ-110.*—**Aerovox Corp.,** New Bedford, Mass.

RESISTOR SELECTOR CHART for solving problems involving power and Ohm's law is available in loose-leaf insert form. On one side the 4 values—current, voltage, power and resistance—are arranged in chart form, on the other side are data on metal-film resistors. Write for form *Z-44-A.*—**Daystrom-Weston Sales Div.,** 614 Frelinghuysen Ave., Newark 12, N. J.

LICENSE HOLDERS for the 11-meter Citizens band are listed alphabetically in a call book.—**George Beyers, International Crystal Mfg. Co.,** 18 No. Lee St., Oklahoma City, Okla. $1

TUNGAR BULB MANUAL contains typical circuits and operating data. This 8-page brochure *ETR-2091* provides data on the use of these rectifiers in low-noise power supplies with low voltage drop and high overall efficiency. Available from distributors or manufacturer. —**Distributor Sales Corp., General Electric Co.,** Owensboro, Ky.

CONNECTORS are listed in alphabetical order by manufacturer in the new *Allied Connector Directory.* This 15-page directory has manufacturer's numbers, stock number and prices.—**Allied Radio Corp.,** 100 N. Western Ave., Chicago 80, Ill. END

OPPORTUNITY ADLETS *(Continued from p. 131)*

new BOOKS

BASIC ELECTRONICS (Vol. 6.), by Van Valkenburgh, Nooger & Neville, Inc. John F. Rider, Inc., 116 W. 14 St., N. Y. 11, N. Y. 6 x 9 in. 136 pp. $2.90.

This is the latest volume in the series known as the "common-core program." Its purpose is to train Navy students better and faster. It has proven highly successful and is now available for civilian use. The present volume deals with semiconductors and FM.

Like the previous volumes, the present one uses a picture approach. Each page discusses a single idea, with large diagrams and cartoons to illustrate the meanings. Without math, the book includes basic theory, experiments and principles. You will find it easy to read, easy to understand, easy to remember. —*IQ*

RADIO AMATEUR'S HANDBOOK, 37th edition, Amateur Radio Relay League, W. Hartford, Conn. 728 pp, 6½ x 9½ in. $3.50.

Another year passes and a new edition of this well-known handbook is published. As usual, it covers all phases of amateur activity clearly and completely. It describes and illustrates the latest home-made receivers and transmitters, measuring instruments, antennas, auxiliary equipment and operating procedure. All models have been tested and performance-proved.

Single sideband, FM, radioteletype, mobile, vhf and transistorized devices are among the important topics of the new edition. Among numerous charts and tables is a comprehensive listing of tube basing and characteristics.

THE TRANSISTOR ERA, edited by C. C. Gee and Charles A. Marshall. Heywood & Co. Ltd., Drury House, Russell Street, Drury Lane, London, W.C.2, England. 11½ x 8¾ in. 95 pp. 5 shillings.

Prepared in magazine style, this book is a guide to British transistors and associated semiconductor devices. It presents some basic semiconductor fundamentals, contains a buyers' guide to transistors and associated products, and discusses the position of semiconductors in today's world. A complete listing of British transistors is also included.—*LS*

TELEVISION ANTENNA HANDBOOK, by Jack Darr. Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 5½ x 8½ in. 248 pp. $3.95.

Most service technicians will find this book a valuable aid for it presents all the information he needs to make successful home TV antenna installations. Both the antenna (which one to use and why) and the actual installation are covered. Detailed illustrated chapters

(*Continued on page* 139)

SCHOOL DIRECTORY

Lafayette Superior Quality HI-FI KITS!

The FINEST . . . through research . . . engineered by LAFAYETTE!

MADE IN U.S.A.

KT-250 A

IN KIT FORM

74.50

LA-250 A 99.50

COMPLETELY WIRED

50 WATT INTEGRATED STEREO AMPLIFIER KIT

• RESPONSE 15-40,000 CPS ± 0.5 DB (at normal listening level) • UNIQUE "BLEND" CONTROL • PREMIUM EL86 OUTPUT TUBES • 50 WATTS MONAURAL—25 WATTS EACH STEREO CHANNEL • CLUTCH-OPERATED VOLUME CONTROL • SEPARATE BASS & TREBLE CONTROLS

A completely new stereo high fidelity amplifier with a high quality of reproduction, remarkable versatility and new distinctive styling. Full range of controls include a unique "blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phasing switches plus outputs for 4, 8 or 16 ohm speakers. Harmonic distortion less than 0.25%, IM distortion less than 0.5%. Hum and Noise 74 db below full output. Assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

KT-250 A WX Stereo Amplifier Kit .... 5.00 Down .... Net **74.50**
LA-250 AWX Stereo Amplifier, wired & tested ... 5.00 Down .... Net **99.50**

KT-600

IN KIT FORM

79.50

LA-600 134.50

COMPLETELY WIRED

PROFESSIONAL STEREO CONTROL CENTER KIT

• RESPONSE 5-40,000 CPS ± 1 DB • UNIQUE STEREO & MONAURAL CONTROL FEATURES • PRECISE "NULL" BALANCING SYSTEM • CONCENTRIC INPUT LEVEL CONTROLS

A truly professional stereo preamplifier and master audio control center—solves every stereo/monaural control problem. Features unique Bridge Conrol for variable cross-channel feed for elimination of exaggerated channel separation effects—plus controlled 3rd channel output. Has all-concentric controls—including clutch-operated Volume Balance control. Provides complete and advanced facilities for accepting, controlling and providing undistorted gain for any and all program sources. Sensitivity 2.2 mv for 1 volt out (low level inputs). Dual low impedance "plate follower" outputs 1500 ohms. Response 5-40,000 cps ± 1 db. Less than .03% IM distortion. Less than .1% harmonic distortion. Hum and noise 80 db below 2 volts (high level inputs). Uses 7 new 7025 low-noise dual triodes. Size: 14" x 4½" x 10⅝". Shpg. wt., 16 lbs. Complete with all parts, tubes, deluxe cabinet and detailed instruction manual.

KT-600 WX Stereo Preamplifier Kit .... 5.00 Down .... Net **79.50**
LA-600 WX Stereo Preamplifier, wired and tested ..... 5.00 Down .... Net **134.50**

NEW!

IN KIT FORM

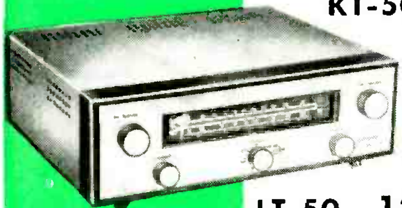
KT-236A 59.50

LAFAYETTE 36-WATT INTEGRATED STEREO AMPLIFIER KIT

• 36-WATTS MONAURALLY—18 WATTS PER CHANNEL • FREQUENCY RESPONSE 15-30,000 CPS ± 1 DB • UNIQUE "BLEND" CONTROL • CONCENTRIC CLUTCH-OPERATED VOLUME CONTROL • DUAL CONCENTRIC BASS AND TREBLE CONTROLS • 4-EL84 TUBES IN PUSH PULL

This exciting new amplifier kit combines dual preamplifiers and dual 18 watt power amplifiers on one compact chassis. Instant selection from monophonic to stereophonic is provided by the turn of a switch. An amazing new "Blend" control gives continuously variable channel separation from full monophonic to full stereo. The concentric clutch-operated volume control offers independent or simultaneous level adjustments of both channels. Dual concentric bass and treble controls furnish 4 independent tonal adjustments. Harmonic distortion less than 0.15% at normal listening level. I.M distortion is less than .3%. Hum and noise 70 db below rated output. Complete with cage, legs and detailed instructions. Shpg. Wt., 24 lbs.

KT-236 AWX Stereo Amplifier Kit .... 5.00 Down .... Net **59.50**



KT-500

IN KIT FORM

74.50

LT-50 124.50

COMPLETELY WIRED

FM-AM STEREO TUNER KIT

• 11 Tubes (4 dual-purpose) + Tuning Eye + Selenium rectifier provide 17 tube performance • Multiplex Output for new Stereo FM • Armstrong Circuit with Dual Limiters and Foster-Seeley Discriminator • Extreme Sensitivity and Wide Frequency Response.

A precision engineered, highly stable tuner—perfect for lifelike stereo FM-AM broadcast reception, FM reception and/or AM reception. Features separate tuning and volume controls for AM and FM. Magic eye on AM and FM, plus automatic frequency control on FM for accurate tuning—stations are "locked" in. Other deluxe features include cathode follower outputs and 5-position Function Selector. Efficient, broadband circuitry on AM with built-in antenna. FM section features include 2 microvolts sensitivity for 30 db quieting, frequency response 20-20,000 cps ± ½ db and full 200 KC bandwidth. Two printed circuit boards make wiring simple—even for such a complex unit. Complete kit includes all parts, deluxe cabinet and detailed instruction manual. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 22 lbs.

KT-500 WX FM-AM Stereo Tuner Kit .... 5.00 Down .... Net **74.50**
LT-50 WX Same as above, wired & tested .... 5.00 Down .... Net **124.50**

KT-310

IN KIT FORM

47.50

LA-310 72.50

COMPLETELY WIRED

STEREO/MONAURAL POWER AMPLIFIER KIT

• 36 WATT STEREO AMPLIFIER—18 WATTS EACH CHANNEL • EMPLOYS 4 PREMIUM-TYPE 7189 TUBES • 2 PRINTED CIRCUIT BOARDS FOR SIMPLIFIED WIRING • FREQUENCY RESPONSE 20-40,000 CPS ± ½ DB AT 18 WATTS • LESS THAN 1% HARMONIC OR IM DISTORTION

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monaural-Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6AN8, 4-7189, GZ-34 rectifier. Size 10-9/16" d x 5¼" h x 13¼" w. Complete kit with cage, all parts, tubes and detailed instruction manual. Shpg. wt., 22 lbs.

KT-310 WX Stereo Power Amplifier Kit .... 2.00 Down .... Net **47.50**
LA-310 WX Stereo Power Amplifier, wired and tested .... 5.00 Down .... Net **72.50**

LAFAYETTE RADIO

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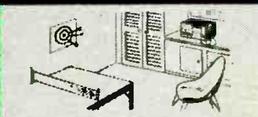
LAFAYETTE

NEW! LAFAYETTE HE-15
CITIZENS BAND 11 METER SUPERHETERODYNE TRANSCEIVER

MADE IN U.S.A.

COMPLETELY WIRED
NOT A KIT!



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Unequaled Performance and Design . . . The Greatest VALUE In The Citizens Band Field!

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- **4 Dual Function Tubes, plus 2 Single Function Tubes, plus 2 Rectifiers for 12 Tube Performance:** Compares with units costing 3 times as much. Unexcelled reception on land and sea with coverage of 20 or more miles depending on antenna height and terrain.
- **Planetary Vernier Tuning:** Controls include 3 position function switch (transmit, receive, plus transmit with spring return) and squelch noise limiter control switch.
- **High Output Crystal Microphone:** 2 position push to talk slide switch; especially designed for sustained transmit operation with a minimum of background noise.
- **Adapts for Use Anywhere:** Modern compact styling. Brackets are supplied for easy mounting of unit in auto, truck or boat. Addition of 6 or 12 volt power supply (separately supplied) adapts transceiver for mobile operation. Only 4½"D x 6"W x 4"H.
- **Anyone Can Operate:** No examination or technical knowledge required — Any citizen 18 years or older is eligible for a license. Simply fill out FCC application supplied with HE-15 Transceiver.

HE-15 Completely wired and factory tested. ..... 5.00 Down . . . Net **59.95**
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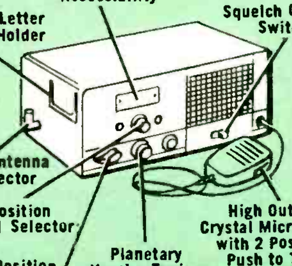
HE-16 Power Supply For 12 Volts .... Net **9.95**
HE-18 Power Supply For 6 Volts .... Net **9.95**

COMPLETELY WIRED
NOT A KIT!

59.95

ONLY 5.00 DOWN



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NEW BOOKS *(Continued from page 134)*

go into characteristics of basic antennas, antenna rotators, on-location tests, tools and equipment, roof-top techniques and safety, unusual installations, servicing the antenna system and other aspects of antennas that affect the service technician.—*LS*

PRINCIPLES AND APPLICATIONS OF RANDOM NOISE THEORY, by Julius S. Bendat. John Wiley & Sons, Inc., 440 Fourth Ave., N. Y. 16, N. Y. 5¾ x 9 in. 431 pp. $11.

Analysis and control of noise are important in radio, radar, automatic control, etc. This book, for advanced seniors and college graduates, treats noise as a continuous phenomenon rather than a series of discrete disturbances. A working knowledge of math, circuit theory and servomechanisms is assumed.

Power spectra, probability, autocorrelation, analog counter technique and zero crossing are among chapter headings. Some of this information appears in book form for the first time.—*IQ*

HOW TO GET THE MOST OUT OF YOUR VOM, by Tom Jaski. (GL No. 85), Gernsback Library, Inc., 154 W. 14 St., New York 11, N. Y. 5½ x 8½ in. 224 pp. $2.90.

The volt-ohm-milliameter is the most common of all test instruments. This book shows how to realize fully its possibilities. It makes it easy to design new ranges, repair and improve one's vom, as well as make measurements other than E, I and R.

The basic meter is described first—pointer balancing, scale changing, etc. This is followed by ohmmeter circuit design, calibration, shunts and multipliers. Both kits and commercial VOM's are discussed.

Other important topics are measurement of L, C, turns ratio; illumination and temperature; how to read db scales; protective devices for the meter. Several unusual VOM instruments are included for the build-it-yourself reader. —*IQ*

HOW TO INSTALL & SERVICE AUTO RADIOS (2nd Edition, Revised), by Jack Darr. John F. Rider Publisher Inc., 116 W. 14 St., N. Y. 11, N. Y. 5½ x 8½ in. 159 pp. $3.25

A detailed account of auto-radio service jobs that the electronic technician has to handle. Written in an authoritive manner, the latest techniques for installing and servicing the latest auto radios are presented. The five major sections of the book are: Installing Auto Radios; Servicing Auto Radios; Transistorized and Hybrid Auto Radios; 6- to 12-volt Conversions; and the Auto Radio Service Shop.

The subject material and the manner of presentation make this book useful to both practicing auto-radio installers and technicians planning to add "Auto Radio Repairs" to the sign in front of their shop.—*LS*

END

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