RADIO-ELECTRONICS

SEPTEMBER 1956

TELEVISION · SERVICING · HIGH FIDELITY

HUGO GERNSBACK, Editor

Service Check List for Transistor Radios

•

Transistorized Hi-Fi Preamp

•

Speech-Music Discriminator for Music Lovers

•

TV Receivers with Remote Controls

•

Set Your Checker for New Tube Types

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Over-the-Horizon Radio P

See p

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YAP... YAP... YAP... BLAH... BLAH... BLAH
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Cathode-Ray Tube Division

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SEPTEMBER 1956, Vol. XXVII, No. 9

RADIO-ELECTRONICS

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Average Paid Circulation over 174,000

EDITORIAL

TELEVISION

TEST INSTRUMENTS

AUDIO—HIGH FIDELITY

RADIO

ELECTRONICS

ON THE COVER

(Story on page 37)

These experimental prototypes of antennas for use in over-the-horizon communications systems are set up at IT&T's Federal Telecommunication Laboratories, Nutley, N. J. Marie Grey, of Federal's drafting department, is studying the construction.

Color original by Dean Price, Handy-Boesser Photographs, Newark, N. J.

NEXT MONTH: Underground Antenna • TV Antenna Adjustments for Eliminating Interference • Long-Tailed Cascode Pair Amplifier • Flea-Power Transistor Transmitter

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RADIO-ELECTRONICS, September, 1956. Vol. XXVII, No. 9. Published monthly at Mt. Morris, Ill., by Gernsback Publications, Inc. Second-class mail privileges authorized at Mt. Morris, Ill.
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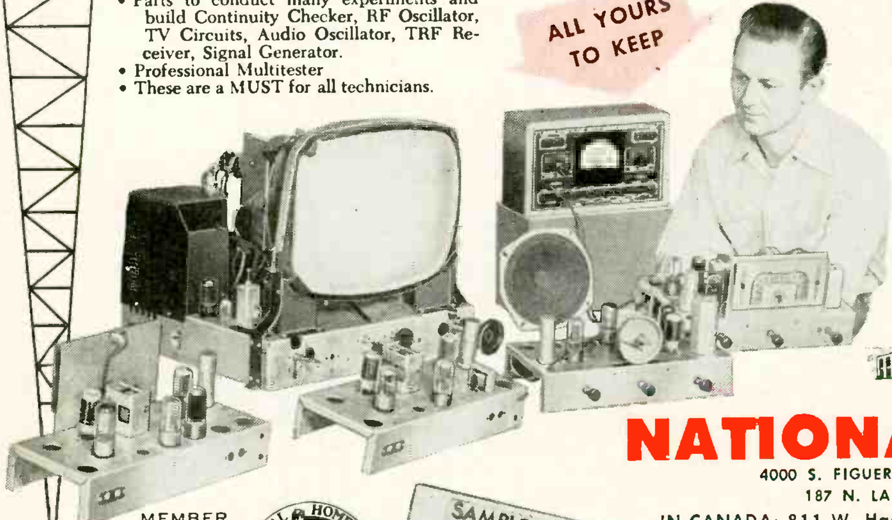

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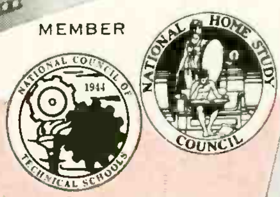

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the Radio month

ALL-UHF TV SYSTEM has been proposed by the FCC. Faced with a difficult problem of allocations, the commission has asked for all comments on the proposal by Oct. 1. A major consideration was the usefulness of the lower part of the vhf band to other services.

The FCC report stated, "If suitable means could be found to overcome the difficulties inherent in so major a frequency reallocation as moving television to uhf and if uhf could be sufficiently developed to permit the elimination of vhf channels without loss of service, a number of basic advantages would result. All stations would be able to compete on a much more nearly comparable basis technically . . . competitive opportunities would be considerable enhanced . . ." The FCC is also entertaining the advisability of limiting the shift to uhf to the eastern part of the United States.

AIR-DEFENSE COMPUTER designed for use in the Semiautomatic Ground Environment (SAGE) system is about to be installed at McGuire Air Force Base in New Jersey. SAGE represents a supersensitive continental air-defense system.

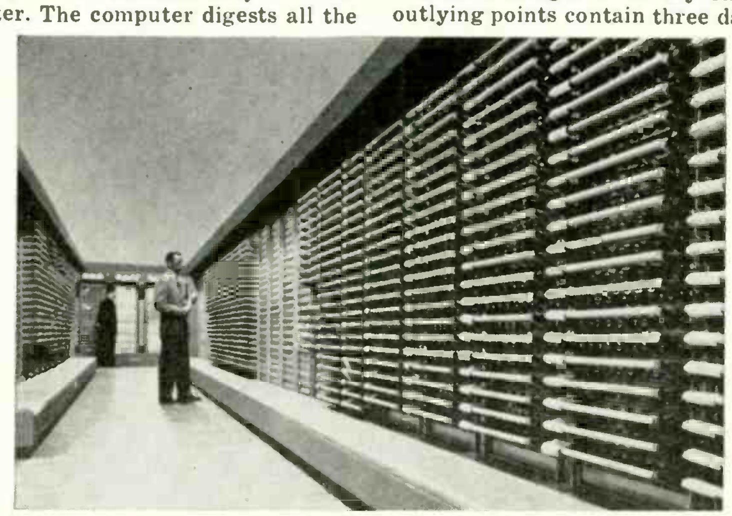
It starts with a radar ring—on land, Navy picket ships at sea, offshore Texas towers and airborne early-warning planes ranging far out over the ocean. These radars are linked by telephone lines or uhf radio directly to the high-speed computer (see photo). Information about aircraft anywhere within the radar area is relayed continuously and automatically to the computer. The computer digests all the information plus ground-observer reports, flight plans of friendly planes and weather information as fast as it is received and translates it into an overall picture of the air situation. Hostile planes can be identified immediately and the most effective defense action taken.

The computer automatically calculates for the operator the most effective application of such defensive weapons as guided missiles, antiaircraft batteries and jet interceptors. In the case of intercepting jets, the aircraft is controlled by directions fed by radio directly from the computer to the automatic pilot in the plane. Missiles are controlled similarly. The computer is designed to operate 24 hours a day, 7 days a week.

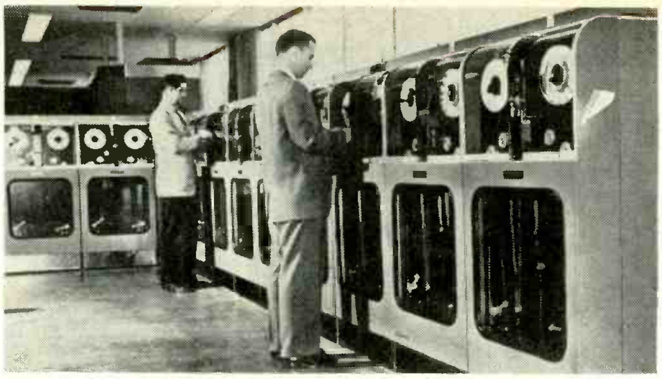
The first computer, built at Kingston, N. Y., by International Business Machines for later shipment to the air force base, covers 3 acres of ground and contains 58,000 tubes.

INDUSTRIAL COMMUNICATIONS made a revolutionary advance with the opening of the Sylvania Data Processing Center at Camillus, N. Y., June 26. An 18,000-mile telegraph network leased from Western Union connects 45 factories, 19 laboratories, 10 division headquarters, the company's corporate executive offices, 27 sales offices and 17 warehouses to the data processing center, which will provide complete accounting and statistical services to all 10 Sylvania operating divisions through seventy-one stations in 61 cities and towns.

Data messages from any one of the outlying points contain three data rout-



A bit of the great computer. White bars are handles of plug-in units holding 6–9 tubes. Panel contains about 2,500 of the instrument's 58,000 tubes.



A small part of the equipment in the new data processing center, which in its entirety contains more than 50,000 square feet of floor space.

ing characters. Thus "DPR" would cause the message to be routed to the payroll section of the data center; "DIC" would send it to inventory control. "D" indicates the message is to go to the data center. The network can be used for administrative messages between any two stations.

Messages arriving at the station are received on perforated tape and are "translated" onto magnetic tape for input to the Univac, 10-ton, 5,600-tube electronic brain of the system. Both punched cards and magnetic tape are used.

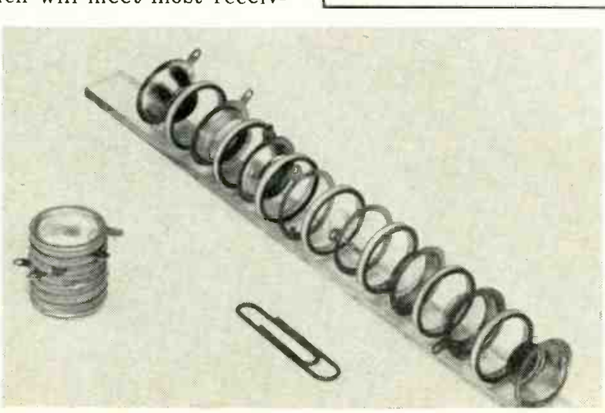
The combination of instant communication plus almost instant computation produces formerly impossible results. A complete payroll, including preparation and signing of checks, can be processed in a couple of hours from information sent in by the scattered stations. All checks will be mailed in bundles to the various outlying points, rather than prepared at each one, resulting in a tremendous saving. Engineers can calculate complex technical problems—each of the 19 laboratories has easy access to the large and expensive computer. Production can be geared exactly to inventory through instantaneous knowledge of the quantity of any product on hand. The Data Processing System is, the company believes, "the only existing concept of an entire company tied together communications-wise from a data processing viewpoint, and with that function housed in its own facility."

CERAMIC RECEIVING TUBES recently developed by Eitel-McCullough (Eimac) are the forerunners of a complete line which will meet most receiving requirements with a minimum number of types. The new design permits them to withstand heavy accelarative forces from shock and vibration, and to operate continuously with envelope temperatures of more than 300°C. Tube life is so long that they will be wired directly into electronic equipment, eliminating the need for tube sockets.

The photo shows an exploded view of one of these tubes—an Eimac 33C3A2 dual triode stacked ceramic unit. Its general specifications are: heater voltage, 6.3; amplification factor, 20; transconductance (at 9-ma plate current), 2,600 micromhos. Maximum plate dissipation per section is 2.75 watts; maximum plate current 20 ma. Tube dimensions are 7/8 inch high, 1-1/32 inches in diameter.

Calendar of Events

23d Annual British Radio Show, Aug. 22–Sept. 1, Earls Court, London, England.
Southern Arizona Hamfest, Sept. 1–3, Fort Huachuca, Ariz.
RETMA Conference on Reliable Electrical Connections, Sept. 11–12, University of Pennsylvania, Philadelphia, Pa.
NATESA Convention, Sept. 14–16, Sheraton Hotel, Chicago, Ill.
11th Annual International Instrument–Automation Conference and Exhibit, Sept. 17–21, New York Coliseum, New York, N. Y.
National Television Week, Sept. 23–29.
New York High Fidelity Show, Sept. 26–30 and **Audio Engineering Society Convention**, Sept. 26–29, New York Trades Show Building, New York, N. Y. (Radio-Electronics will exhibit in Room 523 at the High Fidelity Show.)
Canadian IRE Show and Convention, Oct. 1–3, Automotive Building, Exhibition Park, Toronto, Canada.
National Electronics Conference and Exhibition, Oct. 1–3, Chicago, Ill.
80th Convention of Society of Motion Picture and Television Engineers, Oct. 7–12, Ambassador Hotel, Los Angeles, Calif.
2d Annual IRE Professional Group, Technical Meeting on Electron Devices, Oct. 25–26, Shoreham Hotel, Washington, D. C.



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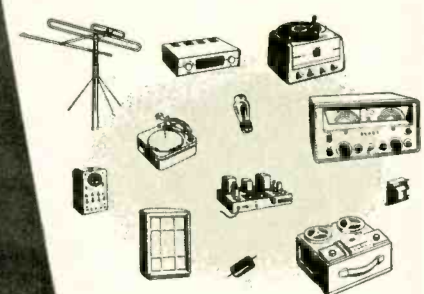

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GERNSBACK SCHOLARSHIP for the academic year 1956-57 has been awarded to Paul Martin Schnitzler. The scholarship was established by Hugo Gernsback for presentation to an outstanding first-year student, through

the department of electrical engineering of New York University.

Paul Schnitzler was born July 20, 1936. He became interested in matters electronic while a member of the Boy Scouts, building a superregenerative receiver. He entered Brooklyn Technical High School in New York in 1950, majoring in mathematics and sciences. Paul began his college career at NYU in February, 1954. He holds general class license K2KOK with his equipment being strictly home-brew.

TWO NEW TV STATIONS have gone on the air since our last report:

WCKT	Miami, Fla.	7
WISC-TV	Madison, Wis.	3

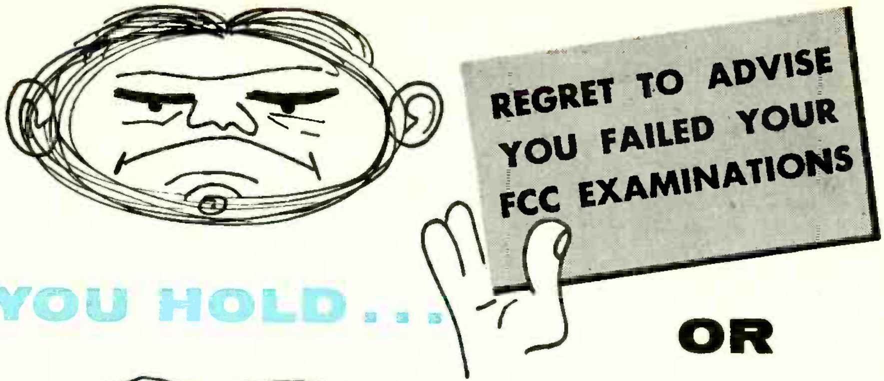
KZTV, Reno, Nev., channel 8, has changed its call letters to KOLO-TV and WBUF-TV, Buffalo, N. Y., channel 17, to WBUF.

Canada now has 35 TV stations. The two latest stations are CFCL-TV, Timmins, Ontario, channel 6, and CFCY-TV, Charlottetown, Prince Edward Island, channel 13.

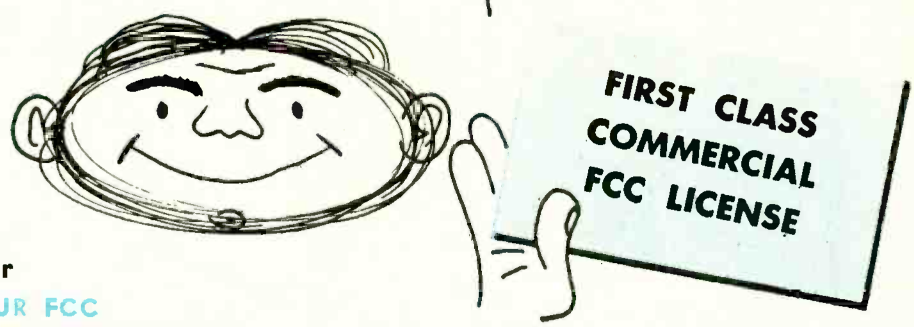
ARMSTRONG'S MEMORY will be perpetuated in a recently established Armstrong Memorial Research Foundation. Formed by his close friends and associates, the expressed purposes of the foundation include aiding in the continuation of basic research that was carried on by Major Armstrong as professor of electrical engineering at the Marcellus Hartley laboratory at Columbia University and to contribute to the education and training of engineers and scientists capable of doing basic applied research in electronics and related fields of science.

Maj. Edwin Howard Armstrong died in February, 1954, after a life devoted to basic research in electronics. Outstanding among his accomplishments were development of the superheterodyne circuit and frequency modulation. The foundation will perpetuate the name and works of Armstrong through grants of money or property to Columbia University and its affiliates, primarily. END

6 months from today



WHICH WILL YOU HOLD . . . OR



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Name and Address	License	Time
Walter Eggers, Pacific Grove	1st	12 weeks
Paul Reichert, West Salem, Ohio	2nd	10 weeks
Harold Phipps, LaPorte, Indiana	1st	28 weeks
John H. Johnson, Boise City, Okla.	2nd	12 weeks
James Faint, Johnstown, Pa.	1st	26 weeks

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Broadcast Station in Illinois: "We are in need of an engineer with a first class phone license, preferably a student of Cleveland Institute of Radio Electronics; 40 hour week plus 8 hours overtime."

West Coast Manufacturer: "We are currently in need of men with electronics training or experience in radar maintenance. We would appreciate your referral of interested persons to us."

Our Trainees Get Jobs Like These Every Month

CHIEF ENGINEER

"Since enrolling with Cleveland Institute I have received my 1st class license, served as a transmitter engineer and am now Chief Engineer of Station WAIN. I also have a Motorola 2-Way Service Station. Thanks to the Institute for making this possible."

Lewis M. Owens, Columbia, Ky.

TEST ENGINEER

"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse). A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."

Boyd Daugherty, Falls Church, Va.

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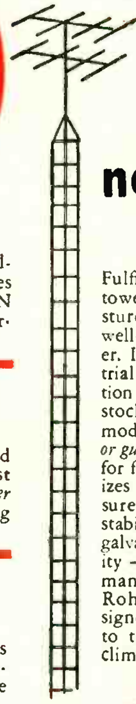

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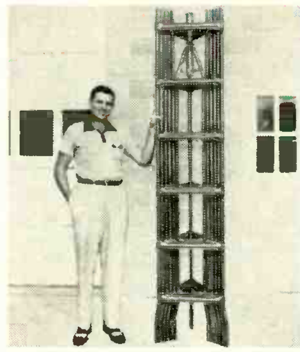

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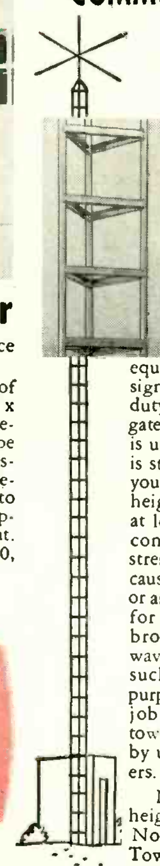

For extreme heights and communication purposes of all kinds, the Rohn No. 40 gives you strength and durability on which you can depend. The time tested and proven equilateral triangle design using extra heavy duty tubing and corrugated steel cross-bracing is utilized. The No. 40 is structurally sound so you can install it for heights up to 300'; or at lesser heights when considerably greater strength is required because of excessive wind or antenna loading. Use for radio telephone, broadcasting, microwave relay and all other such communication purposes. If a particular job calls for this type tower, save real money by using ROHN towers.

Note: For lesser heights, use the Rohn No. 20 or No. 30 Tower.

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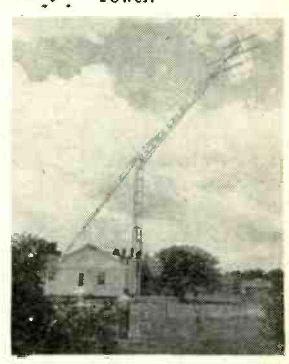

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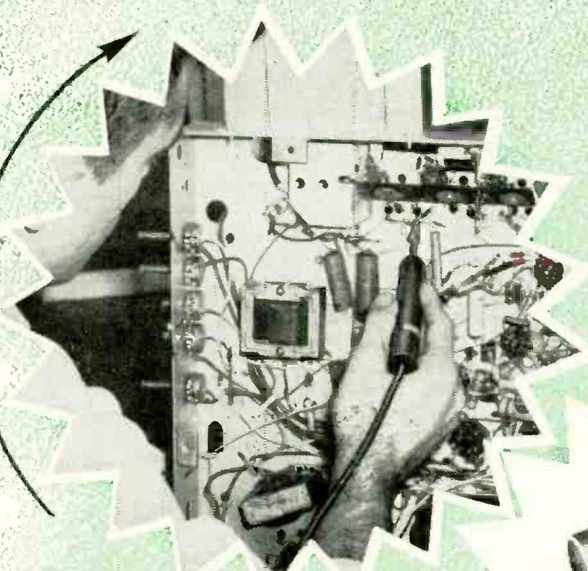

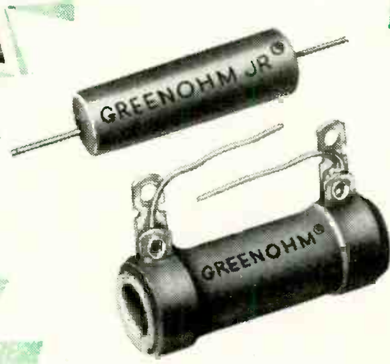

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Correspondence

MORE ON DO-IT-YOURSELF

Dear Editor:

Mayhaps the fact that I live in the wild West has some influence on my thoughts, although my doubts as to this will be better borne out by any other letters you get in dissent with Mr. Margolis' article, "Dealing With Do-It-Yourself" (April, 1956).

Basically this article points out the selfish and egotistical attitude of many service technicians and one that causes them a considerable loss in volume. I have been bitten by the do-it-yourself bug and I think that it is safe to say that we all tinker a bit with plumbing, wiring, our cars, paint, woodworking, ad infinitum. All these other things could be done by a professional. Yet in our desire to do something by ourselves, and save a buck or two in the process, we all dabble at times.

So let us not climb up on a lofty perch and scream that the soul that tinkers with his TV set is akin to a leper or should be dealt with severely. He is usually a normal guy. Let me warn you! Treated wrongly by you, he will eventually benefit a TV service technician, but it won't be you if you were the only one within 100 miles.

The do-it-yourselfer figures he is not as sharp as the TV man but he has a lot of time he could waste for that $5 call. And since he has heard how most of his trouble will be a tube, next time maybe he could handle the job, have fun and save the service call.

Here precisely is the point of perhaps no return for some service technician. Bite him, belittle him, cuss him or what, this adolescent period of the TV owner's formative years is very important. He must learn to have, not only confidence in you, but more important: *trust*. The embryonic set owner has several paths from which to choose at this point and they will mean a difference in money in your till.

Educate him to help with the non-technical problems and he will relieve you of a lot of routine jobs and you will still be in line for that big one coming up. Show him if you can the underside of a set on your bench, show him and demonstrate the easy way he can foul things up so that when in doubt he doesn't experiment. Educate him and win a friend and customer; alienate him and lose all.

ROBERT M. LOHR
Lohr's Lectronic Lab
Bridgeport, Wash.

(Careful consideration of some of
(*Continued on page* 18)

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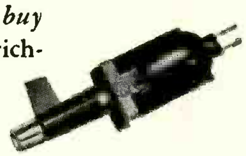

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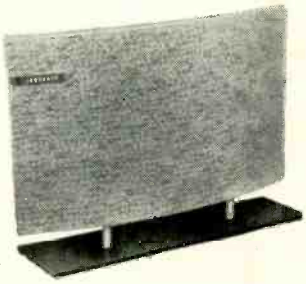

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(*Continued from page 14*)

the points brought up by Mr. Lohr may well repay the service technician for the time involved. But a careful rereading of "Dealing With Do-It-Yourself" indicates that Lohr and Margolis may not be so far apart, after all.—*Editor*)

CLASSIFYING TRANSISTORS

Dear Editor:

I have been recently spending considerable time studying transistors just to familiarize myself with this important new branch of electronics and to be ready when it attains widespread use. I think I now have a good knowledge of the physics and the electronic applications of transistors.

However, what appears to me to be a serious deficiency in this field is the lack of uniformity in classifying transistors as to types. Most companies appear to have their own designation and I have been unable to find a hint suggesting unification. If we consider that we are just at the beginning, there is good reason for concern as to how messed up things can get.

Why don't manufacturers agree on some uniform classification, as they have with tubes. For example, they could evolve a system in which the first letter of a transistor type will indicate whether it is n-p-n or p-n-p. A second letter or number can indicate the transistor's function (af, rf, power, etc.). Additional numbers or letters can indicate important parameters such as cutoff frequency.

The entire situation can easily become even more confused if future developments produce transistors that vary widely in basic design, such as triodes, tetrodes, pentodes and other types. Thus, now is the time to set up a system of classification.

This is just a suggestion and most likely a more elaborate scheme can be laid out. At any rate some consideration should be given to the technician who will soon be called upon to service transistorized circuits and will not have transistors of every make nor an elaborate cross-indexing systems.

SERGIO CLEMENTI
Caracas, Venezuela

A HOBBYIST'S VIEW

Dear Editor:

I read RADIO-ELECTRONICS because radio and television is my hobby. I do some repair work and have no dissatisfied customers. In connection with this I would like to voice my opinion against licensing.

I couldn't afford to pay a big fee for a license. In the little servicing I do I seek only to break even and maintain my hobby. I am sure there are thousands in a situation similar to mine. Personally, I think that if a service technician is afraid he cannot hold his customers he had better try another occupation.

R. BAILEY
Holt, Mich.
END

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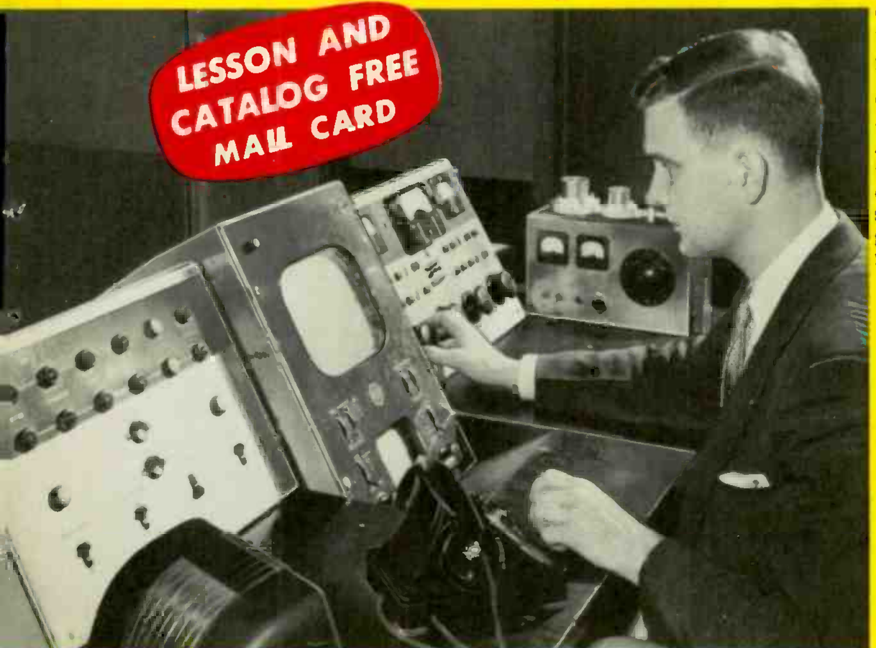

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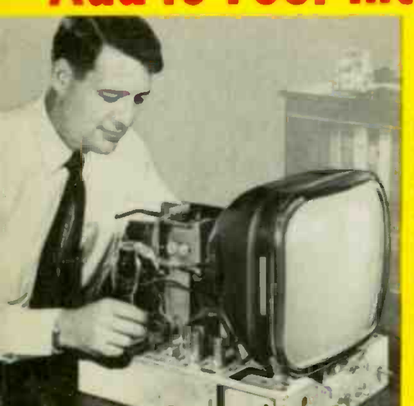

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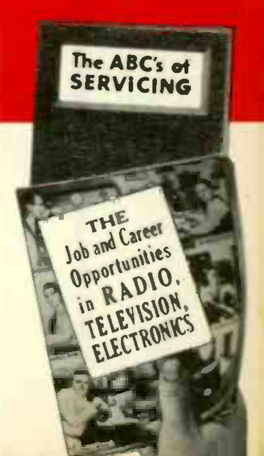

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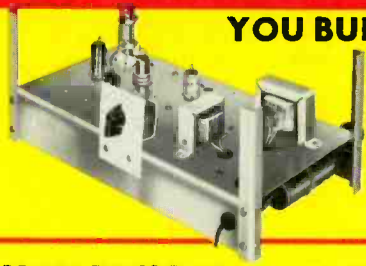

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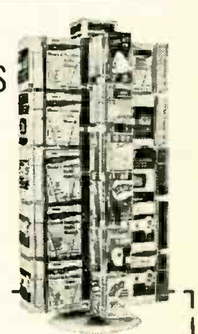

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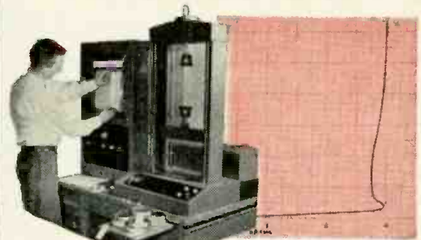
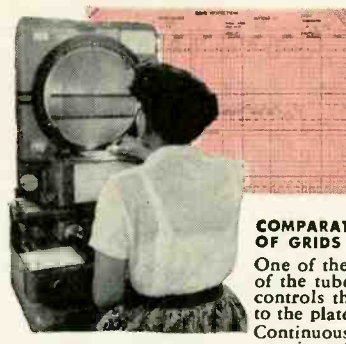


INSTRON WIRE TESTING

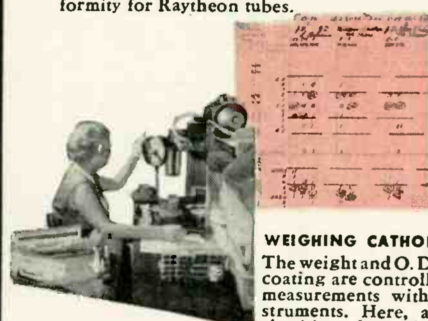
Testing of grid lateral and filament wire on the Instron Tester for specified physical properties as tensile strength, yield point, breaking point and proportional limit insures better tube quality and uniformity for Raytheon tubes.



COMPARATOR INSPECTION OF GRIDS

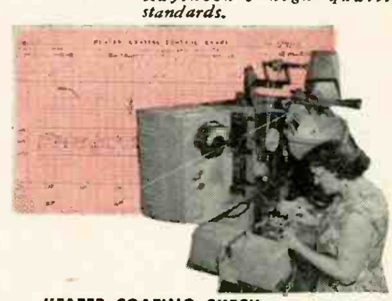
One of the most critical parts of the tube is the grid which controls the flow of electrons to the plate.

Continuous comparator inspection of critical parts such as the above grid (magnified 20x) *supplies information for better quality control and guards against deviations from Raytheon's high quality standards.*



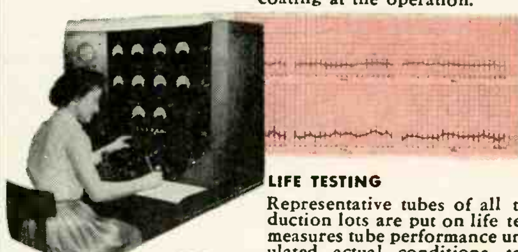
WEIGHING CATHODE COATING

The weight and O. D. of the cathode coating are controlled by periodic measurements with precision instruments. Here, an operator is checking the weight of cathode coating at the operation.



HEATER COATING CHECK

Heater wire must have uniform and closely toleranced coating thickness to insure short and uniform warm-up-time and durability. Raytheon makes continuous inspections of the heater wire coating to make certain of uniformity.



LIFE TESTING

Representative tubes of all tube production lots are put on life test which measures tube performance under simulated actual conditions to ensure original and continuing performance of Raytheon tubes.

ENGINEER CHECKS DESIGN CHARACTERISTICS

Behind all these quality activities stands a large group of experienced, capable engineers whose sole concern is maintaining and developing Raytheon tube quality performance. This engineer is measuring tube design characteristics with the purpose of developing a tube for a customer with special applications.

1ST FINISHED TUBE TEST

All Raytheon tubes undergo a rigid 100% First Test where they must pass strict requirements on both physical and electrical characteristics.

These girls are testing tubes for excessive noise and microphonics, inoperative tubes, specified electrical characteristics and physical appearance.

These and many other vital tests and checks add up to

UNIFORMITY OF CHARACTERISTICS THROUGH RIGID QUALITY CONTROL

RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

Raytheon makes all these: Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

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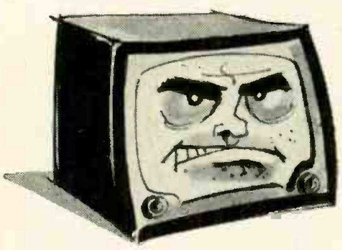

Pick a set that's been giving you plenty of trouble—the tougher the test, the better the proof. Get the make and chassis number of the set . . .

2.

See Your Parts Distributor

Look up the set in the Sams Index to PHOTOFACT Folders. In just 60 seconds you'll find the applicable Folder Set. Buy it—take it back to your shop . . .

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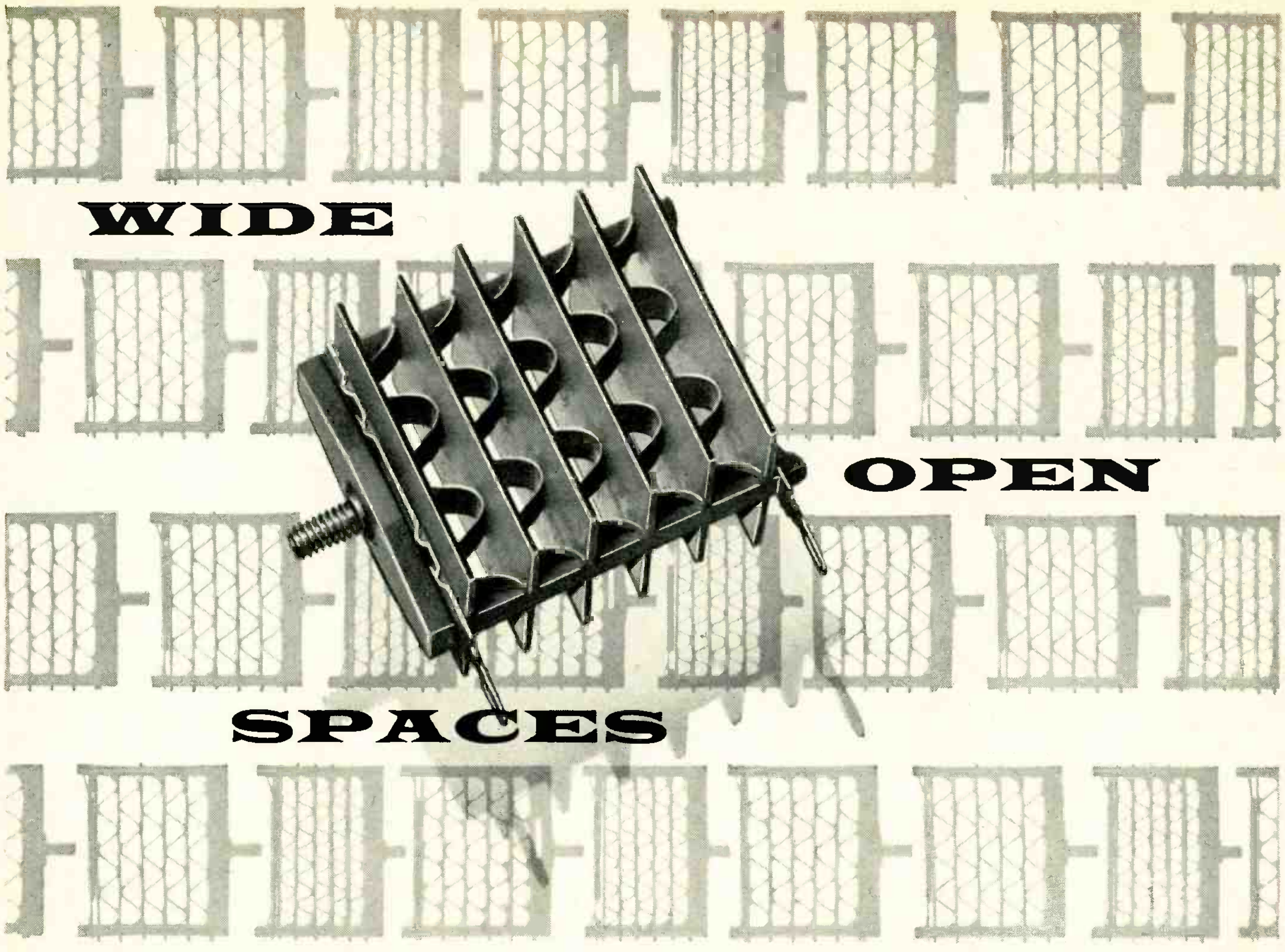
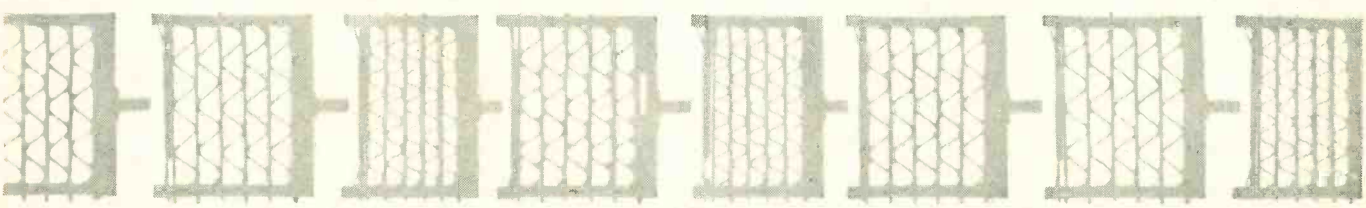


keep operating temperatures down—dependability up!



RCA SELENIUM RECTIFIERS utilize modern design—*full surface ventilation* with no chance of center-core hot-spots. Note the corrugated spring-steel separators which provide positive multiple-area contacts with each plate. This open construction facilitates free-flow of air and efficient cooling of the plates, and minimizes the possibilities of overheated components in compact TV, radio, and phonograph designs.

The one-piece assembly-yoke with the molded mounting stud prevents *twisting* or *squeezing* the stack during installation. Rigid construction minimizes the possibility of "barrier" breakdowns—*gives greater assurance of dependability in operation.*

So, when you need a replacement selenium rectifier, ask your distributor for a dependable, long life RCA SELENIUM RECTIFIER. Available now in 12 types, ratings from 65 Ma to 500 Ma.

RCA®

SELENIUM RECTIFIERS

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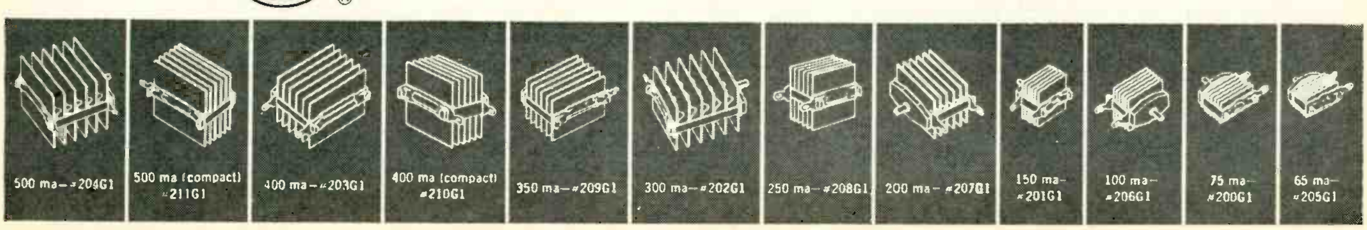

NEW! COLOR and Black-&-White LAB & TV 5" OSCILLOSCOPE #460
KIT $79.95. Wired $129.50

The FINEST professional 5 mc wide-band scope value. Ideal for research, h-f & complex waves, plus Color & Monochrome TV servicing. Flat from DC to 3.58 mc ±1 db (color burst freq.), flat DC to 4.5 mc +1, −3 db. Vert. sens. 25 rms mv/in. Vert. Z 3 megs. Has the following outstanding features not found in scopes up to several times its price, kit or wired:

VERTICAL AMPLIFIER: direct-coupled (DC) thruout to eliminate l-f phase shift; **push-pull thruout** for negligible distortion; **K-follower coupling** between push-pull pentode stages for extended h-f resp. (minimizes h-f phase shift, extends useful resp. to 10 mc); full-screen undistorted vert. defl; 4-step freq-compensated decade step attenuator up to 1000:1. **SWEEP CIRCUIT:** perfectly linear sweeps, 10 cps – 100 kc (ext. cap. for down to 1 cps); **pre-set TV vert. & hor. positions** (30 & 7875 cps); automatic sync. ampl. & limiter eliminates sync amplitude adj. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; anti-glare filter; bezel fits std photo equipt. **OTHER IMPORTANT FEATURES:** High intensity trace CRT. Finest sq. wave resp. (.06 usec rise time). Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in voltage calibration. Intensity mod. Sawtooth & 60 cps outputs. Astigmatism control. Retrace blanking. Instant, drift-free full-screen vert. positioning & 2X full-screen hor. positioning. **Bal., cal., astig. adj. externally accessible.** 5UP1 CRT, 2–6AU8, 2-6CB6, 1-12AU7A, 2-6J6, 1-6AX5, 1-1V2. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. Designed for easy building at home with no special equipment. 13" x 8½" x 16". 30 lbs.

SCOPE DIRECT PROBE* #PD: KIT $2.75. Wired $3.95. Eliminates stray pick-up & signal re-radiation.

SCOPE DEMODULATOR PROBE* #PSD: KIT $3.75. Wired $5.75. Demodulates AM carriers between 150 kc and 250 mc.

SCOPE LOW CAPACITY PROBE* #PLC: KIT $3.75. Wired $5.75. For signal tracing in high frequency, high impedance & wide-band circuits (as in TV) without distortion from overloading or frequency discrimination.

150 kc to 435 mc with ONE generator!

New! RF SIGNAL GENERATOR #324
KIT $26.95. Wired $39.95
for COLOR and Monochrome TV servicing

New wide-range, stable generator — better value then generators selling at 2 or 3 times its cost! Ideal for: IF-RF alignment, signal tracing & trouble-shooting of TV, FM & AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: **150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%;** 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. Colpitts RF osc., directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 volts needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 volts. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. Tubes: 12AU7, 12AV7, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 8" x 10" x 4¾". 10 lbs.

The specs are the proof...

4 NEW BEST BUYS by EICO

for COLOR and Monochrome TV servicing

New! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)
KIT $29.95. Wired $49.95

UNI-PROBE: exclusive with EICO! Terrific time-saver! Only 1 probe performs all functions—a half-turn of probe-tip selects DC or AC-Ohms.

The new leader in professional peak-to-peak VTVMs. Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't-burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. 8½" x 5" x 5". Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 7 lbs.

i Calibration without removing from cabinet.

New! DELUXE PEAK-to-PEAK VTVM #249 with 7½" METER & UNI-PROBE (pat. pend.)
KIT $39.95. Wired $59.95

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VTVM RF PROBES* #PRF-11 or PRF-25: KIT $3.75. Wired $4.95. Accuracy ±10%. Use with any 11 or 25 megohm VTVM.

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*Only EICO Probes have all these features: fully shielded; **rugged terminal board parts mounting;** shock-mounted floating construction; swivel-action; color coding; easy parts accessibility.

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KIT $49.95. Wired $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. Every detail, down to the etched, brushed solid brass control plate, is of the fine quality EICO is famous for.

Rated power output: 20 watts (34 w peak). **IM distortion (60 cps: 6 kc/4:1) at rated power:** 1.3%. **Mid-band harmonic distortion at rated power:** 0.3%. **Maximum harmonic distortion between 20 and 20,000 cps at 1 db under rated power:** approx. 1%. **Power response (20w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Frequency response (¼w):** ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps.

5 feedback equalizations for LP's & 78's including RIAA. Variable turnover feedback tone controls do not affect volume & permit large boosts or cuts at either end of audio spectrum with mid-freqs. unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. 4 hi-level switched inputs: tuner, tv, tape, auxiliary (xtal/ceramic phono or 2nd tuner); 2 low-level inputs for proper loading with all leading magnetic, FM & quality xtal cartridges. Hum bal. control. Extremely fine output transformer has interleaved windings, tight coupling, careful balancing & grain-oriented steel. 8½" x 15" x 10". 24 lbs.

These amazing EICO values are **NOW IN STOCK** at your nearest distributor. Examine them side-by-side with **ANY** competitor. You'll see for yourself why indeed **EICO** is your **BEST BUY**. Fill out coupon on reverse page.

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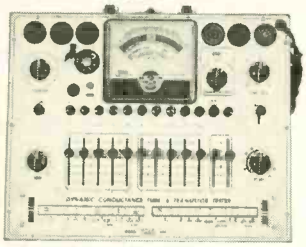
the specs are the test that tells who's best!

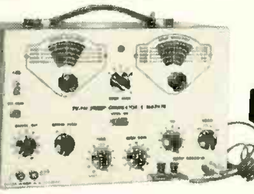


for COLOR & Monochrome TV servicing

NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

Unexcelled testing thoroness & accuracy. **Checks transistor collector current & Beta** using internal dc power supply. **Tests all receiving tubes** including subminiatures (& Color & Monochrome tv pic tubes with accessory adapter). **Composite indication of mutual conductance, plate conductance, & peak emission.** Simultaneous sel. of any 1 of 4 combinations of 3 plate, 3 screen, & 3 ranges of control grid voltage. Grid voltage variable over 3 ranges with 5% accurate pot. **New series-string voltages** for 600, 450 & 300 ma types. 5 ranges meter sens. with 1% precision shunts & 5% accurate pot. 10 SIX-position lever switches for free-point connection of every tube pin or cap. 10 pushbuttons for **rapid** insert of any tube element in leakage circuit & **speedy** sel. of individual tube sections. **Direct reading of inter-element leakage *in ohms.*** New gear-driven rollchart. Steel case with cover & handle. Sensitive 200 *ua* meter.



NEW

for COLOR & Monochrome TV servicing

TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

The FINEST service instrument of this type ever offered in either kit or wired form at ANY price! Outstanding ease & accuracy in FM & TV (including Color) alignment. **Entirely electronic sweep circuit** with accurately biased Increductor: **superb linearity** on both sides of selected center freq. **Newly-designed AGC circuit** automatically adjusts osc. for max. output on each band with min. amplitude variations. Sweep gen. range 3-216 mc in 5 OVERLAPPING FUND. BANDS. Sweep width continuously variable from 0-3 mc lowest max. deviation to 0-30 mc highest max. deviation. **Variable marker gen.** range from 2-75 mc in 3 FUND. BANDS plus a calibrated harmonic band (60-225 mc). Variable marker calibrated with **int. xtal marker gen. 4.5 mc xtal included.** Ext. marker provision. Double pi line filter. **Edge-lit hairlines** eliminate parallax.

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- illuminated roll-chart

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(less batteries)
Professional, all-electronic, sensitive, rugged—at lowest cost! Indicates by neon lamp & headphone clicks.

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150 kc-34 mc, calibrated harmonics to 102 mc. Pure or mod. RF, & Colpitts osc. 400 cps sine outputs.

***NEW!* REDI TESTER #540**
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Wired $15.95
Multi-range ac/dc voltmeter, ammeter, ohmmeter, wattmeter, leakage checker for home & auto repairs.

#944 FLYBACK TRANSFORMER & YOKE TESTER
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- fast check all flybacks & yokes in or out of set.
- spots even 1 shorted turn!

Range 500 kc—228 mc on fund. Cont. sweep width control, 0—30 mc.
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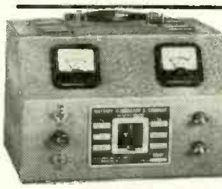
TV/FM SWEEP GENERATOR #360
5MC-4.5MC CRYSTAL .... $3.95 ea.

1% accuracy on all 7 ranges. Range 75 kc—150 mc. Volt reg.
KIT $39.95
Wired $59.95
DELUXE RF SIGNAL GENERATOR #315



Sep. voltmeter & ammeter
KIT $29.95
Wired $38.95
6V & 12V BATTERY ELIMINATOR & CHARGER #1050

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
KIT $24.95
Wired $39.95
DELUXE MULTI-SIGNAL TRACER #147

Reads 0.5 ohms—500 megs, 10 mmfd—5000 mfd power factor.
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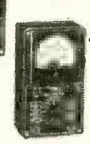
Wired $29.95
R-C BRIDGE & R-C-L COMPARATOR #950B

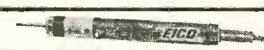
NEW!

HI-FI PREAMPLIFIER #HF-61
KIT $24.95. Wired $37.95. With Power Supply: KIT $29.95. Wired $44.95
Feedback circuitry thruout! Preamp-equalizer, tone controls, scratch & rumble filters, K-follower output.

20,000 Ohms/Volt MULTIMETER #565
KIT $24.95
Wired $29.95



1000 Ohms/Volt MULTIMETER # 536
KIT $12.90
Wired $14.90



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RADIO-ELECTRONICS

Hugo Gernsback, Editor

AIRPLANE COLLISION PREVENTION

. . . *Electronic Collision Control Is Long Overdue* . . .

THE tragic collision and crash of two large airplanes over Grand Canyon, in Arizona, on June 30, with the loss of 128 lives, need never have happened.

For the last few years, many of our pilots time and again have warned our authorities of *near collisions*, which occur more and more frequently, particularly in the vicinity of our airports.

During a single week, airport control towers operated by the Civil Aeronautics Administration guide an estimated 400,000 outgoing and incoming flights. This is likely to grow to around a million within 10 years.

Ground control stations which dot the land theoretically "guide" all planes by radio, keeping pilots informed along the way. The planes also report their position by "fix postings" over specified points along the route. When, however, a plane is flying blind in an overcast, it is "on visual control" and the pilot must look out for other planes—if he can. During violent thunderstorms he is likely to drift from his course and be miles away from the control point which he may think erroneously is directly underneath him. This is exactly what happened on June 30—one of the airplanes being about 25 miles off course.

It is senseless to blame the pilots, who, having their hands full in a violent storm, probably did their best to prevent their buffeted planes from being wrecked. Apparently they could not get them above the clouds, and, as for "visual control," there probably was none or very little visibility—till it was too late. With the two planes approaching each other—most likely at an angle—at 300 miles per hour each, they must have collided at a combined speed of between 400 and 500 miles per hour—much too fast even after they saw each other—to change direction in a few short seconds.

But a plane flies in a three-dimensional medium. Pilots have only a comparatively small angle within which to make visual observations. They cannot look behind them, far sideways or above, or below them at a steep angle in a heavy overcast. Hence the "visual control" is wholly academic and—under certain adverse weather conditions—absurd.

With greatly accelerated air traffic and with jet planes flying at 750 miles an hour in a few years, drastic changes must be made soon to overhaul and modernize our present archaic aviation control.

It is true that the Civil Aeronautics Administration has already under construction an Airways Plan on which $110 million has already been expended. According to a CAA spokesman, the total cost will reach $246 millions for the complete 5-year plan. This plan, according to CAA Administrator Charles J. Lowen, "will give the traffic controller 'radar eyes.' When the plan has been put completely into effect, we will have radar coverage of the entire airspace of the United States at high altitudes."

This would seem to be an excellent plan to keep down collisions, but in our opinion it does not go far enough. Nor can we afford to wait 5 years when we reflect that, since 1950, 65 midair collisions have occurred. Radar control from the ground cannot possibly forestall *all* collisions during thick weather, violent thunderstorms and black overcasts, particularly at night.

Yes, ground radar can warn the planes, but the pilots themselves cannot pinpoint *their own* relative positions in regard to each other. For all practical purposes, the pilots are blind now. Each can move in six directions—east, west, south, north, up, down. Which shall each choose? The distant radar—unless we have radar by triangulation, each connected to a fast radio computer—will prove of little use in such situations.

In our May, 1495, issue, we said, under "Airplane Collisions": "Radar on locomotives will prevent not only head-on collisions, but rear-end collisions with other trains as well. Fog, thick weather and darkness, whether at night or in tunnels, do not interfere with radar. What is true of trains is equally true for airplanes, which no longer will collide with other planes in flight nor run into mountains at great loss of life, as at present."

We foresaw most of today's air complexities as far back as 1951 when, in our May issue, we stated editorially:

"The more planes we operate, the more chances of midair collisions increase. Aerial collisions are by no means a rarity nowadays. They happen right along at great cost of life and property.

"It is physically impossible for a pilot to see simultaneously in six directions: up, down, east, west, north and south. The busy pilot has all he can do to look is one direction, perhaps two at times, but that is all.

"In the not too distant future all planes will be equipped with 'television cameras' in such a manner that screen images from a number of directions will be in front of the pilot at all times. Only the great weight and cost of the equipment make this idea unworkable at present.

"It should be possible in the meanwhile, however, to use a six-way modified—or sweep—radar installation, which need not weigh too much if miniature tubes and other miniature components are used. In this case, too, there would be several miniature screens which pilot or copilot could watch and see if another plane was approaching from any direction. When finally engineered such a device will prevent many collisions. Such radar installations will be particularly advantageous during night flying and while flying in overcast weather when the visibility is extremely poor or nil."

This does not exhaust the subject even remotely, but we do maintain that we have sufficient electronic talent in this country to bring into life an Anti-Airplane Collision Crash Program, now necessary. We cannot wait 5 years for the CAA ground radar, no matter how well it is perfected. By itself it may never prevent all collisions, particularly when jet planes flying at 750 miles per hour move in on each other at 1,500 miles an hour, *25 miles in a single minute*, or over 4 miles in 10 seconds!

From this it would appear that planes soon must be required to carry their own collision alarms, *in addition* to supervision by modern ground radar devices.

We are certain that American ingenuity can devise a reasonably safe collision warning device on board all planes that will be light and noncumbersome.

A comparatively simple instrumentality comes to mind that might be evolved from means in existence now.

Let each plane be equipped with one or more automatic revolving direction finders. Every plane will have a high-frequency transmitter, which emits a special type of signal (or a plurality of signals) assigned only to planes. This signal normally should not carry farther than 100 miles. The receiver is peaked for this special signal only, which can be made to heterodyne with its own signal when another plane moves into its field. As the planes approach each other, the intensity of the received signal rapidly increases in proportion to the diminishing distance between the planes, and the pilot is alerted by visual and aural alarms.

In time it should be possible to evolve an instrumentality whereby the pilot or navigator can read not only the exact distance between two planes in miles, but he will see the vertical or horizontal angle of the approaching plane, too.

By radiophone, both pilots then take the proper steps to change course, thus avoiding collision, no matter what the weather.

If a system such as this, or a similar one is evolved, the nightmare that now continuously frays pilots' nerves and puts thousands of passengers on edge daily, will, we hope, become a bad dream of the past—soon. —*H.G.*

Remote Controls for TV

Popular electromechanical and electronic units for simplified viewing

By HENRY O. MAXWELL

DURING the past 7 years or so manufacturers have sporadically introduced and then discontinued remote controls in some of their TV receivers.[1,2,3] In any one year hardly more than two or three brands had this feature. Now it looks like 1956 will be remote-controlled TV's big year. Almost every major manufacturer offers it in some form.

The control systems may be divided roughly into three basic types: electromechanical, electronic and split-chassis. The electromechanical system has a motor-driven tuner for channel selection and may or may not include remote control of volume, brightness and fine tuning. The electronic type includes those systems that permit controlling the set from a remote point without running wires or cables from the receiver. The split-chassis type has the tuner, and possibly if circuits, on the remote-control chassis along with other controls that may be needed. The electronic and electromechanical types are described in this article. Further electromechanical, and the circuitry and novel features of several split-chassis types will be discussed in subsequent ones.

The Zenith Flash-Matic

This system enables the viewer to control the TV receiver with the beam of light from a small flashlight. Four cadmium-sulfide photocells are mounted behind bezels in the four corners on the front of the TV cabinet. A momentary flash of light on the lower-left photocell turns the power on and off, on the lower-right one mutes the sound. The cells in the upper left and right corners turn the channel selector counterclockwise and clockwise, respectively. Thus, by turning the motor to the left you can flip immediately from channel 2 to 13 or from 5 to 4 without having to switch through all other channels. A large illuminated numeral on the manual channel selector shows the channel in use.

The circuit of the Flash-Matic is shown in Fig. 1. Its functions can be broken down into on–off and motor-control operations.

Cadmium-sulfide photocells are a resistive type in which the resistance varies inversely as the light intensity. In the absence of light the resistance may be as high as 100 megohms; in bright light it may drop to around 25,000 ohms.

The power supply in the control unit supplies 117 volts ac for the plates of the 6BX7-GT motor-control tube, 145 volts ac for the plates of the 2D21 thyratrons controlling the on–off and audio-mute circuits and −25 volts dc bias for the 6BX7-GT and 2D21's.

The basic thyratron control circuit is shown in Fig. 2. The grid of the

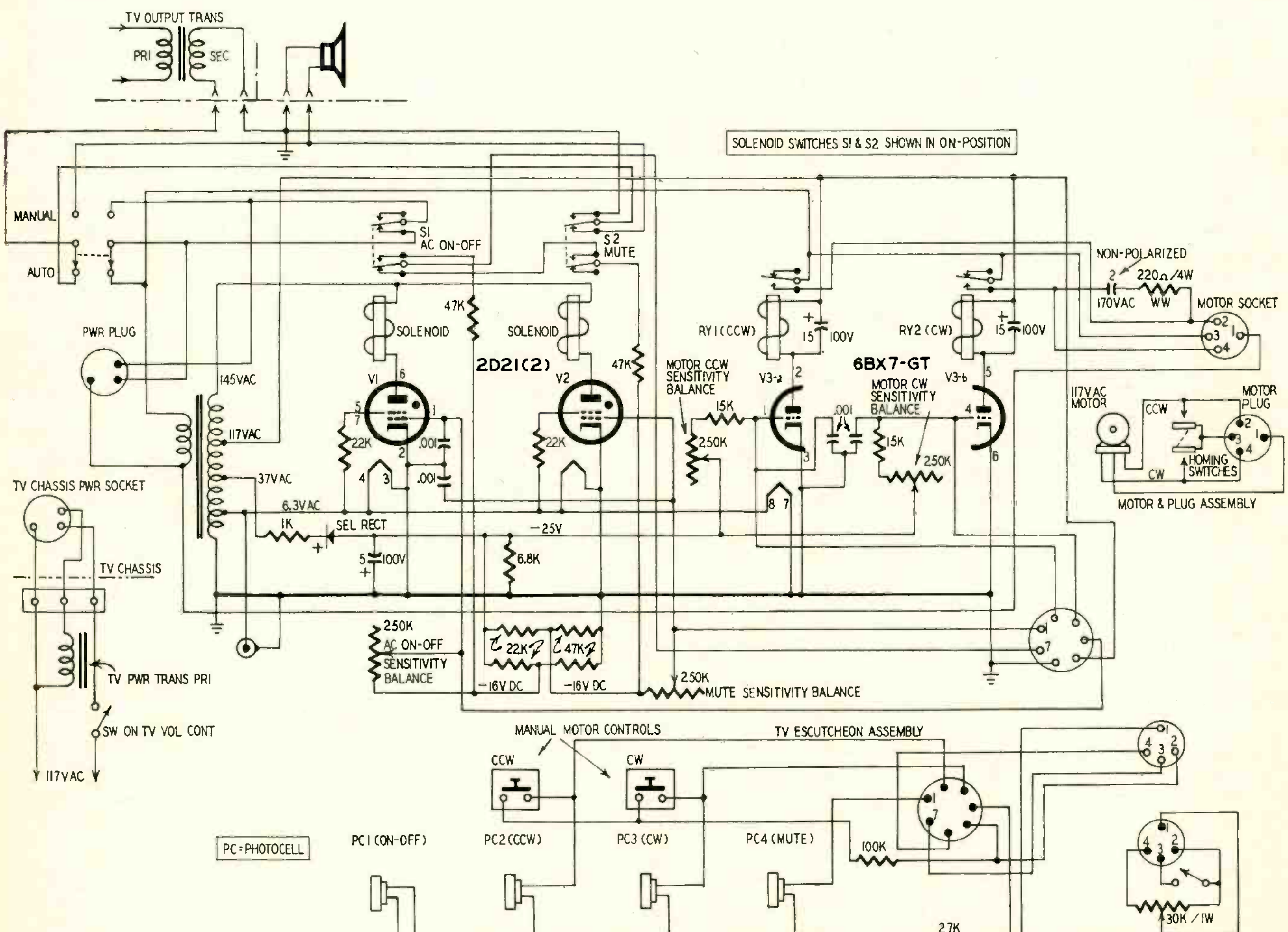

Fig. 1—Schematic diagram of Zenith's Flash-Matic remote tuner. Unit triggered by light falling on four photocells.

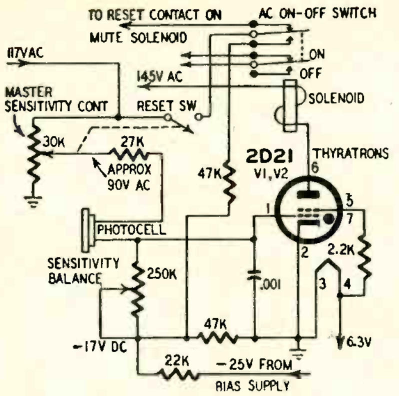

Fig. 2—The thyratron control circuit.

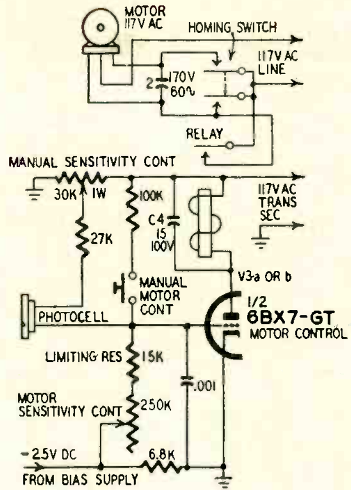

Fig. 3—Zenith motor control circuit.

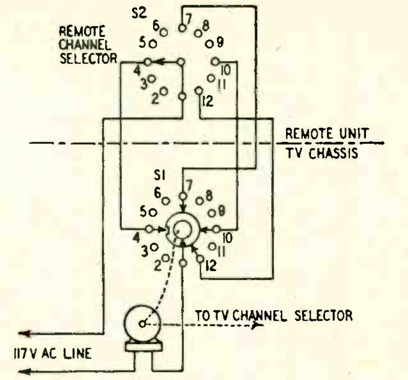

Fig. 4—Basic motor control circuit.

2D21 is biased to cutoff by a negative voltage from the power supply. The plate is supplied with 145 volts ac through the solenoid coil and the grid is supplied with ac through the photocell. The ac voltages on the plate and grid are in phase. The amplitude of the ac voltage on the photocell is determined by the setting of the MANUAL SENSITIVITY CONTROL (Fig. 1) and the ac on the grid is determined by the light on the photocell.

When light of sufficient intensity—as from the flashlight—strikes the cell, its resistance drops and applies a high ac voltage to the 2D21 grid. If the positive peaks of the ac voltage are high enough to override the negative grid bias, the thyratron conducts and the solenoid operates the switch. This switch is a latching type. One operation of the solenoid throws it in one direction and the next operation returns it to its original position. The 2D21 cuts off on the next negative half-cycle of the line voltage after the flashlight is turned off.

When the MANUAL–AUTO switch (Fig. 1) is set to AUTO (for remote control), the switch operated by the solenoid in V2's plate circuit is in series with one side of the speaker voice coil. Similarly, S1, controlled by the solenoid in V1's plate circuit, breaks or makes one side of the ac line to the main power transformer. The second set of contacts on S1 and S2 interlock V1 and V2 so that they fire *only* in sequence.

There is a possibility that the TV set will be turned off manually when S1 is in the OFF position or S2 is set to MUTE. With S1 off, the line voltage does not reach the primary of the TV power transformer and with S2 thrown to MUTE, the speaker circuit is open. To avoid having to use the flashlight to reset S1 and S2, a reset switch is ganged to the MANUAL SENSITIVITY CONTROL so that, when it is turned momentarily to its extreme counterclockwise position, the switch closes and applies a 117-volt ac pulse to the thyratron grids. This pulse overcomes the bias on the 2D21's and returns S1 or S2 to the desired position.

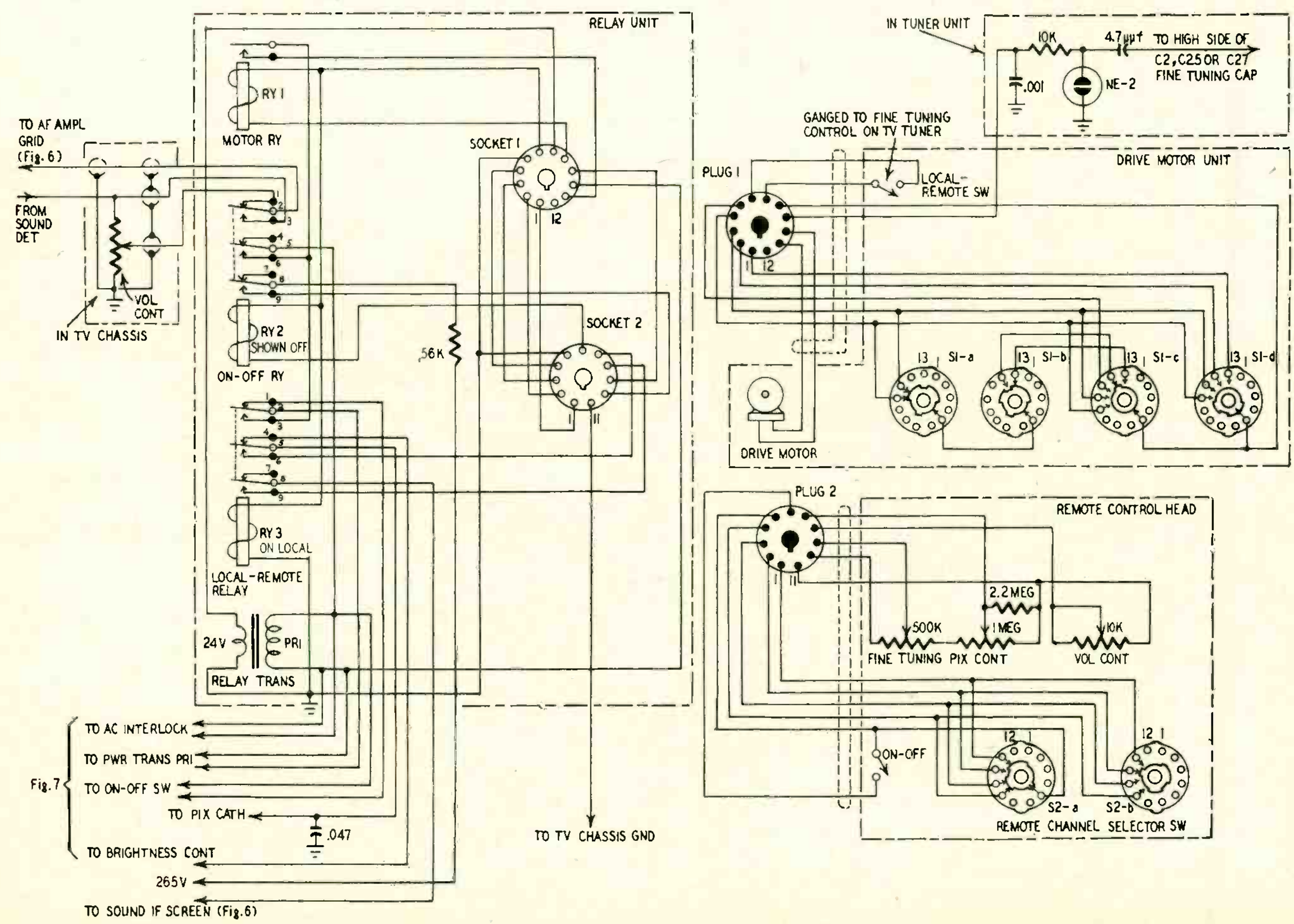

Fig. 5—Schematic diagram of the RCA Magic Brain TV control system. Unit is typical electromechanical control.

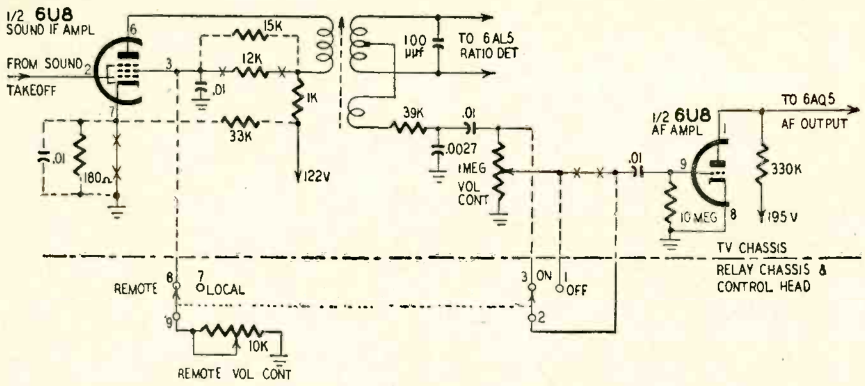

Fig. 6—Schematic of circuit for volume control from the remote panel.

The motor control circuit

A 117-volt induction type ac motor drives the channel-selector shaft of the tuner. Its direction is controlled by V3. The motor has two series-connected windings with one side of the ac line tied to the junction. The ends of the windings are connected to the other side of the ac line through the contacts of RY1 and RY2 in the plate circuits of V3-a and V3-b, respectively.

Fig. 3 is the basic motor control circuit. V3 is biased to cutoff by a voltage supplied through the MOTOR SENSITIVITY CONTROL. When light strikes the photocell, its resistance drops and applies an ac voltage to the grid, causing the tube to conduct on positive half-cycles. The relay pulls in and remains closed as long as the light beam is on the photocell.

Two cam-operated homing or interlock switches insure that the motor always stops with the tuner centered on a channel. One switch is across clockwise relay RY2 contacts, the other across counterclockwise relay RY1 contacts. The homing switches are operated by two index cams that make one revolution per channel. The cams are positioned so both switches are open when the turret is exactly on a channel. Thus, a short pulse of light will start the motor and the homing switch keeps it running until the cam breaks the circuit.

Electromechanical control

Sets with electromechanical control have the control box or head connected to the chassis through a multiconductor cable. Controls on the box permit the viewer to select channels and adjust volume, brightness and fine tuning. Like the Zenith, the tuner's channel selector is driven by a small motor. The circuit is shown in Fig. 4. S1 is the channel selector on the control box and S2 a switch that rotates with the tuner shaft driven by the motor.

When S1 is moved to any new position, the circuit to the motor is completed through the corresponding contact on S2. The motor runs until the wiper on S2 moves around and breaks the circuit. In this basic arrangement, the control cable would have to have 13 conductors for the channel selector alone and additional conductors for the other circuits.

In practice, the number of conductors needed for channel selection is greatly reduced by using a more complex switching system like that shown in Fig. 5 of the RCA Magic Brain TV Control. S1 is a rotary switch ganged to the tuner shaft and S2 the remote channel-selector switch on the control head. These switches are shown in the channel-2 position and the motor circuit is open.

Rotating S2 right or left to another channel completes the circuit to motor relay RY1 and starts the motor. The channel-selector shaft on the tuner rotates to the desired channel, breaking the circuit through S1 and S2 and releasing RY1 and stopping the motor.

Volume control

A simplified circuit showing the method of controlling volume from the remote panel is shown in Fig. 6. The dashed lines indicate wiring and components added to the KCS96 chassis to adapt it for remote control. The dpdt switch is actually made up of parts of RY2 and RY3 (Fig. 5). The switch section labeled ON–OFF is a part of RY2 and the REMOTE–LOCAL section is a part of RY3.

One section of this switch opens the circuit to the arm of the master or local volume control on the TV set and connects the high side directly to the grid of the first af amplifier. The other section connects the remote volume control between ground and the screen grid of the sound if amplifier.

Brightness and fine tuning

In Fig. 7 the contacts of RY3—shown as an spdt switch—transfer the cathode return of the picture tube from the arm of the local brightness control to the arm of a similar control in the remote-control head.

Fig. 8 is a simplified circuit of the vhf oscillator in the tuner and its connection to the remote fine-tuning control. Added components are shown in dashed lines. In this arrangement a 4.7-μμf capacitor and NE-2 neon lamp are in series across the fine-tuning capacitor in the tuner. A positive voltage, tapped off the fine-tuning potentiometer, is applied to the neon lamp through an R-C filter network. The neon lamp acts as a capacitor whose capacitance increases as the current through it. Thus, the oscillator frequency can be controlled within limits by varying the voltage on the lamp.

The lamp may also be considered as a variable resistor in series with the fixed capacitor. When the applied voltage is low, the lamp resistance is high and the 4.7-μμf capacitor has little or no effect on the oscillator frequency. Increasing the voltage decreases the resistance and raises the effective circuit capacitance. Regardless of the method of circuit analysis, the oscillator frequency decreases as the lamp voltage and current increase.

Power on–off circuit

When the receiver is modified for remote control, the 24-volt transformer in the relay unit floats across the ac line. To operate the receiver remotely, the local fine-tuning control is turned clockwise to throw the local–remote switch and apply 24 volts to the coil of RY3. Closing the on–off switch on the control head applies 24 volts to the coil of RY2 to switch the volume-control circuits and complete the circuit to the primary of the power transformer in the TV set.

TO BE CONTINUED

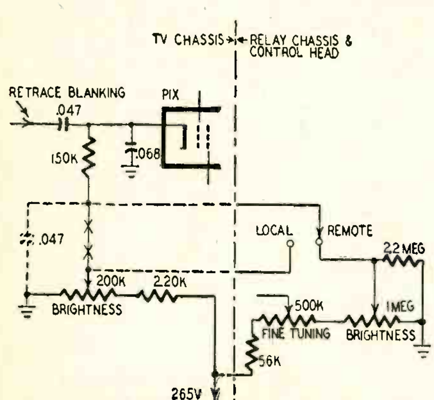

Fig. 7—Remote brightness control.

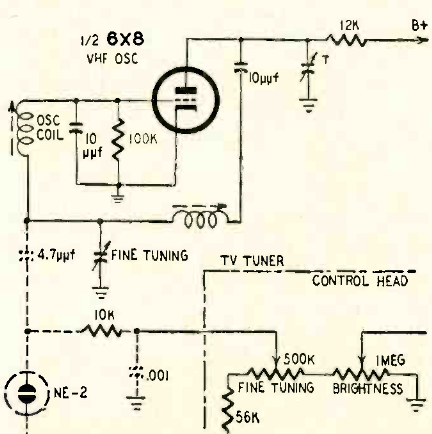

Fig. 8—Control of the vhf oscillator.

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[1] "Extension Viewers and Remote Control for TV," Radio-Electronics, March, 1949.

[2] "Remote Controls for TV Promote Viewer Comfort," Radio-Electronics, November, 1951.

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WWTV
WORLD WIDE TELEVISION

Forward-scatter transmission makes round-the-world relaying entirely feasible

By FRED SHUNAMAN
MANAGING EDITOR

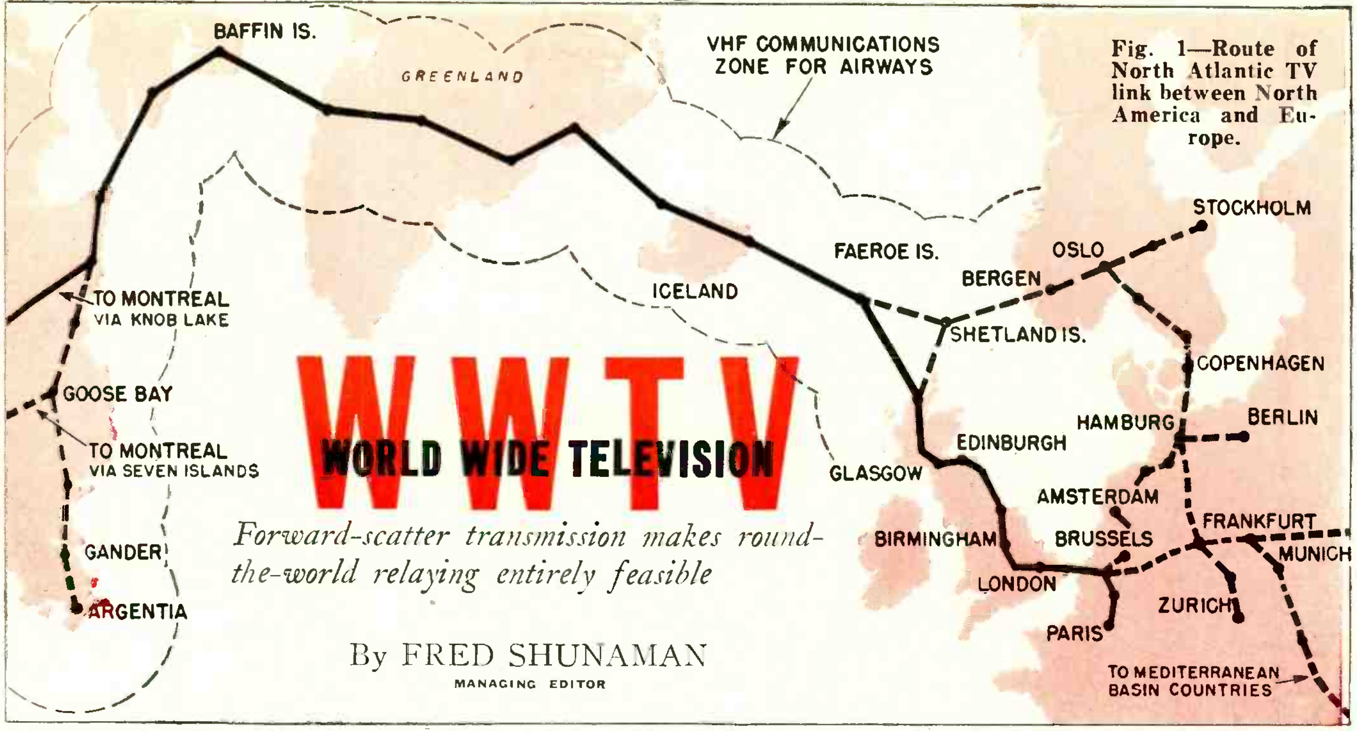


Fig. 1—Route of North Atlantic TV link between North America and Europe.

AROUND-THE-WORLD television network sounds fantastic—at first. Of course, most of us are already sophisticated enough to know that the Atlantic is a big lake only until one decides to travel via Canada, Greenland and over the edge of the world. And the occupation of Attu during World War II jolted us into the knowledge that the Pacific isn't so wide either.

But if these bodies of water don't impose an impassable barrier to TV transmissions, the question "Who will pay for the broadcasts?" does. TV stations must be sustained. More than one American TV broadcaster has had to cease operating—and the failures weren't all in the uhf band!

A TV network's economic problems would be much more serious if it had to pick up its programs on one continent and broadcast on another. True, some important events (such as the Olympic games) might pay commercial sponsors handsomely. Coronations, important diplomatic conferences or historic UN sessions might also justify commercial sponsorship, if the governments concerned did not care to broadcast them. The Voice of America could no doubt use the network for some broadcasts and some governments would probably want to sponsor regular programs. But the sum total could not add up to a self-sustaining system. Here—one would think—is the impassable barrier.

Economic aspect

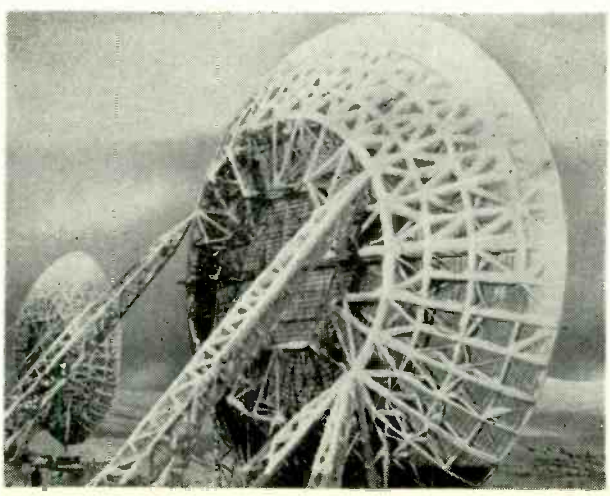
The plain fact is that television wouldn't have to pay for the system—any more than it pays for our transcontinental "television" microwave relay routes. These are broad-band circuits paid for and occupied mainly by telegraph and telephone services, with TV occupying only a portion of the band part of the time.

A transworld relay system would also serve for general communications as well as TV and would thereby fill a genuine need. A single broad-band trans-Atlantic service would in fact be able to carry more traffic than the present cable and radio routes combined.

Engineering problem

Then what of that other difficulty—spanning the oceans between us and Europe on the one side and Asia on the other? The greatest single water gap—as Fig. 1 indicates—is the 290-mile jump between Iceland and the Faeroe Islands. Two other gaps—from Baffin Land to Greenland and from Greenland to Iceland—can be bridged with 275-mile jumps, and all other distances between practical station sites are shorter. The problem, then, is to maintain reliable communication over a maximum distance of 290 miles.

Conditioned by our own experience with TV broadcast reception we may think of 290 miles as almost as bad as the whole Pacific, as far as sending and receiving TV is concerned. But we have recently been hearing more and more about *beyond-the-horizon* transmissions. The August, 1955, issue of RADIO-ELECTRONICS gave a detailed



60-foot-diameter parabolic antenna used for scatter communications in our northern defense perimeter.

Courtesy Spencer-Kennedy Labs.

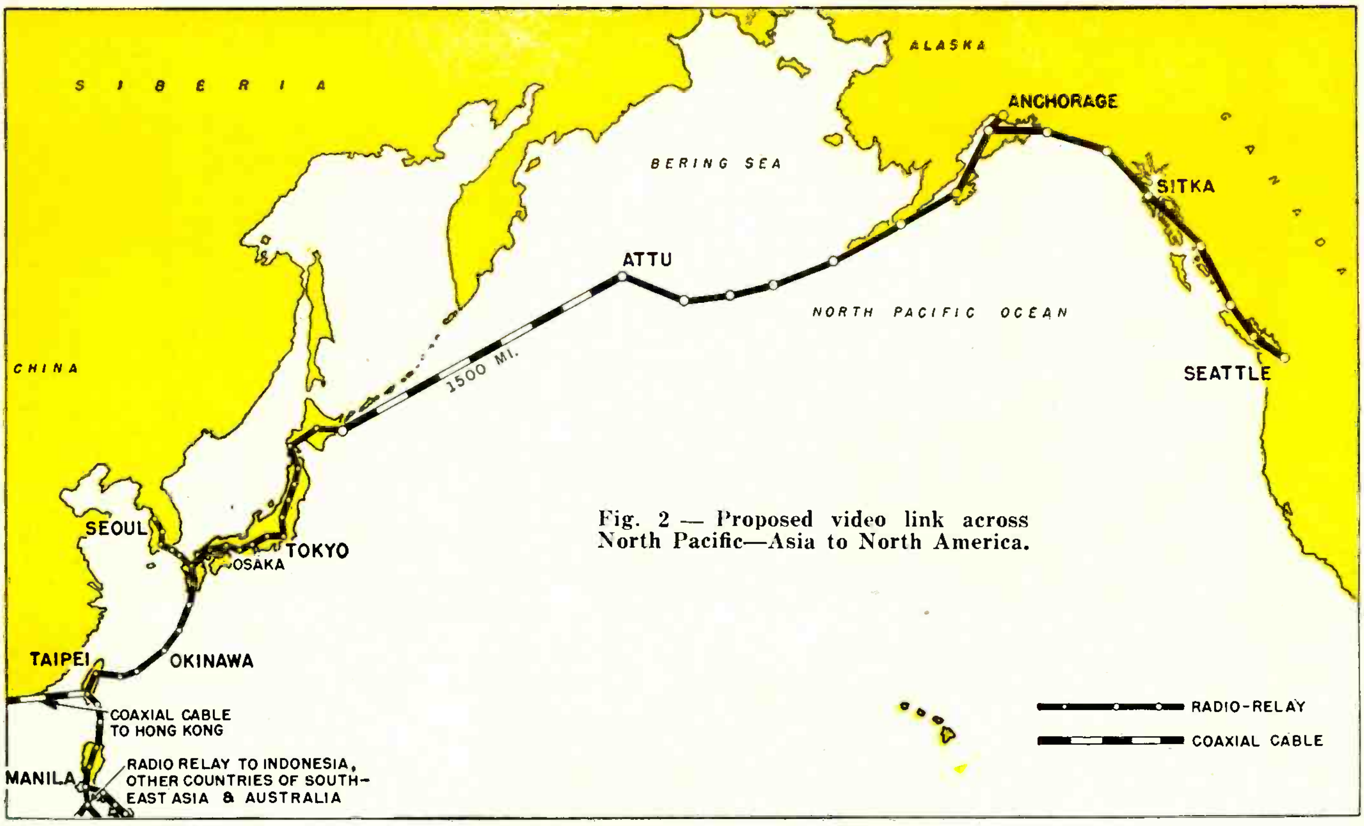


Fig. 2 — Proposed video link across North Pacific—Asia to North America.

account of experiments in which signals from the Bell experimental transmitter at Holmdel, N. J., were picked up regularly at MIT's research station at Round Hill, Mass. Experiments made in Newfoundland for a period of 5 months in 1954 *(Bell Labs Record*, February, 1956) proved that reliable communication can be maintained over a path of 290 miles (from St. Anthony to Harbour Main).

Just such long-distance communication has actually been working in commercial service for several years, though little may have been known of the underlying theory when it was first installed. The French *Compagnie Générale de TSF* has been operating a broad-band transhorizon radio link between Grasse, on the French mainland, and Calenzana in Corsica, since 1947. Frequencies are in the order of 100 mc and the distance is 127 miles. The antenna at Grasse is 1,900 feet above sea level and at Calenzana 1,050 feet.

A still longer jump is that between Mt. Cavo, near Rome, Italy, and Mt. Serpeddi, Sardinia, operated by the same company. A 48-channel telephone service is operated over a 242-mile range, with antennas approximately 3,200 feet high at both ends.

Both these systems are low-power. The French transmitters are rated at 100 watts and operate with 10-db gain antennas, and the Italian system uses 500-watt transmitters and 20-db-gain antennas. These distances could be increased enormously with the power—measured in thousands of kilowatts—used in recent American experiments.

Indeed, a number of spans are now being covered with moderate power. The antennas on our cover are prototypes of those to be used in the Puerto Rico–Dominica system now under construction by the International Telephone & Telegraph Corp. These antennas, mounted on the roof of the Federal Telecommunication Laboratories, a division of IT&T, Nutley, N. J., have been in regular communication with Southampton, Long Island, N. Y., for the last year and a half. Distance is 91 miles; power 500 watts.

IT&T intends to use the same power for the Dorado, Puerto Rico, to Ciudad Trujillo, Dominica, link, as well as for a 240-mile span between Sardinia and the Spanish island of Minorca. Both these systems are relatively narrow-band (6 voice channels) and the Sardinia–Minorca link will use 60-foot dishes. On the other hand IT&T is using 10 kw on a system that will carry 1 TV and 120 voice channels between Florida and Cuba.

Broad-band tropospheric radio is also being used in our northern defense network—the famous DEW line. Detailed information on the number of stations and path lengths is, of course, not available, but it is understood that distances of at least 175 miles are being spanned.

Engineers have no doubt that bridging the longest gap in a world-wide communications service is simply a matter of power plus right antennas.

Beyond the horizon

What is this method of transmission that makes such distances possible? It is based on three fundamentals: recognition that a method of transmission not covered by traditional theory does exist; very high power; directional high-gain antennas.

That such a method of transmission exists has been known for some time. Shortly after the Grasse–Calanzana circuit opened, the *Annales d'Electricité* printed a report showing the fantastic spread between the calculated and actual signal strength—a spread of thousands of times. In 1950, a paper by Booker and Gordon in the *Proceedings of the IRE* announced that it was possible to communicate over greater distances with vhf and uhf than had formerly been believed possible. The paper further suggested that waves may have been reflected or scattered by discontinuities or turbulence in the troposphere or ionosphere.

The effect has been compared to that of a searchlight projecting its beams through foggy, dusty or smoky air. It is possible to see the area illuminated by the beam at distances far over the horizon, due to reflections from airborne particles, though the source itself may be well below the line of sight.

This "scatter" theory falls short in explaining a number of points and for some time other theories were sought. Recently, however, two Bureau of Standards bulletins have supported the turbulence idea very strongly, not even mentioning other possible hypotheses.

Incidentally, there are two types of beyond-the-horizon transmission—the tropospheric scatter we have been discussing, and an ionospheric type that operates best at distances of more than 600 miles. Because of multipath reflections, the ionospheric type is of greatest value for narrow-band transmissions and apparently is not applicable to broad-band systems.

All agree on two necessary factors

Compagnie Générale de TSF microwave installation at Calenza in Corsica.

The microwave installation at Grasse on French mainland.

for beyond-the-horizon transmission—high power and directive antennas. The antenna on our August, 1955, cover was able to pack its 10-kw signals into a beam only 0.25° wide at 4,000 mc and broadening out to only 2.5° at 400 mc. Such quantities of power (or even greater ones) and such antennas are the solution to the engineering aspect of world-wide television.

Practical approach

Unlike many "global" projects, world-wide television is a thoroughly practical proposition. It does not depend on some stupendous combination of finance and engineering which would lay down a global system all in one piece. It can operate in pay-as-you-go stages, first from America to Europe, then to near Asia and so on to its point of origin.

Chief proponent of world-wide TV is William S. Halstead of Unitel, Inc. An old-time communications engineer, he has in the past not hesitated to depart from the more hidebound methods for a reliable communication system (See "Communication by Induction," RADIO-CRAFT, January, 1945).

Mr. Halstead has worked out a method for a feasible and practical system of communication around the world. The route would follow the course of Fig. 1 from North America to Europe, would branch off to the south and go eastward along the Mediterranean, through Turkey, the Near East, India, Pakistan and Indonesia to the Philippines, thence north through the Japanese archipelago and on to the Aleutians by coaxial cable (Fig. 2). The connection between Asia and North America can then be made with even shorter jumps than along the Iceland–Faeroe Islands route from North America to Europe.

The plan was proposed some years ago, but has gained in interest greatly within the past year because of our increasing knowledge of beyond-the-horizon transmission, its reliability and its possibilities. Development of area networks which could form portions of the world-wide system has also helped demonstrate the idea's feasibility. Notable among these are the Mediterranean net, of which the French and Italian stations already mentioned form a part, and a Japanese system, in the design and installation of which Halstead played a prominent part.

We will not be at all surprised to see instantaneous TV from Europe within the next 4 or 5 years. And—since partial success breeds greater success—it may not be many more years before our screens show a presidential inauguration in Manila or a person-to-person visit to the home of the Emperor of Japan. END

The writer wishes to express his appreciation for the assistance given him by William Halstead of Unitel, Arnold Goldburger of Intercontinental Electronics Corp. (U. S. associate of the *Compagnie Générale de TSF)*, Ed. Felesina of Federal Telecommunication Laboratories and C. W. Creaser of D. S. Kennedy & Co.

Did You Ever? . . .

By H. A. HIGHSTONE

• • • GET confused over which tubes belonged to the customer and which were yours, after solving a case of TV trouble by mass tube substitution? A 15c bottle of nail polish will help end such snafus. Use it to color sealoff tips of seven- and nine-pin miniatures. In the case of octals, color the bottom of the key.

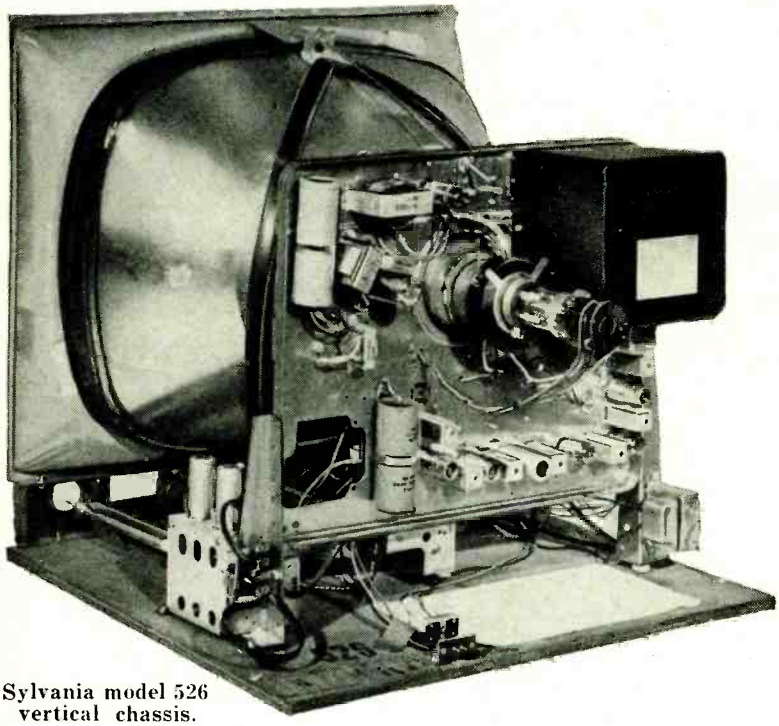
. . . groan when some thrifty customer confronted you with a shopping bag filled with small tubes to be tested? Next time, after inserting a tube in its test socket, briefly jump the heater voltage to the next higher setting on the tester. With only a little practice you can check tubes about as fast as they can be popped in and out of the tester.

. . . get beaten on a poor-sound complaint? I nearly did a while back. A last-ditch hunch saved me when I investigated the speaker itself. Everything was OK after removing half a teaspoon of iron filings lodged between the voice coil and magnet polepiece. (If it's a direct-coupled amplifier you're fighting, a variation as small as 0.75 volt in the first-audio cathode voltage can be the difference between crisp, clean sound and an effect reminiscent of a loudspeaker filled with mush.)

. . . forget to discharge a picture tube and get a sharp bite while rassling it around, removing it from a chassis? Then visualize yourself getting such a bite while the tube is suspended in midair, and dropping it. I used to forget and get bitten at intervals, but never after setting up my foolproof double-check system, like this: Discharge tube. Tape triple thickness of cardboard over second-anode connection, using Scotch Brand Tape No. 33 (10-kv insulation). I probably still occasionally forget to discharge tubes, but it doesn't matter any more. Might have already saved me the price of a glass eye.

. . . give up on a case of vertical jitter? Before you do, give the gain (contrast) control a short snort of standard cleaner–lubricant first. That's all a Mercury chassis recently required, although I got stuck for a callback in discovering the cure. The control was glazed; extremely loud bursts of sound from the speaker jarred it open momentarily, causing jitter which sometimes went to the point of frame-jumping. It never showed up in the shop where speakers ordinarily run in low gear, but in customer's home only, intermittently.

. . . blister your thumb and/or forefinger pulling some superheated rectifier or short-circuited small tube? Buy a few 10c hotpads next time you're in a dime store. Not even a slight scorch around here since thinking up this uncomplicated trick. END



Sylvania model 526 vertical chassis.

New circuit permits transformerless design

Heater–Cathode Stress in FULL-WAVE DOUBLERS

By GEORGE C. CHERNISH*

EVER wonder why transformerless power supplies rarely use the once popular (and much-to-be-desired) full-wave doubler circuit? I say "rarely" because now and then an equipment manufacturer will take a chance on it—usually to his subsequent sorrow. True, some trade literature still displays the full-wave doubler along with series heaters. But today no tube manufacturer will honor a warranty when such a circuit is used.

Fig. 1 shows a conventional full-wave voltage doubler as used until a few years ago. It can be seen that point A rides at a positive potential of 150 volts with respect to chassis ground. Since one end of the heater string connects to point A and since all cathodes are effectively tied to the chassis, a sizable heater–cathode strain will appear along the entire string.

Because this dc potential on the heaters is a static thing, unflowing, there can be no voltage drop. Consequently, 150 volts will appear across the heater and cathode of every tube. The stress or strain will not diminish as you go down the series string.

This force, incidentally, is in addition to that exerted because of the ac potential which also appears across the cathodes and their respective heaters. The ac strain, however, does diminish as you go down the string since ac flows through the heaters.

Thumb through any tube manual now and observe the bad news. Most tubes are rated at only 90 to 100 volts, heater positive with respect to cathode. And that, precisely, is what killed the full-wave doubler circuit for use in transformerless power supplies.

It took some time for tube engineers to catch up with this one. Sylvania was one of the first to recognize the necessity for placing the present ratings on heater–cathode stress. However, shortly after these became standard in the tube industry, abnormal failures ceased.

Then the trend back to half-wave doublers began with, of necessity, larger filter chokes and electrolytics. Some manufacturers even returned to the transformer type chassis rather than contend with the lower ripple frequency of the half-wave doubler.

In Canada, where 25-cycle power is found in large sections of Ontario, the bad news hit hard. A ripple frequency that low is murder to filter out. With the now-condemned full-wave doubler, the resultant 50-cycle ripple had been difficult enough to smooth. It meant a switch to "brute" filtering—or the transformer type chassis.

When management abruptly announced that we were about to enter the Canadian television market, this problem of heater–cathode strain became a pressing one. Among our various chassis requirements was a 25-cycle vertical model (see photo) employing a doubler circuit and series heaters. True, we could have used an isolation transformer to block the dc from the heater string, but that would have lifted the chassis out of the "transformerless" classification—not to mention the fact that there was no room to mount a big 25-cycle transformer on the little chassis. Unless it were well shielded and kept an appreciable distance from the picture tube, its 25-

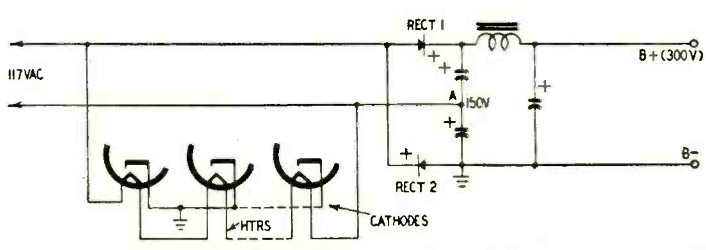


Fig 1—A full-wave voltage doubler.

* Senior liaison engineer, television design, Sylvania Electric Products.

cycle magnetic field would play havoc with the beam.

It appeared, therefore, that we were forced to turn to the half-wave doubler and brute filter. Using such a circuit, it soon became obvious that to obtain a high-quality picture, very large filter chokes would be required for 25-cycle operation. Even so, there was also the problem of wobbly interlace caused by the proximity of heater wiring to the neck of the picture tube—passing as it did through a hole in the chassis.

Fig. 2 shows a circuit developed by the author to overcome this problem of heater–cathode stress in full-wave doublers. Born of sheer necessity, it has been used for some time in the vertical chassis manufactured by Sylvania in Canada. It makes possible, for the first time, a high level of picture quality in 25-cycle television receivers employing series heaters. Here at home, it also imparts a higher degree of quality to those sets using a series string.

During that half of the input cycle when X is positive with respect to Y current will flow through the selenium rectifier RECT 3 charging capacitor C1. One end of the heater string, point B, will assume a polarity which opposes the 150 volts at A. The net positive potential (with respect to chassis ground) depends on the value of C1, and can be made very small. In the Canadian design, point B measured +9 volts.

During the next half of the input cycle, while X is negative with respect to Y, RECT 3 does not conduct, thereby effectively blocking the 150 volts at A. However, X also carries this static dc potential developed at A, for somewhere, either on a pole outside or in a near-by substation, there is a distribution transformer winding linking X and Y. Were it not for dropping resistor R1, we would be back where we started on this problem of heater–cathode stress.

Resistor R1 performs two functions. First, it serves in its conventional role as a current-limiting resistor to protect the heater string. Second, it reduces the injurious static potential developed at A which now must flow, because of this special circuit, and dissipate itself to some harmless level through extraneous circuitry linking X and Y. The value of R1 will depend, therefore, not only on the amount of current limiting required, but also on the desired reduction of the injurious potential at C.

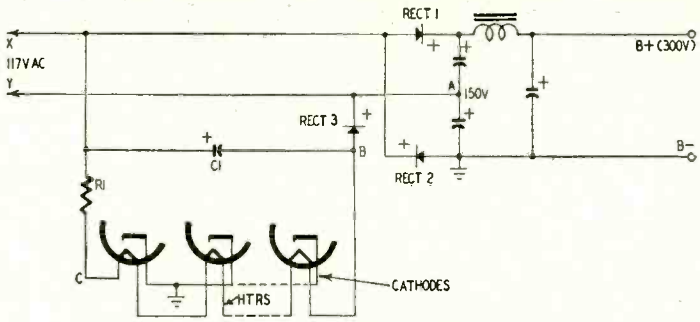


Fig. 2—Circuit developed by author.

Capacitor C1 also plays a dual role. In addition to providing a constant opposition voltage at B, it acts as a dc filter for the pulsating current supplying the series string. Its value depends on the total voltage required by the heaters and the level to which it is required to reduce the damaging potential at B.

As for RECT 3, conventional radio–television stacks may be used. There is nothing special or off-standard about any of the components. RECT 1 and RECT 2 are the same as in Fig. 1. In both cases, these may be vacuum tubes.

Two other important advantages are gained with this circuit: heater-induced hum is drastically minimized; in television receivers whose supply frequency is less than 100% stable, where heater wiring runs near the picture tube—as in vertical chassis—there is far less likelihood of trouble from asynchronous operation.

Anyone owning a transformerless radio or television set manufactured prior to the clampdown on heater–cathode ratings may greatly prolong tube life with this protective circuit. The first step would be to verify that the full-wave doubler is used therein. Then, a rectifier one size larger than normal heater current calls for should be selected for RECT 1. For example, if the series string draws 300 ma, choose the 350-ma size. This is to allow for possible increase in line voltage from time to time.

Next, determine the value of electrolytic capacitor required for C1. After the rectifier has been wired in, start with 40 μf, shunting with other capacitors until rated current flows through the string at normal line voltage. Then a single unit may be selected and installed permanently.

If no dropping resistor is presently used in the series string, one must be inserted. However, when the first tube in the string is, say, a 25Z5, which has a high heater-to-cathode rating, R1 may not be necessary. The trick in any event is to make sure there is enough resistance between the first tube of low heater–cathode rating (less than 150 volts) and the line at X, so that R1 will function as explained earlier. The greater the resistance required, the larger the value of C1.

Measure heater-to-cathode voltage on a vtvm. The reading will be an approximation only, particularly in TV receivers where pulses on the cathode of the damper tube influence polarity at its end of the heater string. However, unless checking a new design in the lab, more elaborate equipment and test procedures are not needed for checking.

Circuits have a peculiar way of growing on us. Sometimes, while designing a conventional series string, we run out of line voltage. Perhaps we would like to use five 25-volt tubes. Or maybe a proposed tube complement in a TV chassis requires more than 117 volts for its heaters. In either case, we have, as it were, too much voltage for a split string—yet not enough for a single string. This problem is quickly eliminated with the circuit of Fig. 2 since, by merely increasing C1, we can obtain an effective dc potential higher than the rms value of the ac line.

Because it lends itself so readily to miniaturization, this new circuit is currently finding favor with manufacturers of airborne and other portable communications equipment. Although it was developed to fill a specific need here at Sylvania, the reader may think of many applications undreamed of by the inventor. END

TV SERVICE CLINIC

Conducted by
JERRY KASS

When picture and raster are normal, any defect in the sound that cannot be corrected by replacing audio tubes or checking voltages and the audio amplifier calls for alignment of the sound if section. This includes all circuitry from the sound takeoff point to the output of the ratio detector. The defeat can include anything from weak or no sound to drift, distortion and oscillations. Sometimes oscillation causes patterns to appear on the screen.

Sound if alignment is comparatively simple because only one frequency is involved—4.5 mc. Test equipment requirements are few and the basic work consists of peaking the sound if stages for maximum output and balancing the ratio detector for zero output at 4.5 mc.

A highly accurate 4.5-mc signal generator is necessary. The best source is a television signal where the video and sound carriers are transmitted precisely (crystal-controlled) 4.5 mc apart. When a TV signal is not available, a signal generator—checked against a crystal calibrator or some other frequency standard—may be used. Accuracy should be within 1 kc at 4.5 mc.

In general, it is a good idea to check the alignment of the video if stages before going on to the 4.5-mc sound. This is especially true where the picture appears degraded. However, where trouble appears limited to the sound section only, with the picture strong and sharp on all channels, video if alignment may be bypassed.

While the circuitry of the ratio detector will vary slightly from set to set, the fundamental operation remains the same. Thus, while space permits a discussion of a limited number of circuits only, the alignment procedure may be applied to virtually all ratio detectors used in today's television receivers.

Fig. 1 shows the sound if section of the Motorola TS-402 chassis. When aligning with a TV signal, use the fine-tuning control and detune the signal slightly until you can measure from about 5 to 8 volts from the positive side of stabilizing capacitor C56-b to chassis. This procedure will permit operation below the limiting level of the FM driver tube and provide sharp alignment.

If a signal generator is used, tune it exactly to 4.5 mc, adjust its output to approximately 5,000 microvolts and short the antenna input terminals or remove the antenna lead-in. Connect the hot side of the unmodulated AM signal generator output to pin 2 of the third if transformer T3: the cold side goes to chassis. From this point on, the alignment procedure is the same whether a TV signal or generator is used.

From the positive side of C56-b, a 10-μf electrolytic capacitor, connect a dc vtvm or other high-impedance voltmeter (at least 20,000 ohms per volt) to chassis through a decoupling resistor of about 10,000 ohms. The first tuned circuit after the point of sound takeoff is C62–L33; tune L33 for maximum reading on the voltmeter (parallel resonance). Interstage trimmer C66 should also be tuned for maximum reading.

During alignment, as adjustments are tuned to resonance and the 4.5-mc signal strength is increased, reduce the signal generator output or TV signal input to the receiver to prevent overloading and to get sharper peaks and nulls. It is often advisable to insert an attenuation pad at the antenna input.

The ratio detector primary (top core in this chassis) is now tuned for maximum reading on the meter. In tuning this and the secondary circuits of the ratio detector there will usually be two tuning points. Only one is correct—the point at which the cores are farthest out of their windings (minimum inductance). The inner position produces improper bandpass.

For balancing the secondary, connect a matched (1%) pair of 100,000-ohm resistors across the ratio detector load resistor R62 and connect the ground side of the meter between the resistors. The high side of the meter is connected to the output of the de-emphasis network (junction of R63 and C74).

Now vary the ratio detector secondary for zero response on the lowest range of the meter. Make sure the slug is tuned to the outside of the coil winding—this corresponds to the crossover point of the detector curve. The symmetry of the curve may now be checked by tuning the signal generator 25 kc above and below 4.5 mc and observing the plus and minus voltages obtained, reversing the meter connections as necessary. The voltages should be approximately equal. If not, repeat the entire procedure and try replacing the ratio detector tube. Repeat the process for maximum accuracy.

Fig. 2 shows the sound if system of the Admiral 20Y4H chassis. Here again, either a TV signal or generator may be used. Tune to a strong station or connect the high side of the generator to the junction of L304–L305 (in series with an isolating resistor or, better still, a .01-μf capacitor); the generator cold lead goes to ground. Connect the vtvm from the negative side of C206 (4 μf) to chassis.

With the vtvm set on a low dc scale and the generator tuned to exactly 4.5 mc, vary L201 and the primary of the ratio detector transformer for maximum indication on the meter. Keep reducing generator or signal strength so the meter reading does not exceed a few volts.

To adjust the ratio detector secondary, move the ungrounded lead of the vtvm to point A and vary the secondary core for zero reading on the meter. It will be between a positive and negative maximum. If available, use a vtvm having a zero-center scale.

To touch up the ratio detector secondary using a TV signal, vary the core for best sound with minimum buzz. Make this adjustment carefully since only a very slight rotation will usually be necessary. The correct alignment point is between the two maximum buzz peaks that are generally obtained by turning the slug back and forth about one-half turn.

While manufacturers' alignment instructions vary slightly, the above indicates the general process; align all sound if circuits up to and including the ratio detector primary for maximum output across part of or the entire stabilizing capacitor (the voltage developed here acts as sort of an avc indicator or signal strength). Align the ratio detector secondary for zero output (balance) at 4.5 mc with the vtvm connected between the electrical center of the secondary and the output of the de-emphasis network.

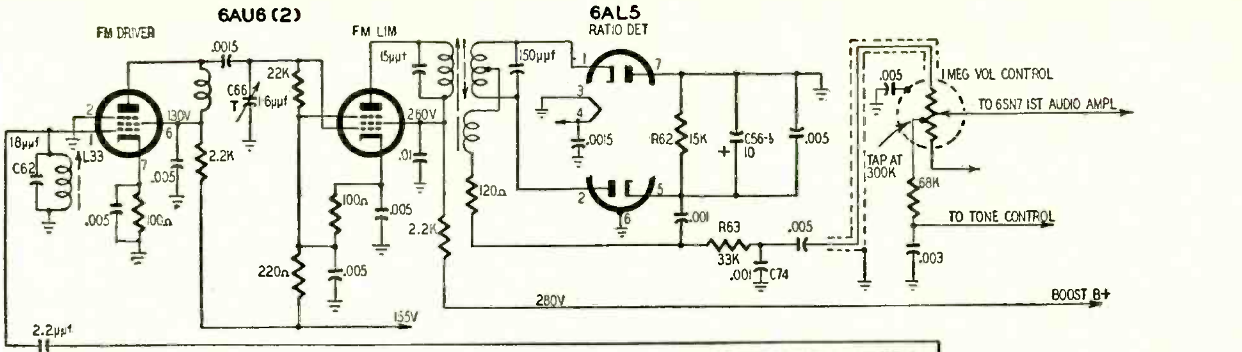
Sound buzz and oscillation

A peculiar condition occurs in an RCA KCS83 chassis. An intermittent oscillation can be clearly seen on the screen. At other times this trouble disappears and there is a strong buzz in the sound with an accompanying beat pattern on the screen. The customer said both defects occurred about the same time, but it seems unlikely that one component would cause both symptoms.

I have replaced all rf and if tubes, both video and audio, without improvement. All voltages appear as per RCA schematic and, while I have noted changes in the sound signal during the trouble, I have been unable to clear up the defects.—T. L., Richmond, Va.

Ordinarily, from the information furnished, I could only suggest a thorough check of all components in the sound if section together with alignment. However, in this chassis the probability is very great that the trouble is due to a defective dual capacitor Cl-a and Cl-b. (Fig. 3). It is used as a screen and cathode bypass capacitor in the first sound if amplifier.

When Cl-b decreases in capacitance, as it often does, this stage oscillates at about 2 mc or so and will generally produce the buzz and beat pattern you



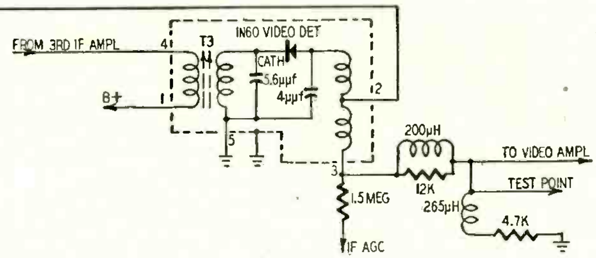


Fig. 1—Sound if circuits in Motorola television chassis type TS-402

describe. Replace this capacitor with two separate units. The cathode bypass should be a .01-μf capacitor, with the screen bypass preferably a smaller unit of about .001 μf. Both capacitors should have a positive temperature coefficient. Try to maintain as closely as possible the original lead dress, keeping the leads short and to the same points on the chassis.

Line fuse blows

Back in the shop for the third time is a Sentinel 443 set with a blown fuse in the primary circuit of the power transformer. Every tube has been checked and the wiring carefully inspected. What makes this all the more puzzling is that there is a ½-ampere fuse in the secondary circuit of the power transformer which does not blow. On this basis I assume that the trouble must be in one of the filament circuits but have drawn a complete blank.—P. R., Waco, Tex.

The fact that the ½-ampere secondary fuse does not blow is important. And since you have checked all tubes and filament wiring without finding any faults, the fuse blowing is probably due to a defect that was very common about 5 years ago when this particular chassis was produced.

There is a 1-inch self-tapping back mounting screw that holds the back to the chassis near the interlock plug. This places it very close to one of the filament pins of either the 6W4-GT or 6BY5-G rectifiers and occasional vibrations will produce contact and blow the primary fuse. This can be corrected by placing a heavy washer under the head of the screw, thus shortening it. On the possibility that the fuse is blowing due to transients, replace it with a 3-ampere Slow-Blo unit.

Phase reversal in picture

The picture on a General Electric has practically no contrast range and could be considered a monotone. The set, model 810, shows very little change when the contrast control is varied. In fact, it would be correct to say that the picture is reversed—whites where the blacks should be and vice versa.

At first I took it to be the picture tube, but a new tube had no effect. I also noted that synchronization was very poor. The trouble could not be weak signal because there is no snow in the picture. I then aligned the video if amplifier. This produces a slight change, but not very much. All if and video amplifier tubes have been replaced with no luck.—B. S., Houston, Tex.

From your description, the trouble seems almost surely to be in the video amplifier section. Often many effects are mistakenly called a phase reversal. However, if you clearly see a black–white reversal of tones, accompanied by very little contrast and a faint signal, the cause is an inoperative video amplifier stage. With this the video signal could feed through the internal grid-to-plate capacitance of the 12AU7 (Fig. 4). The usual 180° phase reversal would be missing, causing the black–white reversal. In addition, with sync pulses of the wrong polarity, synchronization would be virtually destroyed, depending on how close to 180° the phase reversal was.

So check for plate voltage on the first and second video amplifier stages. Watch out especially for R39, as unreliable a resistor as any. It often opens and cuts off that stage. Also replace C27 regardless of what your checker indicates. If this does not help, check all components shown in Fig. 4. Most likely, the trouble will be, not an off-value part, but one completely open or shorted. END

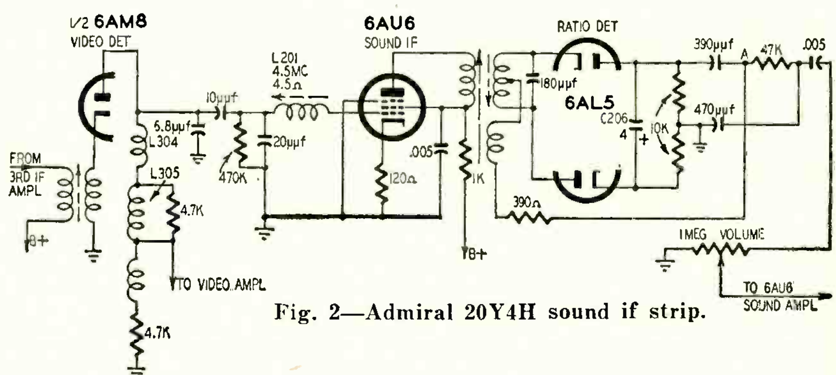


Fig. 2—Admiral 20Y4H sound if strip.

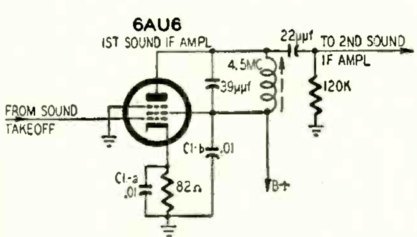


Fig. 3—The first sound if amplifier stage in the RCA type KCS83 chassis.

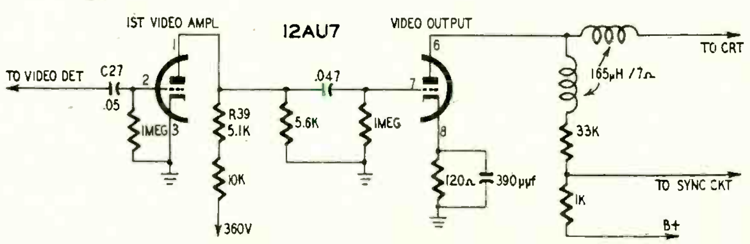
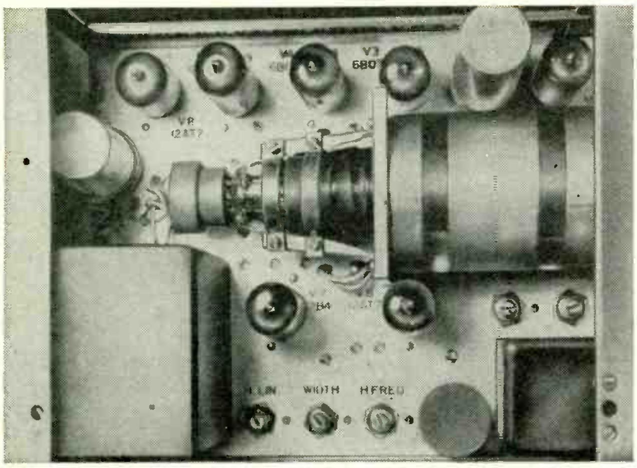


Fig. 4—Video amplifier in G-E 810.



Dage television camera—controls are easily accessible.

ITV PULSE-GENERATOR TECHNIQUES

By EDWARD M. NOLL *

Part II—The noninterlaced sweep system for closed-circuit TV

THE noninterlaced pulse generator of a closed-circuit television system forms line-rate (horizontal) and field-rate (vertical) timing pulses. These two pulse-generating circuits are not locked together, as they must be in an interlaced system, but run freely with respect to each other. Consequently, the noninterlaced pulse generator forms a sequential line structure instead of an interlaced one. When a standard television receiver is synchronized by the pulses from a closed-circuit camera using a noninterlaced pulse generator, a 60-frame raster is formed having some 250 scanning lines. If the pulse generator were of an interlaced type, a 30-frame raster with some 500 lines would result.

The noninterlaced generator is frequently used in closed-circuit cameras because of its circuit simplicity—it requires no counter chain nor phase-comparison circuit.

The pulse and sweep systems of the Dage 60-B closed-circuit camera are shown in Fig. 1. The frame-rate 60-cycle pulse is derived directly from the 60-cycle power line. A 60-cycle high-voltage sine wave is taken from a winding on the power transformer and applied through resistor R1 to a rectifier diode and the grid of V1.

The sine wave is clipped by the selenium rectifier and then fed to a differentiating or sharpening circuit consisting of C1 and R2. This circuit shapes the clipped sine wave which must excite the discharge-tube grid.

The shaped 60-cycle wave applied to the grid has a very high amplitude and drives the tube between cutoff and grid conduction. In fact a major portion of the applied grid waveform is below cutoff and therefore holds the tube cut off for a long interval. During this time a sawtooth trace is formed across capacitor C4. As this capacitor charges toward B plus through resistor R3, a sharp positive swing of the grid waveform causes the discharge tube to conduct for a short interval. Now the C4 voltage is discharged because of the shunting of the conducting tube.

This portion of the cycle on the capacitor constitutes the retrace segment of the generated sawtooth wave. Hence the sawtooth wave generated in the plate circuit of the discharge tube can be used as a driving sawtooth for application to the grid of the camera vertical output tube. The output tube develops the deflection energy for the vertical deflection coil of the Vidicon camera tube.

Actually, the grid of the discharge tube is driven so far positive that it draws grid current and charges capacitors C2 and C3 to a high negative value. This action limits the extent to which the grid can be driven positive and prevents excessive plate current flow. The negative capacitor charge and the now-swinging negative portion of the grid waveform carry the tube way beyond cutoff. Once again capacitor C4 charges to begin another frame scanning cycle.

Note that the discharge tube conducts for only the short interval that the grid waveform (Fig. 2) swings positive. However, during this time the cathode–plate current is high and develops a sharp positive voltage across cathode resistor R4. This positive voltage is in the form of a pulse because, as soon as the tube is driven quickly to cutoff, the plate current ceases and no voltage is developed across the cathode resistor. The pulse developed across R4 coincides in time with the discharge period of the sawtooth wave developed across capacitor C4. The retrace time of the sawtooth constitutes the synchronizing and blanking periods of a television system. Hence the pulse developed across the cathode resistor can be used for synchronizing and blanking functions because it does coincide with the retrace period of the deflection waveform.

This is an important fact in understanding the operation of a closed-circuit system. During the retrace interval of the deflection waveform the scanning beam of the Vidicon is in retrace. Thus the camera itself must be blanked during this period. The blanking pulse is, in fact, the pulse developed in the cathode circuit of the discharge tube. Furthermore this very same sync-blanking pulse is also inserted into the video signal and, at each television viewer, will cause the picture-tube beam to be blanked during vertical retrace.

This very same pulse in a closed-circuit system can be used for synchronization. At the viewer the pulse is also applied to the vertical synchronization and sawtooth-generating circuits. As with standard TV receivers the synchronizing pulses start the retrace periods of the sweep waveforms. In other words, the retrace period of the viewer vertical sweep waveform has been made to coincide with the retrace period of the camera vertical-deflection waveform. In effect the vertical motion of the viewer picture-tube scanning beam corresponds with the similar motion of the Vidicon camera beam.

The frame rate is set at 60 cycles and framing thus follows in frequency and phase the variations of the power-line frequency. The close lock-in between frame rate and power-line frequency minimizes many of the hum and synchronizing disturbances to which a television system can be subject. It does so because any 60- or 120-cycle hum field produces a stationary disturbance on the scanning raster because the scanning rate itself follows in frequency and phase the troublesome hum activities.

The sawtooth wave developed across capacitor C4 is properly spiked by resistor R5 before application to the grid of the Vidicon vertical output tube. This step insures a linear change of current in the vertical deflection coil. A low-impedance coil is used and, consequently, it can be driven by a cathode-follower output stage. During the trace portion of the sawtooth wave applied to the grid of the vertical output tube the current rises linearily in the vertical deflection coil to produce a linear motion of the scanning beam. The cathode potentiometer permits linearity control by setting the output tube bias at a correct point.

Horizontal pulse formation

The horizontal pulse generator is a combined horizontal output tube and cathode-coupled multivibrator. To in-

* Author, *Closed-Circuit and Industrial Television* (Macmillan).

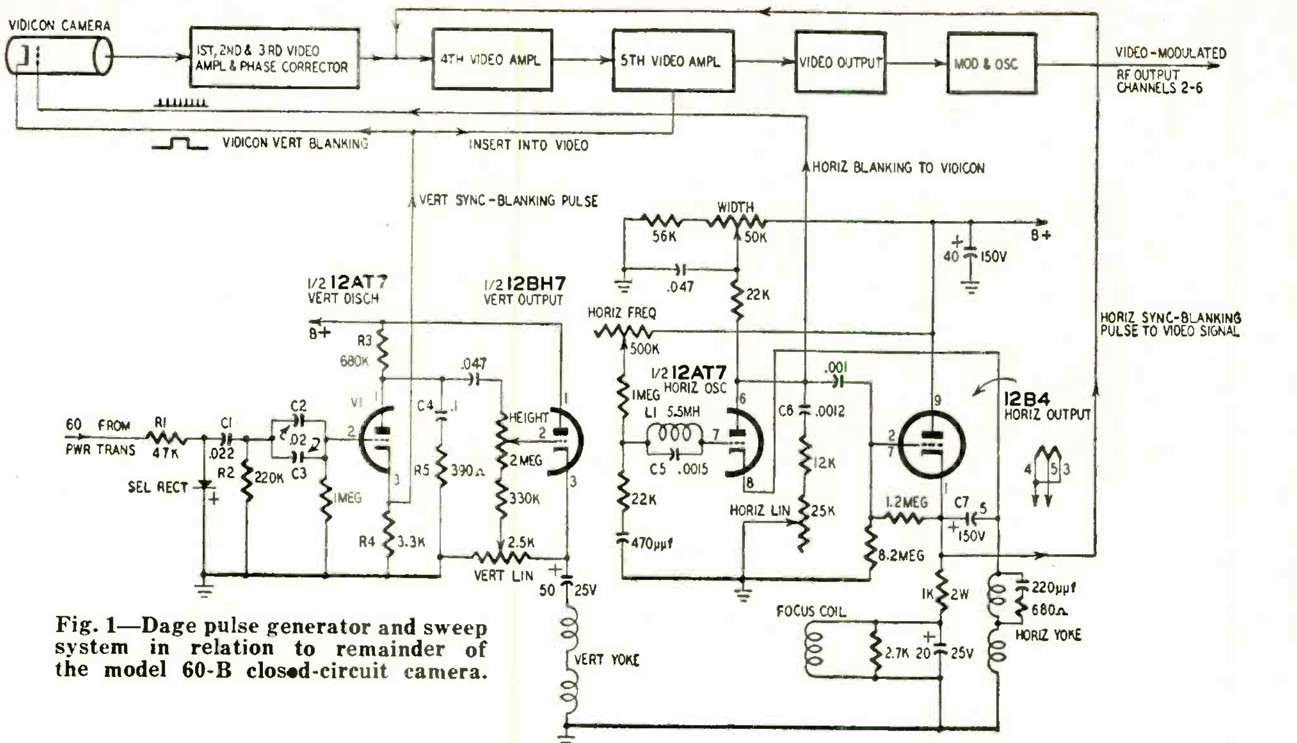


Fig. 1—Dage pulse generator and sweep system in relation to remainder of the model 60-B closed-circuit camera.

sure stable operation of the multivibrator at the high horizontal frequency, a stabilizing tuned circuit consisting of inductor L1 and capacitor C5 is inserted in the grid circuit of the first section. The multivibrator frequency is also controlled in this grid circuit by regulating the B-plus value toward which the grid circuit discharges during the nonconducting period of the first section. During a long cutoff period of this tube, capacitor C6 charges toward B plus to form the trace portion of the deflection waveform. When the feedback cycle drives the first section into conduction for a short interval, this capacitor discharges quickly because of the shunting influence of the tube, forming the retrace period of the horizontal deflection waveform.

The horizontal sweep waveform excites the grid of the horizontal output tube. In so doing it produces a sawtooth current in the horizontal deflection coil located in the cathode circuit. Inasmuch as the second section conducts for a longer period than the first, the current in the deflection coil rises linearily to produce the horizontal trace period of one line.

The dc required by the focus coil also flows in the horizontal-output cathode circuit. The cathode of the first section is linked through capacitor C7 to the cathode of the second section to form the necessary cathode-coupled feedback link to sustain relaxation oscillations.

The width control is in the plate circuit of the first section. It regulates the B plus toward which capacitor C6 charges during the trace interval. Therefore it regulates the amplitude of the deflection waveform applied to the grid of the second section.

The second section of the horizontal cathode-coupled multivibrator conducts for a long interval. Consequently, a long positive pulse is developed at the cathode during this period. When the tube is nonconducting, the cathode waveform drops to zero. However, if we notice the cathode waveform closely (Fig. 3) we can see that in effect it can be considered a short-duration negative pulse. This negative pulse coincides with the horizontal retrace period. Again we have developed a useful pulse output that coincides exactly with the timing of a horizontal retrace interval. Thus we can use this pulse as a combined horizontal sync-blanking pulse for synchronizing the horizontal sawtooth-forming circuits of the viewer and to supply blanking for the picture-tube scanning beam of the viewer.

The functional block diagram of Fig. 1 demonstrates the simplicity of the synchronizing methods employed in closed-circuit television. The pulse generator is really a combined pulse and deflection waveform generator. By proper choice of circuits the sync-blanking pulses, as formed, can be made to coincide with the retrace intervals of the camera-tube vertical and horizontal deflection waveforms. Therefore the system can be synchronized and viewer and camera tubes blanked coincidentally with only a few tubes.

The number of pulse-generator controls is surprisingly few. The vertical circuit contains linearity and height controls only. No vertical frequency control is necessary because of the direct link with the 60-cycle power frequency. The horizontal circuit contains frequency, width and linearity controls.

The horizontal frequency control is adjusted to lock in the picture on the viewer. In many cases the viewer is a standard television receiver which has been adjusted previously to the correct horizontal frequency by tuning in a standard telecast station. The horizontal frequency of the camera is then adjusted until it too produces a locked-in picture on the receiver screen.

The linearity and size adjustments are generally set correctly at the factory. However, if adjustments are necessary a standard test chart is provided by the manufacturer. The chart is placed in position in front of the camera at a prescribed distance and the linearity and size controls are set to produce a linear and full-size picture on the viewer screen.

The next article will be on an interlaced pulse generator for closed-circuit television. TO BE CONTINUED

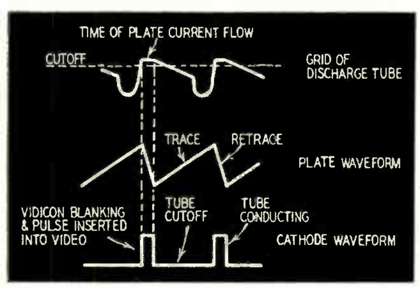


Fig. 2—Waveforms of the vertical pulse and sawtooth-forming circuits.

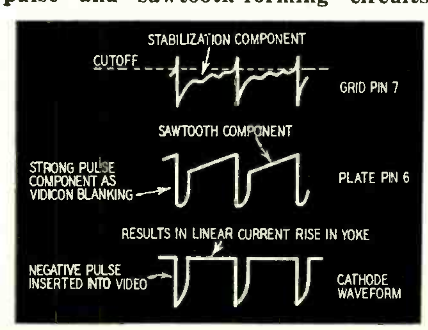


Fig. 3—Horizontal multivibrator action.

VTVM servicing is not so simple!

Recognize the limitations when servicing with this instrument

The Simpson model 303 vacuum-tube voltmeter — uses 1.5-volt ohmmeter battery.

By ROBERT G. MIDDLETON *

THE vtvm appears to be an easy-to-use service instrument and, in general, this is so. Nevertheless, perplexing situations arise in practice. Some of these are discussed and analyzed here.

A good vtvm will always indicate the same resistance value, no matter which range is used, provided the resistor under test is linear. However, not all resistors are linear. Consider, for example, the filament of a small receiving tube. It has a higher resistance when hot than when cold (Fig. 1) and hence exhibits rated resistance only when rated voltage is applied to the terminals. But the voltage applied to the filament varies with the range which is used.

Consider, for example, a vtvm with a 1.5-volt ohmmeter battery (see photo) used to measure the filament resistance of a 1R5:

1R5 TUBE

Range	*Ohms*
R×1	24
R×10	10

Since the 1R5 is rated to draw .05 amp at 1.4 volts, its rated filament resistance is 28 ohms. Hence it appears that the rated resistance was approached on the R×1 range, but was not approached on the R×10 range.

Consider a picture-detector crystal diode. The diode has a nonlinear characteristic, like a tube filament. Fig. 2 shows the difference between a linear and a nonlinear detector. The apparent resistance of a crystal diode on various vtvm ranges is as follows:

1N34A CRYSTAL

	Resistance (*ohms*)	
Range	*Forward*	*Backward*
R×1	120	unreadable
R×10	150	unreadable
R×100	295	800,000
R×1,000	1,000	250,000
R×10,000	4,000	140,000
R×100,000	20,000	unreadable

The varying resistance values are easy to understand by observing Fig. 2. The varying E/I ratio implies a different resistance value at different applied voltages. Thus, a rated front-to-back ratio for a crystal diode is meaningless, except at a specified voltage.

* Field engineer, Simpson Electric Co.

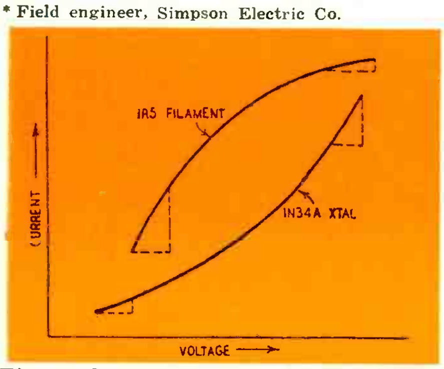


Fig. 1—Voltage-current characteristics of crystal diode and tube filament. Dashed lines indicate voltage-current ratio at opposite ends of the curves.

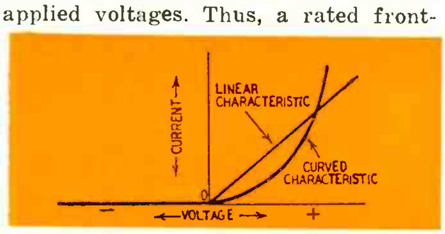
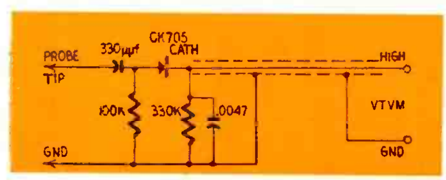


Fig. 2—Detector characteristic types.

High-frequency measurements

To measure high-frequency voltages, a detector type probe, such as shown in Fig. 3, is often used. This probe provides an indication of the peak values of unmodulated high-frequency voltages when the ouput from the probe is applied to the dc input terminals of a vtvm. It also indicates the peak value of the carrier voltage in a modulated wave. The probe indicates the rms value of the modulating voltage in a modulated high-frequency voltage when its output is applied to the ac input terminals of a vtvm. Indication of the rms value is the result of passing the modulating voltage as an unrectified and unfiltered component in the probe output voltage, and the calibration of the ac ranges of the vtvm in rms values.



Courtesy Simpson Electric Co.

Fig. 3—Circuit of detector probe–measures peak of high-frequency voltages.

Just as the crystal diode is a nonlinear device, so is the demodulator probe. The practical result of this nonlinearity is that when voltage values of less than 1 are measured, the scale indication is somewhat less than the actual value of the voltage. And as smaller and smaller voltages are applied, the error becomes proportionately greater. To avoid this difficulty it is necessary to provide an auxiliary scale for the probe when small voltages are to be indicated. The probe scale is cramped at the low-voltage end, as is required by the diode characteristic.

Some care must be taken when applying the output from a high-frequency probe to the ac voltage ranges of a vtvm because some service vtvm's do not have a high-impedance input for ac, but provide only a copper-oxide or selenium type ac circuit which has a low input impedance of 1,000 or 5,000 ohms per volt. Unless the input impedance is much higher, the probe will not operate satisfactorily. The input resistance of the instrument shown in the photo is 270,000 ohms on the ac-volts range.

Test points must be avoided which apply excessive input voltage to the crystal probe, as loss of sensitivity or complete burnout will result. If a 1N34 crystal is used, probe manufacturers usually rate the maximum input voltage as approximately 20. Test points which have a high impedance must also be avoided, since the loading effect of a demodulator probe is appreciable.

Thus, signal tracing in the if circuits of a TV receiver with a vtvm and demodulator probe is a questionable procedure because the input capacitance of the probe detunes the circuit under test and impairs the measurement. Sometimes the indication is only attenuated, but sometimes the shunt capacitance throws the circuit into oscillation and the indication is enormously increased. Since the lower voltages which can be read on a vtvm scale are useful only at the last if stages, signal tracing by this means is largely impractical.

Testing with weak batteries

A linear resistance will appear to be nonlinear when tested with a vtvm which has weak batteries in the ohmmeter circuit. For example, a 100-ohm composition resistor gave the following apparent readings when tested under this condition:

Range	*Ohms*
R×1	50
R×10	90
R×100	100

The variation in apparent resistance is caused by the varying current drain in the ohmmeter circuit on the various ranges and the great increase in internal resistance of the ohmmeter battery on the heavy-current ranges. A fresh battery has a practically constant internal resistance in the ohmmeter circuit. It gives correct indications on all ranges.

Tracing ac signals on dc range

It is sometimes not clearly understood how an ac signal can be traced through some sync circuits; for example, using the dc voltage ranges of a vtvm. How this is possible is shown in Fig. 4. The applied sync pulse is an ac voltage waveform which is partly positive and partly negative. There is just as much positive electricity in the waveform as there is negative, so that the zero-volt level in the waveform exists at the point which divides the waveform into equal positive and negative areas. ("As much" electricity means *current × time*. Zero-volt line is a time axis.)

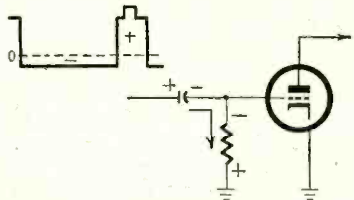


Fig. 4—Developing grid-leak bias.

The positive excursion drives the tube to grid current flow in a circuit using signal-developed bias. The grid current flow traps electrons on the grid coupling capacitor, which then have a limited rate of escape through the grid leak. The end result is the buildup of a negative dc voltage on the grid when a signal is present. This dc voltage from grid to ground can of course be measured on the dc ranges of a vtvm.

To obtain a clearer understanding of the voltages in a capacitively coupled circuit, refer to Fig. 5. Here the sync pulse is superimposed on the dc plate voltage on the plate side of the coupling capacitor; the voltage here is pulsating dc (which never goes negative) and consists of an ac voltage superimposed on dc. The capacitor will "conduct" the ac voltage but blocks the dc.

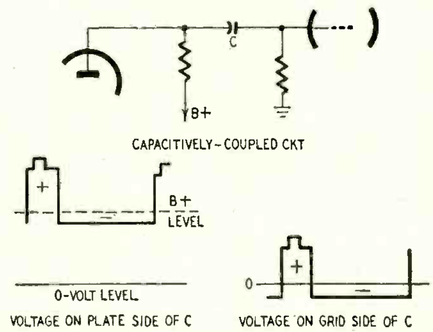


Fig. 5—Voltage relationships on plate and grid sides of coupling capacitor.

When the ac function of a vtvm is used to check the voltage on either side of C, the same value is indicated. This equality results because the ac function of the vtvm itself utilizes a blocking capacitor whereby only the ac component of the voltage is passed into the meter circuit.

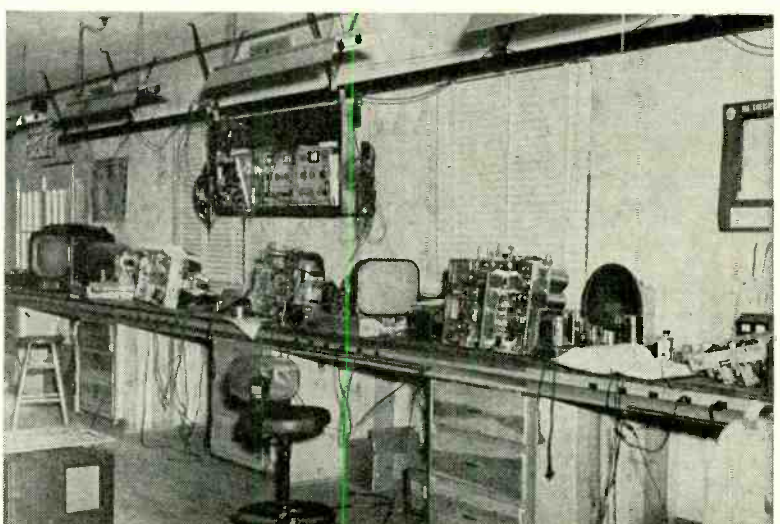
When the dc function is used to check the voltage on either side of C, different values are indicated. This inequality results because the dc voltage on the plate side of C is determined by the value of B plus; the dc voltage on the grid side of C is determined by the amount of grid current drawn by the tube in response to the applied ac signal. END

DAUGHTER OF NECESSITY

FORCED to do a minimum amount of lifting due to a bad back, I constructed what I believe to be an interesting and unusual workbench arrangement. This setup (see photo) has been in use some 4 years with no changes except the addition of antenna outlets. For these, I installed Blonder-Tongue equipment composed of channel strip amplifiers for channels 3, 4, 12 and 13, using an eight-outlet distribution amplifier to feed my workbench.

The bench is approximately 40 feet long, with National Trolley rail mounted overhead. From this I have all my test equipment, as well as the telephone, suspended on rollers so that it can be rolled to any location on the work bench. The telephone line travels on pulleys from one side of the rack with the ac power (to test equipment) traveling on the opposite side.

This arrangement permits me to work my entire bench with one set of test equipment by rolling the instruments to any position.—*Jack Wise*



AUDIO SIGNAL GENERATOR

Resistance-tuned instrument is small, light, safe and versatile

By LYMAN E. GREENLEE

A SIGNAL source was needed for checking audio equipment. The basic requirements were: small size, light weight, adequate isolation from power lines, complete frequency coverage, provision for monitoring the signal with a scope and enough power output to check loudspeakers without additional amplification. No low-priced commercial equipment available met all the above requirements, so I designed and built my own audio signal generator. It is rugged and reliable, and anyone interested in working with sound equipment may find it a tool well worth the time and cost of construction.

No chassis is used or needed—all parts are mounted directly on the front and back covers of a standard 6 x 6 x 6-inch utility cabinet (see photo). Although the front and back panels are permanently wired together, they can be easily removed from the cabinet for service by turning the back panel at an angle so it will slip through along the diagonal.

The power supply, which is built on the back panel, uses a small filament transformer combined with an output transformer for isolation from the power lines, a necessity for successful operation of test equipment. This power supply has proved very satisfactory. Since the normal plate drain of the two tubes is about 5 ma, the small transformers do not even get warm. This power supply is easily adapted to other test equipment and is much lighter than most supplies using conventional power transformers.

A 12AU7 miniature dual triode is used as a resistance-tuned audio oscillator. With the values shown in Fig. 1 the tuning range should be from about 75 to more than 30,000 cycles; the upper range extends well beyond the limits of the human ear. The output voltage is uniform through the audible range but will fall off rapidly as the ultrasonic limit is approached. The top and bottom frequency limits will depend somewhat on the characteristics of individual tubes and the tolerances of the various parts.

The values of C1 and C2 have a considerable effect on the frequency coverage of this generator. The combination of .002 and .005 μf, respectively, provides a usable range from 75 to 35,000 cycles. Using .007 and .01 μf, the range goes from 50 to 25,000 cycles; .012 and .015 permit a range from 25 to 15,000 cycles. Thus, increasing the values of C1 and C2 gives a lower frequency response at the expense of reducing the high-frequency coverage.

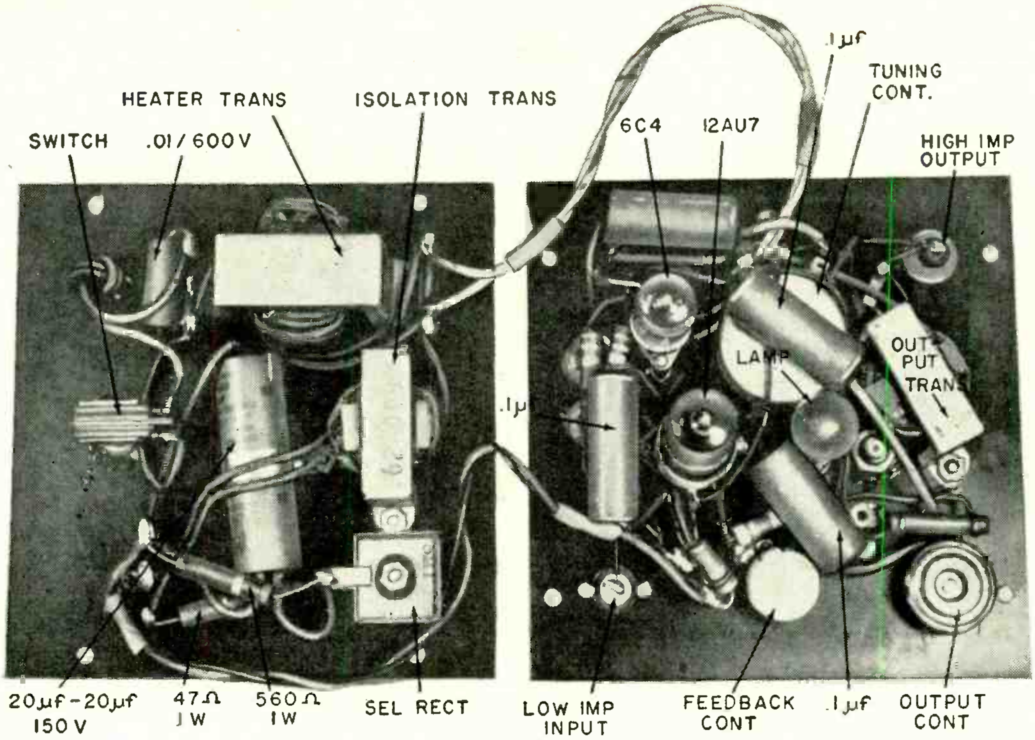
There is a slight shift in frequency as the feedback control is varied. To calibrate the dial accurately, a fixed setting of this control must be marked on the front panel. This point may be ignored for most applications since we are not always too concerned about the exact frequency when checking speakers or audio amplifiers.

The feedback control should always be set at the lowest point which will produce satisfactory oscillation. This adjustment should be made while observing the waveform on an oscilloscope so that the waveform will have minimum distortion. If excessive feedback is used, the output will contain highly distorted pulses. Actually, owing to the stabilizing effect of the 3-watt bulb in the cathode of the 12AU7, very little change in the feedback control is necessary while tuning from one end of the dial to the other. By monitoring the output on a scope, the distortion can be held to a minimum and a very pure sine wave will result. The waveform is of little concern unless checks for distortion are being made.

The signal generator is useful for making distortion checks when used with an electronic switch and scope so that input and output waveforms can be viewed simultaneously. I found it convenient to monitor the output on a small scope, using a larger scope as a signal tracer to observe the waveform at various points in the amplifier being checked. This method is faster and involves no difficulties in the way of feedback, crossed wires and haywire hookups, bound to occur if a single scope is used with the electronic switch for signal tracing. For an overall check the electronic switch may be preferred because a direct comparison of waveforms can be made on the same screen.

The 12AU7 feeds a 6C4 miniature triode used as the output amplifier. A low-voltage high-current signal is thus available for checking speaker voice coils. However, since some distortion is introduced by the small output transformer, a direct output connection from the 6C4 plate is also provided. This connection may be used when making checks with the scope for distortion or for any application where higher voltage output is needed. Although the distortion from the output transformer cannot be detected by ear, it is easily visible on a scope.

Provision is made for connection to the 6C4 grid through a pin jack and 0.1-μf capacitor. This input connection may be used to mix another audio sig-



All components are mounted on the front and back covers of the utility box.

nal into the 6C4 grid while calibrating the instrument or it may be used for low-amplitude audio output directly from the 12AU7. A calibration chart should be made for the signal generator. The most convenient way to do this is to use another audio generator as a reference source. Couple them together and tune to zero beat to locate fundamentals or harmonics. A cathode-ray oscilloscope is a useful zero-beat or null indicator.

A cathode connection to the 6C4 provides a signal 180° out of phase, useful whenever a phase inverter is called for (checking push-pull amplifiers, etc.). The cathode connection may also be used to monitor the waveform on a scope. These features are extremely worth while when a critical analysis of amplifier performance must be made, yet they are missing from most commercially built instruments.

Generator construction

The two miniature tube sockets should be fully wired before they are fastened to the panel. They are slipped over 1-inch 6-32 screws and soldered fast. Very little actual wiring is required, as most connections are made with the capacitor and resistor leads. The 3-watt lamp in series with the 750-ohm cathode resistor is mounted in a socket salvaged from a candelabra panel-light assembly. Since one side of the lamp (G-E 3S6) is grounded, the socket can be bolted directly to the front panel, the bolt making the center contact.

Different transformers from the ones specified may give an unsatisfactory dc voltage, so a preliminary check should be made to make sure the voltage is within the 120–150 range. (Up to 250 volts could be used on the plates of the tubes, but this is too high for the filters and selenium rectifier in the power supply.) To operate the 12AU7 on 6 volts it is necessary to connect its two heaters in parallel by joining pins 4 and 5 together at the socket. Total heater drain for the two tubes will be 450 ma. Certain parts have been specified by manufacturer's name and part number to enable the constructor to duplicate the generator more easily. Other items are standard and require no particular care in their selection.

Fig. 2 shows an alternate output circuit that may be used when an output transformer is not used in the plate circuit of the 6C4. The circuit is a cathode follower and delivers a surprisingly uniform output voltage over the usable range of frequencies. The output voltage shown is the minimum average over the entire range. END

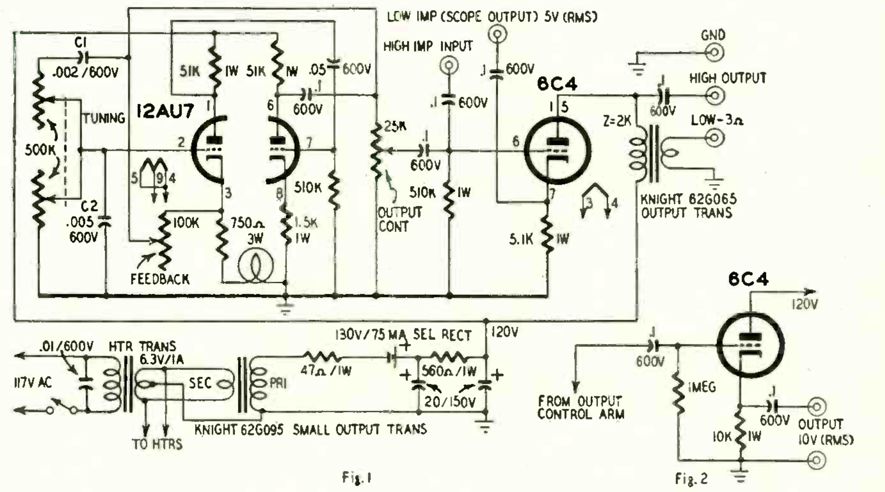


Fig. 1—Schematic of the resistance-tuned af signal generator with three output terminals. Fig. 2—Alternate output circuit eliminates transformer.

Parts for audio generator

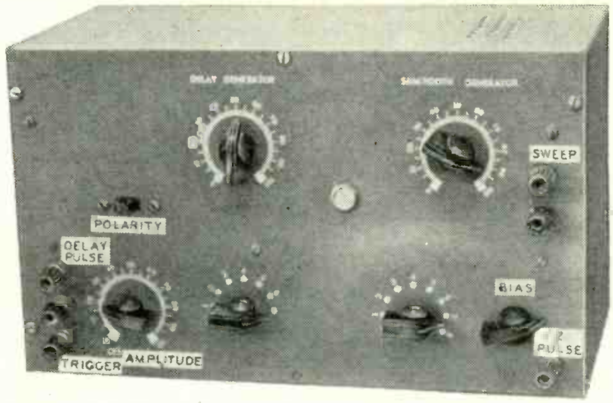
Resistors: 2—510,000 ohms, ½ watt, 5%; 1—47, 1—560, 1—750, 1—1,500, 1—5,100, 2—51,000, 1 watt, 5%; 1—25,000-ohm carbon potentiometer (Ohmite CU2531 or equivalent); 1—500,000-ohm dual potentiometer (Ohmite CCV5041 or equivalent); 1—100,000-ohm potentiometer (Ohmite CU1041 or equivalent).

Capacitors: 1—C1 and C2 (see text); 1—.01, 1—.05, 5—0.1 µf, 600 volts; 1—20-20 µf, 150 volts, electrolytic.

Miscellaneous: 1—12AU7; 1—6C4; 1—7-pin, 1—9-pin miniature socket; 1—75-ma selenium rectifier; 1—6.3-volt 1-amp filament transformer; 1—small output transformer, primary impedance 2,000 ohms at 50 ma, secondary 3-4 ohms (Knight 62 G 065 or equivalent); 1—small output transformer, primary impedance 5,000 ohms at 40 ma, secondary 3-4 ohms (Knight 62 G 095 or equivalent); 1—line cord; 1—3-watt lamp (G-E 3S6) and candelabra socket; 1—6 x 6 x 6-inch cabinet; 1—tuning dial; 1—spst switch; 4—phone tip jacks; 1—connector for cable; 1—3-foot length of microphone cable; 2—alligator clips for cable; 1—handle for cabinet.

DELAY and TIMING GENERATOR

By TOM JASKI



FOR the great majority of service tasks and the most frequently encountered experimental work commercial oscilloscopes in the low- and medium-price ranges are adequate. A compromise between versatility and economy, they are designed for a specific and, in some respects, limited field of work.

With new high-speed films generally available and with a greater interest in pulse techniques applicable to the growing uses of electronic control, the prospects of observing and photographing cathode-ray tube patterns become more feasible and attractive.

However, this type of work brings with it certain demands not readily met in the average oscilloscope. Observing transients, for example, requires close control of the scope sweep so that the trigger producing the transient can be made also to place the transient waveform in the proper position on the screen. Or, it may happen that a certain sequence of events has to take place ahead of the desired trace observation. Fairly long delays may be needed; relay sequences could be such a case.

It is possible to use a camera with shutter-operated flash contacts, allowing these contacts to trigger the event. This places a somewhat serious limitation on the delay, generally fixed at some convenient values such as 5 or 20 milliseconds. In photography these delays are short, but in oscillography we work in *micro*seconds and delays measurable in milliseconds are enough to waste a good deal of film and effort.

There is another class of work not readily performed with standard oscilloscopes, excluding again those in the higher price bracket: the observation of very slow or very fast voltage variations. The very fast phenomena put another demand to the scope, generally requiring special vertical deflection amplifiers which are connected directly to the vertical deflection plates.

The limitation of the scope amplifier is not so much the frequency response, as often advertised, but the rise time, not so much emphasized. A real problem in industry, the requirements are rarely as severe for the average experimenter. No such limitation is encountered at the other end of the scale—the low-frequency waveforms. Virtually all scope amplifiers are usable to 1 cycle or lower, and all we need then is a slow enough sweep to scribe our pattern.

To solve my problems of observing and photographing transients and low-frequency waveforms, a separate sweep generator was built to supply a sawtooth waveform of excellent linearity, as slow as 1 cycle and up to almost 1 megacycle. For a 4-inch deflection this works out from 0.25 second per inch to 0.25 microsecond per inch (*if* the horizontal amplifier will permit). The generator also furnishes sweep

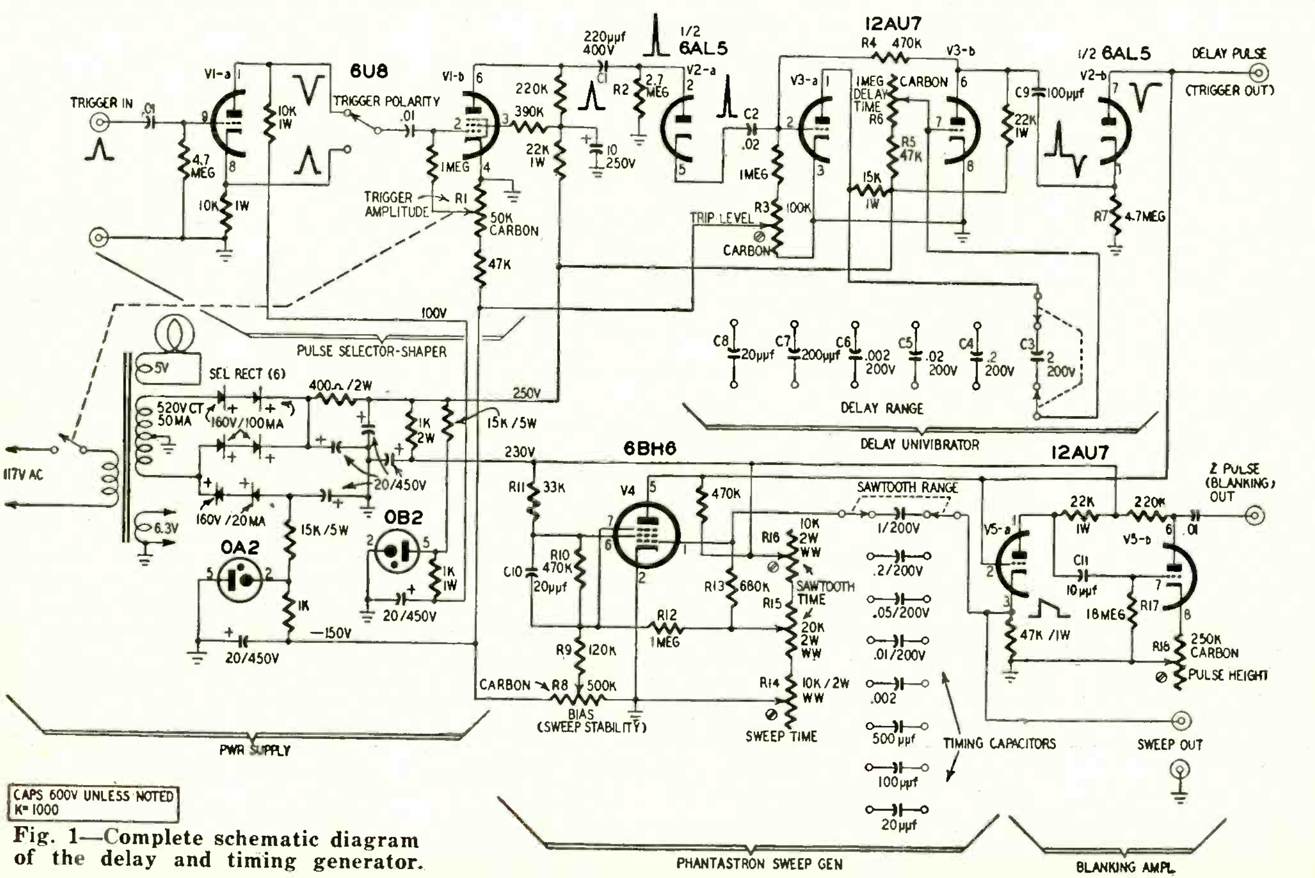
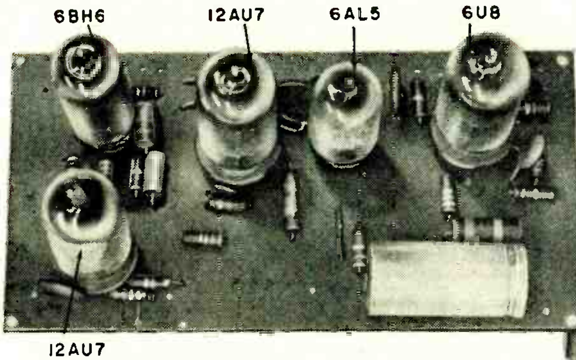
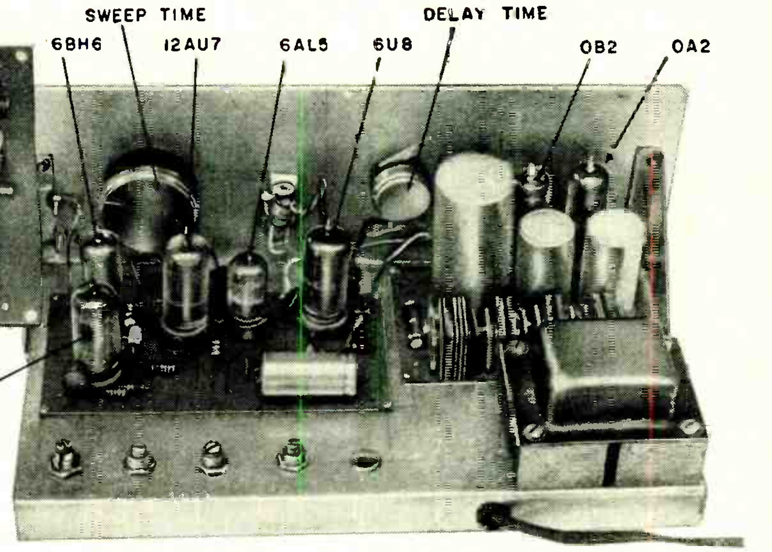


Fig. 1—Complete schematic diagram of the delay and timing generator.



Top view of the generator circuits.



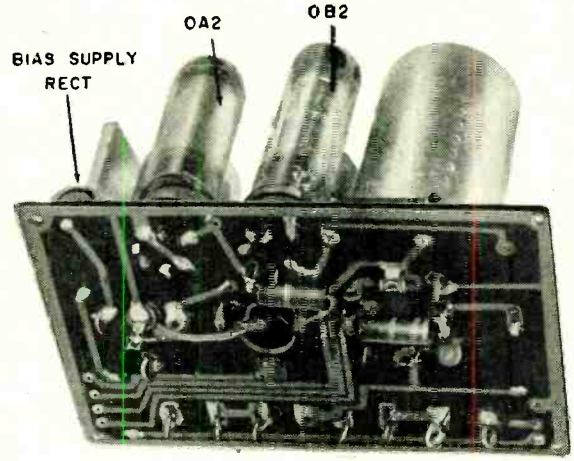
Rear top view shows the mounting of major components and circuit boards.

delays from 2 seconds to 1 microsecond and supplies externally a delayed pulse and a blanking pulse at the end of the sweep. The sawtooth wave can be repetitive or triggered. The repetitive sawtooth can be synchronized with an external input.

Fig. 1 shows the complete circuit diagram of the generator. This can be divided, for discussion, into four parts: the power supply, the pulse selector and shaper, the delay univibrator and the phantastron sawtooth oscillator with blanking pulse discriminator. The power supply needs no discussion, except that the better the regulation, the greater the accuracy of the sweeps and the greater the stability. If very high accuracy is required, more effective regulation should be considered. Excellent voltage-regulated power supplies have been described in RADIO-ELECTRONICS (August, 1952, page 47; April, 1952, page 66).

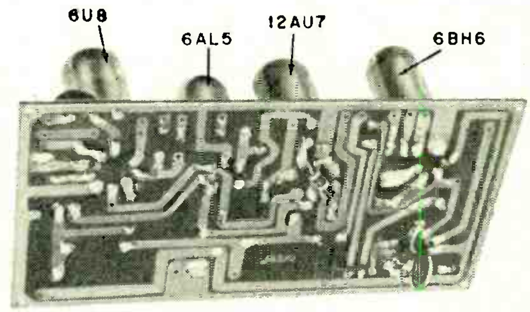
Pulse selector and shaper

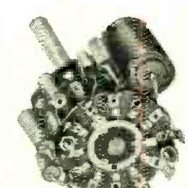
The function of the selector and shaper is as follows: A signal of any waveform or a pulse of any polarity is applied to the grid of the triode half of the 6U8 through the .01-μf capacitor. The signal then appears at the cathode of the triode in the same polarity as the input and at the plate with opposite polarity. The trigger polarity switch is used to select the negative polarity trigger always. Thus at the plate of the pentode a positive signal appears. The pentode always conducts, but conducts less when the trigger signal is impressed on the grid. The amplitude (and with certain waveforms, the pulse shape) is regulated by R1, which alters the bias on the pentode. If the trigger is a sine wave, the signal from the pentode will contain both a negative and a positive peak. Since a positive peak only is required to trigger the delay univibrator, the trigger is next sent through a diode, one half of a 6AL5, which effectively eliminates the negative peaks. The 6U8 is coupled to the diode through differentiating network C1–R2, which further sharpens the pulses. The positive trigger is applied through coupling capacitor C2 to the univibrator. The coupling capacitor is needed since otherwise the cathode of the diode would be biased and the signal would be blocked.



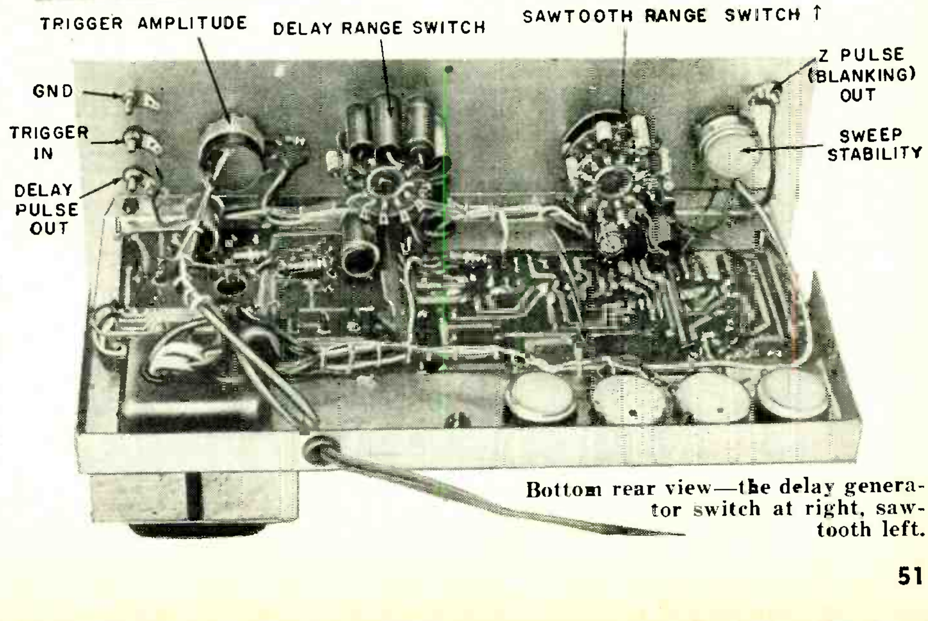
The power supply circuit board.

Generators and pulse shaper board.





SAWTOOTH RANGE SWITCH



Bottom rear view—the delay generator switch at right, sawtooth left.

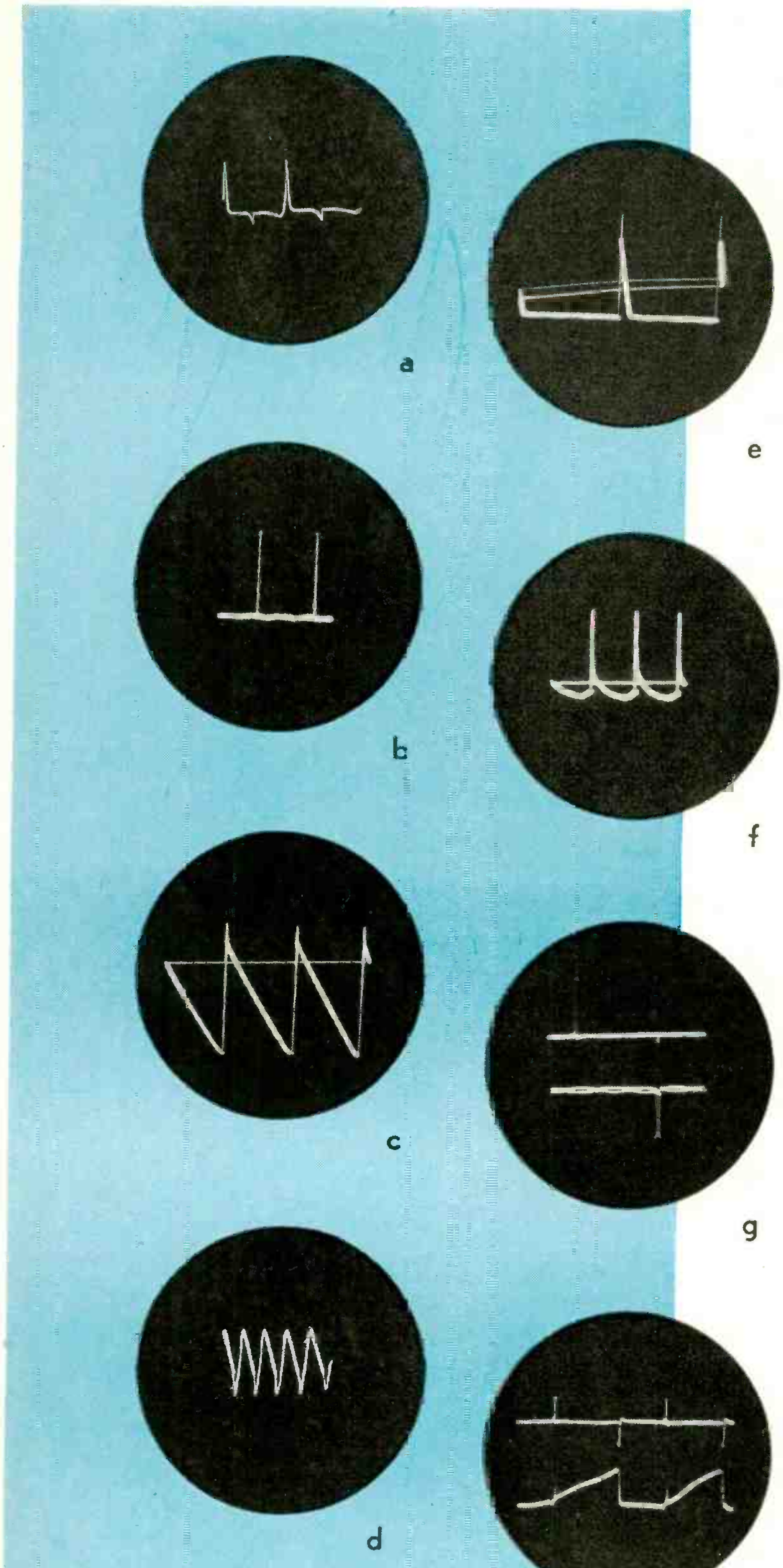


Fig. 2—Oscilloscope patterns from sweep generator: a, pulse shaper output with sine-wave input; b, delay univibrator output pulses; c, free-running sawtooth—1 kc; d, free-running sawtooth—500 kc; e, triggered at 200 cycles, sweep at 0.25 millisecond per inch; f, blanking pulse at 200 kc; g, trigger pulse (top) produces delay output pulse; h, trigger pulse (top, up), blanking pulse (top, down) and resulting sweep (bottom) near zero delay.

Fig. 2-a shows the resultant pulse when a sine wave is applied to the pulse shaping circuit.

Delay univibrator

There are many circuits which can provide a variable delay. For example, a phantastron similar to the one described here as sawtooth and blanking generator is frequently used. All that is required, basically, is a monostable circuit which after a period of time returns to the rest condition. However, the univibrator has certain advantages: the pulse output varies only very little with different delays; it is a relatively simple circuit and very easily controllable over a very wide range. The univibrator was described in the October, 1954, issue of RADIO-ELECTRONICS.

The first triode is normally cut off; the second triode conducts. A predetermined bias is placed on the grid of V3-a, set by potentiometer R3. When a positive pulse arrives from diode V2-a, V3-a conducts and charges capacitors C3–C8, selected by the delay time switch.

The current of V3-a lowers the voltage at the plate and also the grid potential of V3-b until it is cut off. This causes a sharp rise in potential at the plate of V3-b (see Fig. 2-b) and the grid of V3-a coupled to it through resistor R4. Triode V3-a conducts more vigorously, charging the delay capacitor through R5 and R6 and finally reaching the point where the grid of V3-b has sufficient voltage on it to once more make it conduct. The resultant drop of V3-b plate voltage coupled back to V3-a cuts off the latter and the original condition is restored. The *off* period of V3-b corresponds to the delay time, forming a square wave of that length. Through differentiating network C9–R7 this appears as a pair of pulses, one negative and one positive. The negative pulse only is passed on through diode V2-b to the phantastron. Potentiometer R8 is adjusted to prevent the univibrator from running free without a trigger. With trigger applied and trigger amplitude full on, set R8 to allow the univibrator to trip at the trigger frequency.

The phantastron

For the sweep oscillator the phantastron circuit was selected because of excellent linearity and wide frequency range. It is also suitable for repetitive (free) running (Figs. 2-c, d) and for trigger operation (Fig. 2-e) and can be changed from one type of operation to the other by merely changing the bias with potentiometer R8.

The phantastron is made up of two tubes: a 6BH6 (V4) and a cathode follower which is one half of a 12AU7 (V5-a). Basically the phantastron is a transitron type of oscillator. But when triggered, the transitron characteristics are not used as the circuit operates here. The plate resistor in the V5-a plate circuit can be ignored in the discussion of function for it was put there only to provide a takeoff point for the blanking pulse amplifier.

At rest position the voltages at the tube elements are:

Pentode		*Cathode Follower*	
plate	180	plate	230
screen grid	80	control grid	180
suppressor	−20	cathode	185
cathode	0		
control grid	−0.5		

The apparently lowered plate voltage on the plate of V4 reaches 180 because V5-a is drawing grid current through the 470,000-ohm plate resistor.

At rest position the plate of V4 is cut off by the negative voltage on the suppressor grid. The triode conducts heavily and keeps the timing capacitor charged. The screen of V4 also draws current. When a negative pulse arrives on the plate of V4 and grid of V5-a, grid current drops and the plate will momentarily conduct a part of the total cathode current. Since the control grid remains at equilibrium, the total cathode current will be the same. The screen will draw less current, allowing the screen voltage to rise sharply.

Through voltage divider R9–R10–R11 the suppressor will be brought up to almost 0 and the plate continues to conduct, lowering still further the plate voltage on V4. This eventually falls to about 15. The lowering plate voltage on V4 drops the grid voltage of V5-a also, considerably below the cathode voltage, and cuts off V5-a for the time being.

The timing capacitor selected discharges the so-called "rundown" at a rate determined by the values of divider network R9–R12–R13 and also by the position of sweep-time potentiometer R14, which determines the equilibrium point for the grid. These resistors are so arranged that with increasing plate current the grid becomes more rapidly less positive, thus restoring equilibrium and assuring a linear rundown.

When the capacitor contains no further charge, V4 is very near cutoff for the very low plate voltage then present. At this point the energy stored in capacitor C10 is sufficient to kick the suppressor grid negative and cut off V4. It remains cut off until another negative pulse arrives on the plate. The sudden jump in plate voltage resulting from the plate cutoff allows V5-a to conduct heavily and rapidly recharge the timing capacitor. When continuous operation is desired, the bias on the suppressor grid is so arranged that, when the timing capacitor contains no further charge, there is not sufficient energy to restore the plate-cutoff condition and the cycle repeats itself—when V4 momentarily cuts off altogether and allows V5-a to recharge the capacitor.

Blanking amplifier

The frequency range of the sweep generator is determined by three factors: potentiometers R8, R14 and R16. Potentiometer R16 sets the upper limit, R14 the lower. These pots interact to a certain extent since changing either affects the relative value of R15 and the other. The following shows the approximate range in each position:

1	1–5 cycles	*5*	0.5–4 kc
2	3–25 cycles	*6*	3.6–30 kc
3	12–100 cycles	*7*	25–200 kc
4	80–650 cycles	*8*	180 kc–1 mc

The above cover about a 1-to-8 frequency range. By resetting R8 a frequency ratio of 1 to 10 can be obtained with a minimum frequency down to ½ cycle. Thus, if a calibration scale is desired, it must be made with R8 in one certain, resettable position.

The blanking amplifier is supplied with a sawtooth signal from the plate of the phantastron cathode follower through differentiating network C11–R17. The small capacitance and the high bias on the tube (V5-b) allow only the very highest peaks of the sawtooth wave to be amplified, resulting in a sharp negative pulse (Fig. 2-h). These pulses are of the correct polarity for direct connection to the grid of a cathode-ray tube. The blanking pulse (Fig. 2-f) voltage obtained is about 15 volts peak, depending on the setting of the cathode bias on the blanking amplifier triode. This is usually sufficient to do an adequate blanking job. Potentiometer R18 varies the shape of the blanking pulse, generally close to tube cutoff.

The output voltage of the sawtooth oscillator is approximately 40 volts peak in the free-running condition. This again depends on the bias setting in this case of the suppressor grid bias. The output voltage in the triggered operation is somewhat less, primarily because a greater bias must be applied to prevent free running. The output voltage of the delayed pulse (Fig. 2-g) is approximately 25 volts peak. This pulse is always of very short duration. Any device to be operated by the delayed pulse will generally require some intermediate amplifier or triggered relay, such as a 5823. The narrow pulses have been used successfully to trip a 5823 cold-cathode relay tube.

Construction

A compromise between etched circuits and wiring has been used. See chassis photos. It would have been possible to use a larger printed circuit which could contain the screwdriver-adjusted potentiometers, or even the capacitors mounted on the range switches. Or a single circuit board could contain both power supply and generator chassis. For those who wish to use etched-circuit techniques to build this generator, see "Making Printed Circuits Is Easy," September, 1955, and "Making Photoetched Circuits," December, 1955, and January, 1956. The boards in the photos can be used as guides, but it would not be practical to copy them exactly unless it is first established that parts of exactly the same dimensions are available. I had some thick, short 15,000-ohm 5-watt resistors and designed the power supply board accordingly. More length may well be required, unless a miniature 5-watt type is available. The generator board, however, is designed with entirely standard parts.

Those desiring to use wired construction will find the wiring not particularly critical. The univibrator will not trigger on anything but a positive signal, and the phantastron must have a negative signal. However, it would do well to keep the input trigger circuit wires away from those connected to the univibrator input and the phantastron trigger input to prevent false triggering. The phantastron sockets and connections must be kept clean and the tubes used of good quality for leakage discharge of the capacitor might start a rundown without a trigger, no matter what the bias setting is.

Operation

If a repetitive trigger is supplied to the univibrator delay circuit, the delay setting must be less than the space between triggers. If this is not observed, triggers will be missed and the operation will become erratic. Similarly it is not possible to operate with a sweep time greater than the space between triggers. If such a setting is made, the phantastron will simply trigger on alternate pulses or will operate on some other multiple or submultiple of the trigger repetition rate.

Parts for delay and timing generator

Resistors: 1—1,000, 1—33,000, 2—47,000, 1—120,000, 2—220,000, 1—390,000, 3—470,000, 1—680,000 ohms, 3—1, 1—2.7, 2—4.7, 1—18 megohms, ½ watt; 1—1,000, 2—10,000, 1—15,000, 3—22,000, 1—47,000 ohms, 1 watt; 1—400, 1—1,000 ohms, 2 watts; 2—15,000 ohms, 5 watts.

Potentiometers: 1—50,000 (with switch), 1—100,000, 1—250,000, 1—500,000 ohms, 1—1 megohm, carbon; 2—10,000, 1—20,000 ohms, wirewound, 2 watts.

Capacitors: 1—10, 3—20, 2—100, 1—200, 1—220, 1—500 μμf, 600 volts, ceramic; 1—.002, 1—.01, 1—.02, 1—.05, 2—0.2, 1—1, 1—2 μf, 200 volts; 1—.002, 3—.01, 1—.02 μf, 600 volts, ceramic; 1—10 μf, 250 volts, electrolytic; 6—20 μf, 450 volts, electrolytic.

Miscellaneous: 1—power transformer, 520 volts ct at 50 ma, 6.3 volts at 1.2 amps; 4—100-ma selenium rectifiers; 2—20-ma selenium rectifiers; 1—spst switch; 1—2-circuit 6-position switch; 1—2-circuit 8-position switch; 1—6U8; 1—6AL5; 2—12AU7's; 1—6BH6; 1—0A2; 1—0B2; 1—pilot light and assembly; 3—9-pin, 4—7-pin miniature sockets; 1—chassis; 1—cabinet; 6—output terminals; line cord; printed wiring materials (optional).

To calibrate the delay time, an electronic switch can be used. Two traces are displayed on the C-R tube, one containing at least two pulses at the trigger rate (Fig. 2-g, the end of the trace is at a trigger mark). This can be a calibrated frequency from a signal generator or other source. With the delay range switch and the delay potentiometer, the delay-output pulse can be made to walk the other trace from trigger to trigger. The desired delay can be measured with a scale as a portion of the trigger spacing. The univibrator is reasonably accurate, but for very accurate work it is best to calibrate the delay time for each setting used. Minimum trigger voltage required is about five volts peak and pulses are preferable as triggers. END

Setting Your Checker For New Type Tubes

Checking the latest tubes, or, what to do until the new roll chart arrives

By BASIL C. BARBEE

NEW tube types are appearing at the most rapid rate in electronic history, making it quite a problem to keep tube-tester data up to date. A new type need not be any *better* than its predecessor; all that is required is that it be *different*, if only in some minor respect such as a slight change in basing. How can the technician test a new type he has never even heard of and cannot find listed on the roll chart of anybody's tube tester? Here is the procedure I developed during the testing of some hundreds of thousands of tubes over a period of years. It may not be the *best* approach, but it is one that has worked for me.

The oldest and simplest way of determining whether a tube is defective is to substitute a known good one of the same type and note whether the performance of the set is improved. This method is sometimes useful even when a tube tester and up-to-date chart of settings are available. For instance:

A tube may test *good* yet may oscillate in its circuit due to an open screen or other internal shielding.

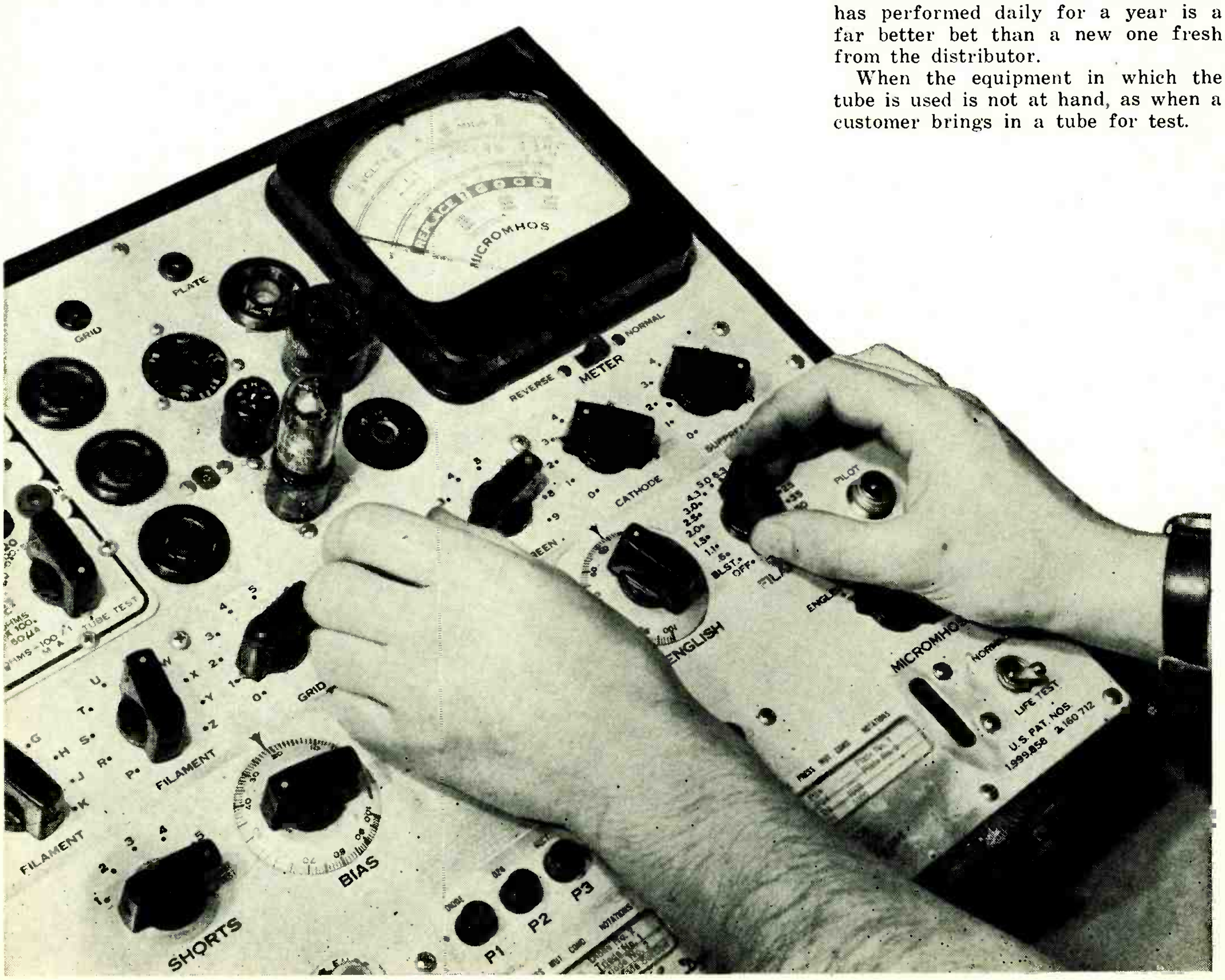
A tube may test *good* yet may fail to perform in a high-frequency oscillator circuit due to small changes in interelectrode capacitance as a result of misalignment of the tube elements.

A tube may test *good* yet not work satisfactorily in a TV horizontal oscillator or sync-clipper circuit due to its being used in the circuit under conditions other than those for which it was designed and tested.

The substitution method fails under certain conditions:

When no known-good tube of the same type is available for substitution. Having a new tube on the shelf is no guarantee that a good tube is available; new tubes, particularly of a new type, may be defective, usually due to interelectrode shorts. A tube which has performed daily for a year is a far better bet than a new one fresh from the distributor.

When the equipment in which the tube is used is not at hand, as when a customer brings in a tube for test.



When there are one or more faults in the set in addition to the suspected tube.

Data-compilation method

The first step in this method is to understand your tube tester. Read the instruction book thoroughly and find out just what each of the controls on the panel is for and how it works. Study the schematic so that every time you turn a switch or dial and push a button you visualize what is happening inside the instrument.

The second step is to accumulate every scrap of information on the characteristics and base connections of every new tube type that comes out. A subscription to one of the looseleaf tube-data services offered by the leading tube manufacturers will pay for itself several times in a year in time saved. Better still, subscribe to two or more such services since a new type will sometimes be announced first by one company, sometimes by another.

Take sample sheets from each looseleaf tube manual to your stationer and buy a sheaf of blank sheets to match one of them. Then order an extra looseleaf binder from the tube manufacturer (if you want it to match the others) and make up a volume of new and unusual types from clippings from RADIO-ELECTRONICS and other magazines by pasting the clippings to the blank sheets. When these types are covered by the printed supplements issued for the looseleaf manuals, the homemade sheets may be thrown away.

The third step is to identify the new tube with a similar type which appears on the roll chart of the tube tester or to make up the test settings for a unique type. A complete and up-to-date interchangeability chart will frequently be of value in determining kinship of tube types.

"There is nothing new under the sun" is almost always true in new tube types. Usually a new type will be simply a well-known one with different base connections or heater ratings or a combination of two or more single-purpose tubes in one envelope. If the electrical characteristics and base connections of the new type are at hand, it is an easy matter to find a similar type whose test settings are given on the chart of the tester—unless the new one has unusual base connections, in which case a knowledge of the workings of the tube tester, as recommended above, will be necessary.

When comparing published characteristics, the interelectrode capacitances are of no importance and may be neglected since the testing will be done at 60 cycles.

In most tube testers one heater pin, the cathode, the suppressor (if any) and any other elements other than grid, plate and screen of the section of the tube being tested are grounded. (In emission type testers, suppressors are not necessarily grounded; with triodes, of course, there is no screen.)

Which pin goes to the heater supply is selected by a switch or by plugging the tube into the proper one of two or more sockets. The heater voltage is selected by another switch which may or may not be calibrated in volts. If it is simply labeled with consecutive numbers, the meaning of each number in terms of voltage may be determined by referring to the settings on the chart for tube types of known heater voltage. If the tube has a tapped heater, it is essential that the tap be ungrounded. Some of the more flexible tube testers make it possible to test centertapped heater tubes with the two halves in either series or parallel. In the parallel case, both ends of the heater are left grounded, with heater voltage applied to the tap.

A third switch usually selects the plate load resistance for the tube under test. One position will be for all ordinary amplifier tubes, another for rectifiers, a third for diode detectors and perhaps other positions will be provided for pentagrid converters, triodes of unusually low or high transconductance and other tubes of special characteristics. This switch may take the form of a series of pushbuttons.

Grid, plate and screen pins are selected by other switches or pushbuttons. (In emission testers, usually all elements except the cathode are connected together and tested as a diode plate.) A variable resistor is used as a fine adjustment of plate load resistance or as a sensitivity control in the meter circuit. The setting of this control will vary roughly as the plate resistance of the tube type under test and may be estimated fairly closely for a new type of known characteristics from a knowledge of the characteristics of tube types listed on the chart.

Another variable resistance (except in emission testers) is used to adjust the ac excitation applied to the control grid. Settings of this control will vary roughly inversely as the amplification factor of the tube and may be estimated by comparing characteristics as in the case of the plate load or sensitivity control. On a transconductance tester, sharp-cutoff tubes may be differentiated from remote-cutoff (variable-mu) types by noting the manner in which the meter reading varies as the grid excitation control is varied.

Inspection method

Suppose the questionable tube is so new that no published data are available, either in the tube manuals or in the magazine clippings? Most new types are glass miniatures and with the aid of a magnifying glass the base connections may be determined by visual inspection, particularly if you have ever dissected discarded tubes and studied their structure.

In drawing your diagram of base connections, don't forget that the pins are numbered clockwise looking at the base of the tube, whereas you will be looking from the opposite direction since the button of a miniature tube is not very transparent. Be sure also not to overlook any "built-in shorts" (where two or more pins are connected together internally) as frequently found in high-frequency tubes. Otherwise, you may discard a perfectly good tube as being "shorted." An easier method of determining the base connections is by noting the small numbers around the tube symbol on a schematic, if one is available, or by inspecting the connections to the socket underneath the chassis in which the tube is used.

Electrical characteristics other than heater ratings may be estimated by the experienced eye from the tube geometry (relative spacing of elements, pitch of grid windings, cathode area, etc.) and by comparison with types of known characteristics.

Heater ratings may be estimated by inserting the tube in the tester (after having first identified the heater pins) and slowly raising the heater voltage from the lowest tap until the color of the cathode corresponds with that of a similar-looking tube operated at normal heater voltage. If desired, the heater current may now be determined with an ammeter (with normal voltage, as determined above, applied to the heater). When working with tubes taken from a series-string set, it may be simpler and quicker to adjust the heater voltage till the ammeter reads the correct heater current. Then it should be operating at the nominal voltage and the heater should look normal. If the tube is in series with others of known characteristics, its correct heater current is known. Similarly if a tube is in parallel with others which are known, its heater should appear normal at the heater voltage which the others are getting.

A knowledge of the heater current is useful in estimating the other characteristics of the tube inasmuch as the transconductance is roughly proportional, all else being equal, to the heater power (voltage times current).

Characteristics estimated in the manner described, while not highly accurate, are sufficiently so for all practical purposes in tube testing. In combination with a thorough short check, a tube-quality test conducted on the basis of data arrived at by inspection will tell whether or not a given tube could have caused the operational fault of which it is suspected. These data are therefore valuable enough that it is worth while to record them on a looseleaf sheet to be filed in the extra tube-manual binder until the manufacturer's data arrive, and to add the test settings derived from them to the supplementary test data chart.

Even though the type number on a tube may be illegible, the inspection method will still yield the approximate data. If the tube tests *bad*, you have the data to help in finding a replacement for it; if it tests *good*, all you have to worry about is how to file the data sheet. END

THE LABORATORY GOLDEN EAR

By JOSEPH MARSHALL

Part II—Adding variable damping; construction and adjustment

As pointed out in the first part of this article, the Laboratory Golden Ear has gone through many modifications and has not yet reached its final form. (Nor will it do so in the foreseeable future.) Fig. 1 is a basic diagram showing the features which have been more or less preserved throughout the various evolutionary steps. In its present form, the amplifier is used experimentally in testing tubes, transformers, etc., and for other purposes. It is therefore fitted with an assortment of pots by no means necessary for normal use. The photo (Part I) shows an assortment of inputs and outputs not needed by the average user.

Neither schematic nor photo is therefore intended as a model for exact duplication. They are offered as basic ideas to be modified to suit the requirements of the advanced audiophile. The amplifier portion can be built on a 7 x 12 x 3-inch chassis with room to spare. I recommend a separate chassis for the power supply; hum is minimized and low-level intermodulation held down to the vanishing point. Aluminum chassis material is recommended.

Layout is completely noncritical if separate chassis are used. I recommend using Vector turret sockets for the twin-triode portion of the circuit. Better yet are the Vector turret decks; the No. 8-4N-64-2 is a four-socket unit. Completely wired it will hold all the components except the large capacitors and occupy a space a little over 5 inches long, 1½ inches wide and just under 3 inches deep. The deck can be wired completely before mounting on the chassis. All interconnections with the rest of the circuit will come into easily accessible lugs on the bottom of the deck. If you cannot obtain this item from your dealer, Vector Electronic Co., 3352 San Fernando Rd., Los Angeles 65, can supply it direct for about $2.30 plus postage. The pots can be mounted on one end of the chassis. The output-stage components are few and can be mounted from socket to socket. Ceramic or mica-filled sockets are recommended because of the high voltages applied to adjacent plate and screen pins.

Run a common bus bar of No. 18 or larger wire from the input jack to the center terminals of all turrets, or the turret deck, and return all circuit grounds to this bus. Be careful not to ground one of the filament lugs. The filaments are biased about 50 volts; grounding the loop will remove the bias. This may not be noticeable in increased hum but it will increase the IM at low levels.

The power supply (Fig. 3) uses readily available components. If the amplifier is to use a single pair of KT66's, a simpler and cheaper supply with a single 5U4-G and capacitor-input filter can be used (see parts list). With two tubes the no-signal current will be less than 125 ma and maximum-signal current about 175 ma. With four tubes the no-signal current is around 225 ma and maximum under 300.

Variable damping

This amplifier was designed primarily, as its name implies, to serve as a laboratory-grade piece of equipment that can be used for measurements. For this reason, variable damping was not included in the original. However, due to the current popularity of this feature, I did some experimenting with variable-damping circuits and

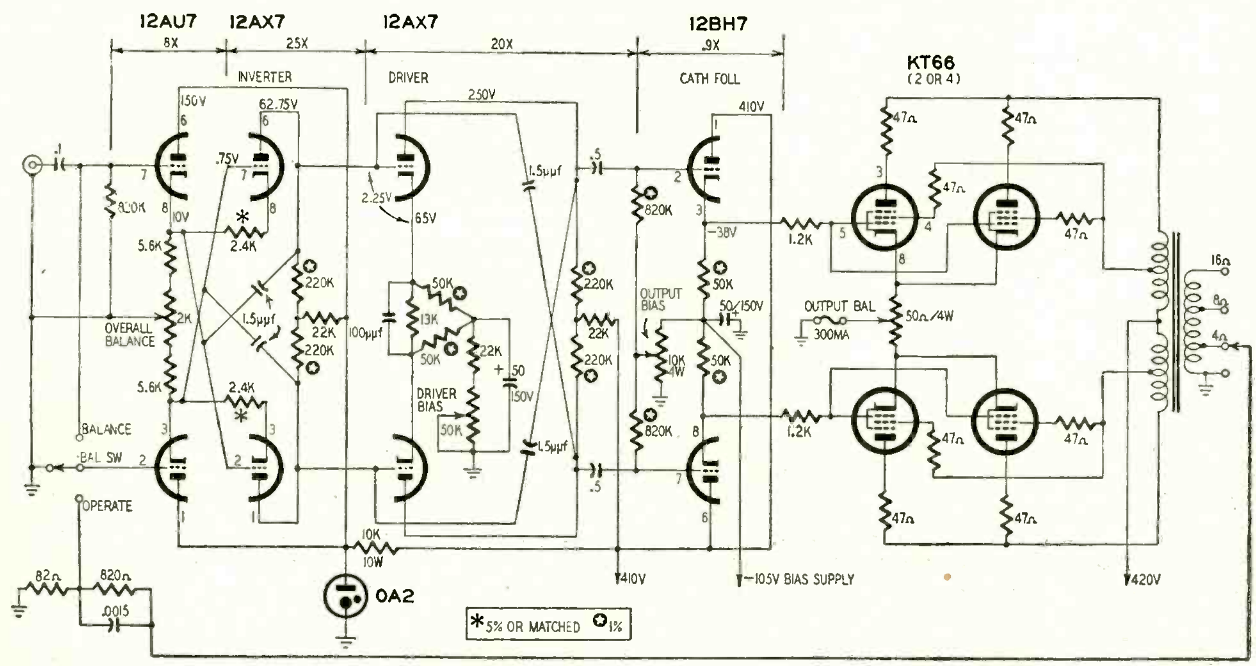


Fig. 1—Schematic diagram of the Laboratory Golden Ear—less power supply.

came up with a modification (Fig. 2) that works well. The feedback circuit now includes switching so the variable-damping feature can be put out of action when using the amplifier for measurements.

The variable-damping arrangement follows the principle used in Bogen's amplifiers. Due to the choice of values, the adjustable current feedback is effective only at frequencies below about 200 cycles. Adjusting the 25-ohm pot provides a choice of either positive current feedback for increased damping or negative current feedback for decreased damping. When the 1-ohm 10-watt variable resistor is correctly set, the 25-ohm unit provides continuous adjustment over a range of about ±10 db. The 100-μf electrolytic capacitor restricts the current feedback to the low frequencies. The 1-ohm resistor will rob the speakers of some power, but audibly the loss is insignificant.

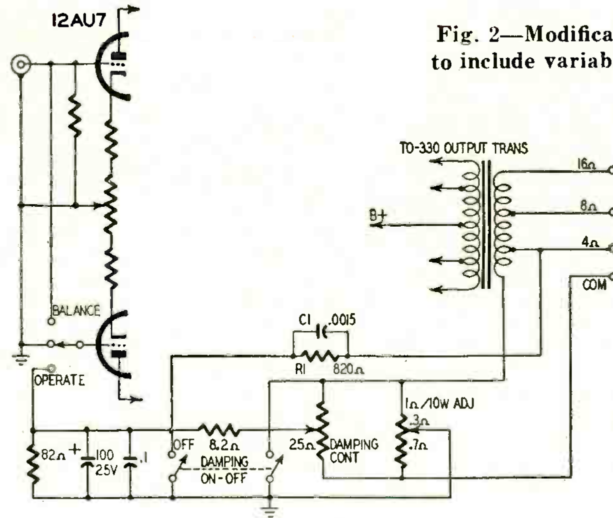


Fig. 2—Modification in feedback line to include variable damping feature.

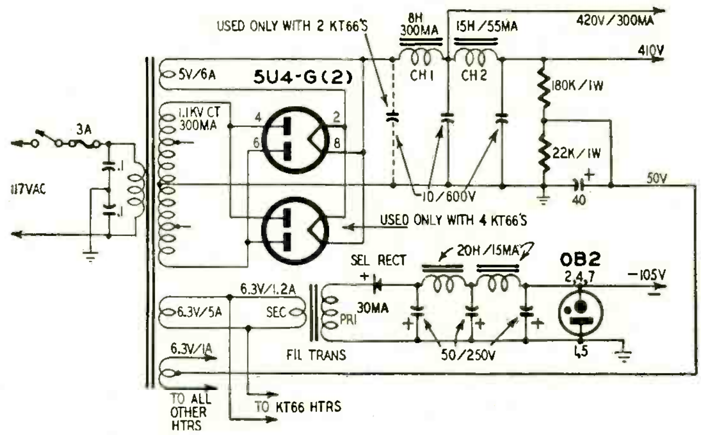


Fig. 3—Schematic diagram of power supply for use with the amplifier.

Adjustment

When the amplifier is finished, check for continuity and shorts with an ohmmeter. When you are sure all is well, adjust as follows:

1. Insert only the 12BH7 with the output bias pot about half on. Connect a vtvm from one cathode to ground and adjust for a reading of *minus* 38 to 40 volts. (It is possible to obtain positive bias, so be sure the polarity of the vtvm is right.)

2. Insert the KT66's and readjust the bias to obtain a total cathode current of about 100 ma for a pair and 200 ma for four KT66's.

3. Balance the output tubes with the output balance control in the cathode leg of the output tubes. Use a voltmeter connected from plate to plate and adjust for zero voltage difference.

4. Insert the other tubes (with power off). Connect the vtvm from cathode to grid of one section of the 12AX7 driver tube. (Be sure it is the same section.) Adjust the driver bias pot for a bias of −2.25 volts.

5. Throw the balance switch to BALANCE (which ties both input grids together and disconnects the feedback loop). Feed in any signal and adjust OVERALL BALANCE in the input tube circuit for a null or minimum output.

6. Set the balancing switch in its center position and feed in a sine-wave signal; adjust the input to provide an output reading of 1 volt.

7. Throw the balance switch to OPERATE. If variable damping is used, inactivate it by throwing its switch to OFF (contacts closed). Observe the reading on an output meter. It should be about 18 to 20 db down from the 1-volt reading (between 0.1 and 0.11 volt). If the reading is higher, reduce the value of feedback resistor R1 (Fig. 2) slightly; if lower, increase the value slightly. If you have a scope and square-wave generator, check the appearance of a 20- or 30-kc square wave; it should be quite vertical and with little or no trace of ringing. If the ringing is excessive, add small capacitances in parallel with phase-shifting capacitor C1 which shunts the feedback resistor. If there is rounding of the leading edge, replace C1 with a smaller capacitance. The values given should be satisfactory unless the capacitor used is way off its rated value.

8. If using variable damping, throw the damping switch to the ON position. If you have a square-wave generator and a scope, set the generator for 200

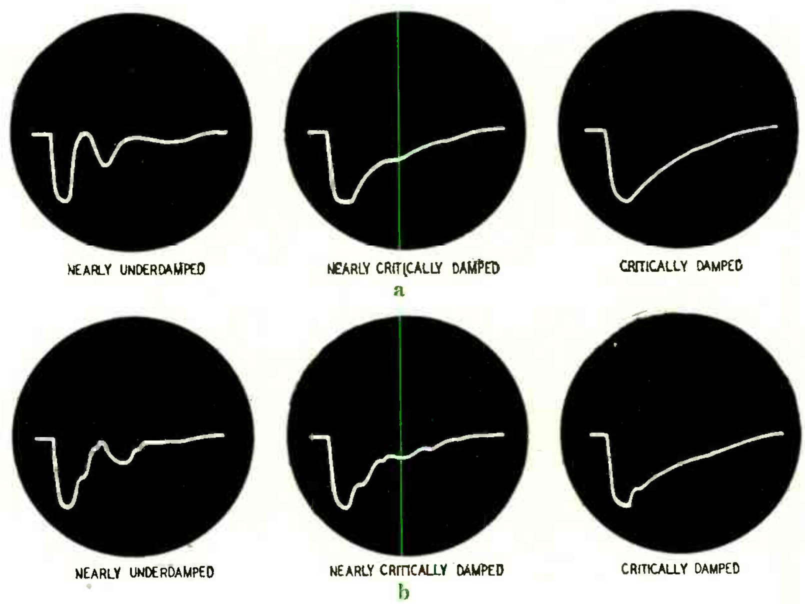


Fig. 4—Effect of the damping control on the keyed step-transient response.

cycles and turn the damping control until you get the flattest and squarest top on the scope trace. This indicates the neutral position of the damping control. If you have no square-wave generator and scope, set the control about half on. Now, with the speaker you are going to use with the amplifier, adjust the damping control for critical damping. The best way to do this is with a step-transient input and a scope across the speaker line. A 1.5-volt cell keyed momentarily into the amplifier input will provide the step transient. For best results the scope should have a triggered sweep. Set the sweep for its lowest rate. Key the 1.5-volt cell and observe the trace. What you want is the nearest approximation to traces indicating critical damping. The traces at *a* in Fig. 4 are those obtained by Tomcik (RADIO-ELECTRONICS, January, 1955) with the speaker in an infinite baffle and those at *b* were obtained with the speaker in a large bass-reflex enclosure. You will probably get a slight bounce or hangover but in any case adjust the control for the smallest bounce or the straightest line.

The adjustment can also be made with the square-wave generator. Again set the generator for 200-cycle square wave and adjust the damping control for flattest top and squarest wave, an indication that the voltage developed across the speaker voice coil is as flat as possible. The adjustment can also be made by ear. Alternately feed 500- and 50-cycle notes to the amplifier and adjust the damping control so both are about the same volume. When adjusting by ear keep the volume as loud as you can stand without endangering the speakers, to make the adjustment at a point where your ear is fairly flat; if you adjust at low volume levels, you will underdamp. The damping control should not be used to obtain a bass boost; it should be used merely to flatten out the speaker peak and to damp speaker hangover. The critically damped point is *not* the point of maximum bass response. If the constants in the feedback loop are adhered to rigidly, adjustment of damping will have only the slightest effect on distortion (raising it from 0.3% to perhaps 0.35% at the most). It is possible for the damping control to produce subsonic oscillation at one extreme or the other with some speakers. This can be verified by watching the inside of the KT66's through the top of the envelope; oscillation will produce periodic ionization. It may also cause the speaker cone to move slowly, and can be measured by meters with good response below 20 cycles.

If you have an IM meter, the final touching up can be done with extreme accuracy. Take an IM reading at a level of about 10 watts. Leave the IM meter on and adjust OVERALL BALANCE for minimum IM. If you like, you can increase the level to just under maximum output and readjust the driver bias control slightly for lowest IM. When adjusting be careful to obtain minimum IM without reducing output more than a fraction of a watt. The OUTPUT BALANCE can be used as a vernier for OVERALL BALANCE. It is possible that using it this way you may sacrifice a watt or so of maximum output, but you can obtain a more complete balance at lower outputs.

There will be some tendency for the adjustments to drift until the tubes are aged. In the early period OVERALL BALANCE can be reset about once a month by the null-output method. After tubes are aged, the adjustments will hold good for long periods.

Listenability

An amplifier such as this could be expected to produce good listening and the expectation is realized. The reserve power is reflected in unusual cleanness in peaks. The definition is exceptional and actually is limited almost entirely by the speaker system. The most notable difference from home type amplifiers is the remarkable ability to handle low frequencies. Given a preamplifier with sufficient stability, the low end can be brought up by bass boosting to provide startlingly realistic reproduction of high-level bass—especially bass drums and tympani. With a smooth bass boost and speakers capable of taking and dishing it out, it is possible to bring these instruments up to true concert-hall level with all their floor-shaking awesomeness. Similarily, the crash of cymbals can be reproduced cleanly, assuming they are recorded with anything like proper dynamic balance. There is never any sense of strain. I have applied as much as 80 db of boost at 20 or 30 cycles (including equalizer boost) and the amplifier takes the bass peaks in stride and with no tendency to break up.

At ordinary home listening levels, however, the improvement over Milady's Golden Ear is so slight that except for record reviewers and others requiring the most complete definition, the much higher cost would probably not be justified. Moreover, the full capabilities are realized only with the very finest speaker systems. But for those who, like myself, chase the phantom of perfection, whether or not it has any practical worth when caught, the Laboratory Golden Ear may satisfy far beyond the added money and time expended. END

Parts for Lab Golden Ear (Fig. 1)

Resistors: 8—47, 1—82, 1—820, 2—1,200, 2—2,400 (5%), 2—5,600, 1—13,000 (5%), 3—22,000, 1—820,000 ohms, ½ watt; 4—50,000, 4—220,000, 2—820,000 ohms, 1%, ½ watt; 1—10,000 ohms, 10 watts; 1—50 (4 watts), 1—2,000, 1—10,000, 1—50,000 ohms, potentiometers.

Capacitors: 4—1.5 (NPO), 1—100 µµf, 1—.0015, 1—0.1, 1—0.5 µf; 2—50 µf, 150 volts, electrolytics.

Tubes: 2—12AX7, 1—12AU7, 1—12BH7, 2 (or 4)—KT66, 1—0A2.

Miscellaneous: 1—7-pin, 4—9-pin miniatures, 2 (or 4) octal, sockets; 1—TO-330 Acrosound output transformer; 4—Vector turret sockets, novel, or No. 8-4N-64-2 turret deck; 1—300-ma fuse and holder; 1—1-pole 3-throw switch; 1—chassis, approximately 7 x 12 x 8 inches, aluminum. (For triode operation use either Chicago BO-11 or Stancor 8052 output transformers.)

Components for variable damping

1—8.2-ohm resistor; 1—1-ohm resistor, with slider, 10 watts; 1—25-ohm potentiometer; 1—0.1-µf capacitor; 1—100-µf 25-volt electrolytic capacitor; 1—dpst switch.

Parts for power supply

1—22,000, 1—180,000 ohms, 1 watt, resistors; 2—0.1-µf 400-volt capacitors; 2 (or 3 for 2 KT66's)—10 µf, 600 volts, electrolytic; 1—40-µf 450-volt, 3—50-µf 250-volt electrolytics; 1 (or 2)—5U4-G, 1—OB2; 2—octal sockets; 1—7-pin miniature socket. 1—3-ampere fuse and holder; 1—selenium rectifier, 30 ma; 2—20-henry filter chokes, 900 ohms (Stancor C1515 or equivalent); 1—filament transformer, 6.3 volts at 1.2 amperes (Stancor P-6134 or equivalent); 1—choke (CH2), 15 henries, 55 ma, 420 ohms (Chicago RC-1555 or equivalent).

For 2 KT66's:

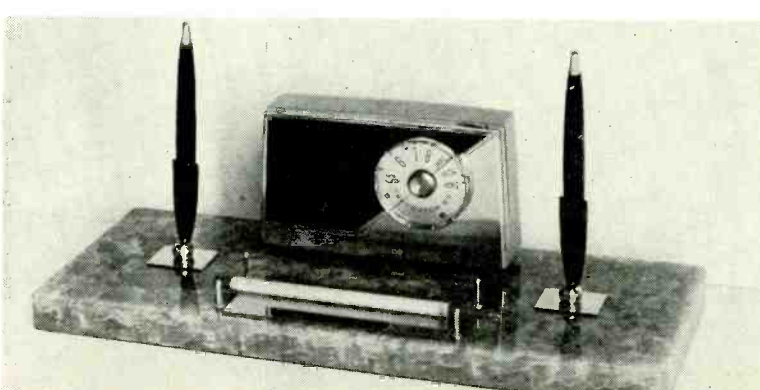
1—power transformer, 800 volts ct at 200 ma, 5 volts at 4 amps, 6.3 volts ct at 5.5 amps (Chicago PV-200 or equivalent); 1—choke (CH1), 8 henries, 200 ma, 125 ohms (Chicago R-7200 or equivalent).

For 4 KT66's

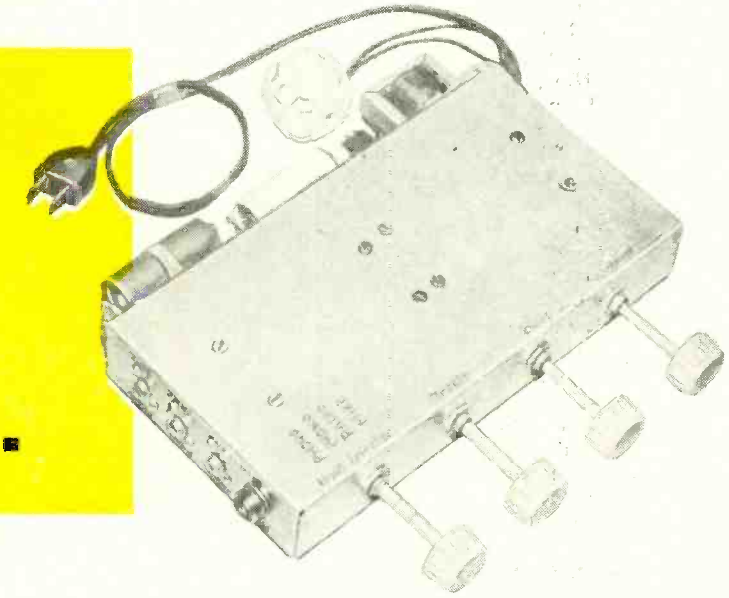
1—power transformer, 1,100 volts ct at 300 ma, 5 volts at 6 amperes, 6.3 volts ct at 5 amps, 6.3 volts ct at 1 amp (Chicago PCR-300 or equivalent); 1—choke (CH1), 8 henries, 300 ma, 60 ohms (Chicago RC-8300 or equivalent).

TRANSISTORIZED EXECUTIVE DESK SET

OLD-TIME readers may remember a construction article on "The Executive" radio–clock desk set. That set, which included a clock radio almost a foot long, 8 inches high and about as deep, remained on Hugo Gernsback's desk for some years. It has now been replaced by this set, which occupies a fraction of the space and has styling far more in keeping with the transistor age. The portable radio is bolted to the desk-set base. There is a hint here for the office-supply manufacturer or even the technician with the right kind of clientele—more than one businessman might like a similar desk set.



HI-FI preamp for easy listening...



Preamp power supply is at the rear.

Transistorized unit features very low hum and distortion, and no microphonics

By J. H. OWENS

HI FI doesn't have to be loud! It can be soft and sweet—just like "Lo Fi" or "Mid Fi"—provided the distortion is low, the overall response smooth and pleasantly balanced at low levels. Of course, the reproduction must not be marred by buzz, hum, rumble, hiss, pops, ticks and other inharmonic, nonrhythmic, attention-attracting extraneous sounds which jar the listener's nerves and callous his senses.

One of the important links in the chain of hi-fi components is the preamp, a link which often becomes the limiting factor in the quest for low distortion, low hum and freedom from microphonics. Insofar as balance is concerned, the preamp–equalizer is almost always the sole controlling element.

So the preamp *is* worthy of review, especially in view of components available today which promise to make performance improvements possible. Transistors alone offer freedom from certain hum sources and microphonics common to tubes. Generally speaking, transistors are more linear than tubes.

But enough about transistors. This is a story of a hi-fi preamp which features low distortion, low hum and low noise, plus the adavntages of continuously variable tone controls. With a bass boost ranging from flat to 20 db up and a treble-control range of 10 db up to 10 down, more or less, lows and highs can be balanced as well for low-level relaxation music as they can for high-level exhilaration sound.

Take the output stage (see diagram), for example. Here a 2N109 is used in a common-emitter circuit which is analogous to a grounded-cathode tube hookup. The signal from the preceding stage is fed to the base; there is collector load resistor R21; an emitter resistor R22 and a base-bias network R18 and R20.

The emitter resistor provides a degree of degeneration which reduces distortion and—of equal importance—stabilizes against the effects of temperature changes. It also helps the circuit accept a range of transistors with considerably different characteristics. However, at this stage of the art (or science) some transistors may still require individual circuit adjustments—and this can be done by increasing or decreasing the value of either or both of the resistors in the bias network. The bias adjustment is for obtaining a voltage at the collector which is about 40 to 50% of the collector supply voltage. Thus the collector voltage should be about 6 to 7 for a 15-volt collector supply. This principle applies to the first and second stages (both of which use 2N109's) although only one 2N109 out of a dozen tested required a change in the bias network.

The first stage will be recognized as either a common-emitter or common-base circuit. Actually, it is either, as desired—the switch not only selects the input but applies it to either the base or the emitter. The selector switch has two other functions: it connects or disconnects the components which convert a constant-velocity to a constant-amplitude characteristic (R6 and C13); it inserts series load resistors (R23 and R24) where needed to match the input impedance to a particular source.

Sound-source positions

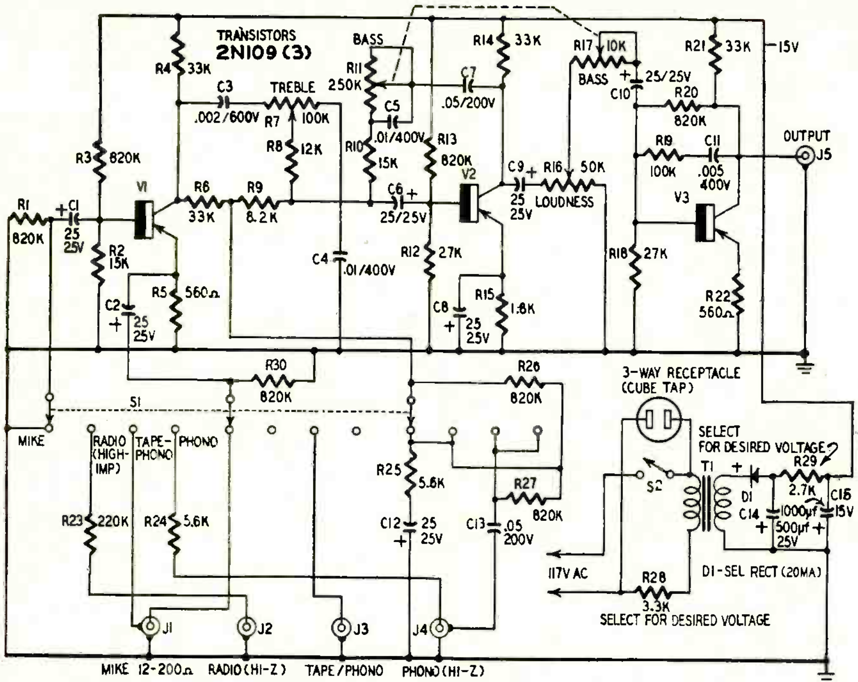
The MIKE position connects a low-impedance microphone to the emitter of the transistor in a common-base circuit. The output of the transistor is attenuated by R6, R25 and C12, but in a nonfrequency-selective manner. This input circuit is for sources with output impedances of approximately 12–200 ohms and may be used with low-level lines as well as mikes.

The RADIO position connects the output of an AM–FM tuner to the base of the transistor in a common-emitter circuit. The input signal goes through R23 which attenuates it to the level of a phono pickup and at the same time increases the input impedance of the preamp as "seen" by the tuner. The output of the transistor is attenuated the same as for mike input.

The TAPE–PHONO position connects the output of a tape reproducer head or a low-impedance phono pickup (like Fairchild or Elector-Sonic) to the emitter of the transistor in a common-base circuit. The output circuit of the transistor (R6 and C3) converts the velocity curve to an amplitude curve.

The PHONO (Hi-Z) position connects the output of a high-impedance magnetic pickup (G-E variable reluctance) to the base of the transistor in a common-emitter circuit. R24 is a series load resistor—a higher value will accentuate highs, a lower value lows. The transistor output is converted from a velocity to an amplitude characteristic as in the tape–phono position.

Many variations are possible. For example, high frequencies can be further accentuated in the radio and phono positions by connecting small capacitors (in series with resistors of 1,000 ohms or so) between the unused contacts of the middle switch section and ground. Or a dynamic microphone with a high-impedance transformer can be connected to the radio position (series resistor R23 might have to be reduced to about 50,000 ohms or so for



Schematic diagram of high-fidelity preamp—unit uses three 2N109 transistors.

maximum gain to be developed).

Resistors R1, R30, R26 and R27 simply maintain capacitors charged at proper levels so that there will be no switching "plops." Should there be a switching plop when going to RADIO position, it will probably be due to a capacitor with no ground return in the tuner. Correction can be made by connecting an 820,000-ohm resistor between the capacitor and ground, either in the tuner or the preamp.

Looking now at the output circuit of the first stage, the treble control stands out as a very simple but effective circuit. Highs are picked off the collector by C3 and adjusted in level by R7. At the other end of R7, highs are bypassed to ground by C4. R8 and R9 are simply isolating resistors which prevent objectionable circuit interaction.

The second stage is the bass booster. In the position where R11 is shorted out, C5 is also short-circuited. Thus, there is negative feedback at all frequencies between the collector and the base, by way of C7 (a dc blocking capacitor) and R10. But when R11 is rotated clockwise, the negative feedback is removed for the lower frequencies which cannot "get through" C5, and a bass boost results. R17 is ganged with R11 as a complementary control. In its maximum-resistance position it increases the effectiveness of the C11–R19 feedback circuit and reduces the gain of the amplifier except at the bass-note frequencies. It works in conjunction with R16, the result being a fair degree of self-compensation with changes in the loudness-control setting.

Finally, the power supply. After long seeking, a suitable power transformer was located—a familiar TV vertical blocking oscillator transformer, readily available at low cost. Hooked up "backward," it provides the necessary step-down ratio for a transistor power supply.

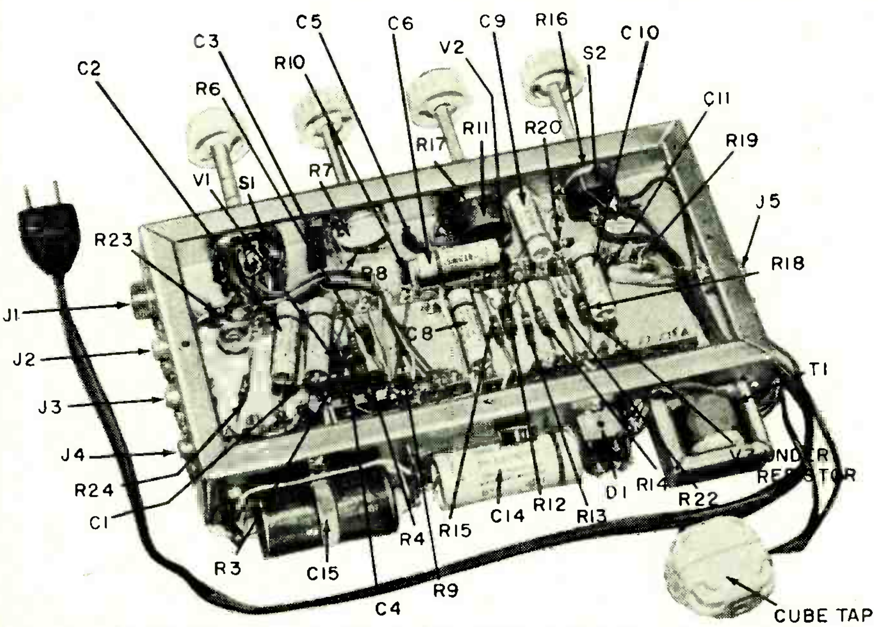
Preamp construction

The entire preamp is built on a 1½ x 9 x 5½-inch chassis with a bottom plate. The power supply is mounted on the rear apron (see photos) to simplify the assembly and guard against hum pickup. This leaves more than enough space inside to mount the resistors, capacitors and transistors, point-to-point, on four eight-point terminal strips.

Electrically, a ground bus is used and connections to it are made progressively from the output stage to the input stage to the input end where the bus goes to chassis ground. The ac line enters the case at the "output end" of the chassis, going to the power switch. A point of novelty is the three-way ac receptacle to which other components in the system may be plugged. Thus the preamp power switch may be used to turn the entire system on and off.

Tests on the model produced very gratifying results. Distortion was measured at 0.25%. Maximum voltage output was over 3 rms. Hum was inaudible at normal levels, as was noise (hiss) produced by the transistors. There was plenty of gain, with adequate reserve for all the sound sources listed.

Consideration was given to provision for compensation (turnover and roll-off) to match the several recording characteristics. This complication was abandoned, however, when experienced ears failed to recognize an improvement over results obtained by adjustment of the bass and treble controls for most pleasing reproduction. END



Underchassis of the preamp; tie strips make for extremely neat circuitry.

Parts for hi-fi preamp

R1, R3, R13, R20, R26, R27, R30—820,000 ohms
R2, R10—15,000 ohms
R4, R6, R14, R21—33,000 ohms
R5, R22—560 ohms
R7—100,000-ohm pot, linear taper
R8—12,000 ohms
R9—8,200 ohms
R11—250,000-ohm pot, log taper
R12, R18—27,000 ohms
R15—1,800 ohms
R16—50,000-ohm pot, log taper
R17—10,000-ohm pot, log taper
R19—100,000 ohms
R23—220,000 ohms
R24, R25—5,600 ohms
R28—3,300 ohms
R29—2,700 ohms
All resistors ½ watt unless otherwise noted
C1, C2, C6, C8, C9, C10, C12—25 μf, 25 volts
C3—.002 μf
C4, C5—.01 μf
C7, C13—.05 μf
C11—.005 μf
C14—500 μf, 25 volts
C15—1,000 μf, 15 volts
Where capacitor voltages are not shown, use any paper units of 200 volts or more.
V1, V2, V3—2N109 transistors
S1—3-pole 4-position shorting type switch (Mallory 3134J or equivalent)
S2—spst switch on R16
J1, J2, J3, J4, J5—jacks or connectors
T1—vertical blocking oscillator transformer, about 1.4:2; primary resistance 208 ohms, secondary 1,060 ohms (RCA 209T1 or equivalent)
D1—selenium rectifier, 20 ma
Chassis—about 1½ x 9½ x 5 inches with bottom plate
Miscellaneous — tie strips — 4 8-point, 3 2-point; 4 knobs; line cord; receptacle.

FOR GOLDEN EARS ONLY

Shure WC10 ceramic cartridge; Elac Miratwin cartridge

By MONITOR

THE Shure WC10 ceramic cartridge is intended as a universal replacement for various crystal, ceramic and even magnetic cartridges. Shure makes no extravagant claims for it and it is highly probable that its excellent performance has been overlooked.

As indicated by Fig. 1, taken directly off the cartridge into the 1-megohm load of a Heathkit ac vtvm, it has a reasonably smooth response under this relatively low load. The response at 8,000 cycles is only 1 db down from that at 1,000 and at 10,000 cycles only 5 db down. Response rolls off pretty sharply beyond that.

The most gratifying thing is the low-frequency response, which is plus 2 db at 50 cycles and 0 db at 30. Most crystal and ceramic cartridges require a much higher load to achieve such a bass response. Indeed, the WC10 delivers an excellent response even into the normal 500,000-ohm input of most amplifiers. The 4-db dip between 1,000 and 6,000 cycles is much less serious to the ear than it looks to the eye. As a matter of fact, the WC10 produces a highly pleasing sound with most of

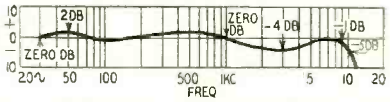
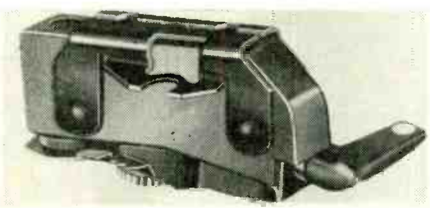


Fig. 1—Response of Shure WC10 cartridge with Dubbings D-101—RIAA curve.

today's recordings. Because of the sharp rolloff beyond 8,000 cycles, it actually sounds cleaner on most pop records than magnetic cartridges of flatter response because most pop records are still much overcut and the spectrum above 8,000 cycles has more distortion than worth-while high highs.

The cartridge is particularly felicitous at 78 rpm on old shellac recordings, which it reproduces with very low scratch and—given a little judicious bass boost—surprisingly good tonal quality. It can also be fed into the low-resistance input of magnetic preamps and works acceptably well with magnetic equalizers—though there is some possibility of overloading modern high-gain preamps. Distortion is very low. All in all, this is one of the best of the piezo cartridges. While it does not come up to the finest (and most expensive) of today's magnetics, I am confident that most people will be hard put to tell it from some of the magnetics. Its higher output, lower susceptibility to hum and low price are advantages which should give it wider application in the high-fidelity field.



The Shure WC10 ceramic cartridge.

Elac Miratwin cartridge

The Miratwin, the product of the same mechanical ingenuity which produced the Miracord changer, presents along with first-class performance several innovations.

Performancewise the Miratwin ranks with the finest available cartridges. Under optimum conditions my sample delivered a response (Fig. 2-a) flat within 2 db to 19,000 cycles at 33 rpm, to 22 kc at 78 rpm (into a pentode preamp, very low-capacitance input, short three-wire cable). Fed into a good equalizer with a 50,000-ohm triode input, through 3 feet of shielded cable, it delivered the response of Fig. 2-b. It is notably indifferent to load, both resistive and capacitive. Decreasing load resistance or increasing capacitance produces a quicker rolloff at the high end, but the capacitance has to be very high to produce a peak and even then it is broad and results in no serious deterioration of audible quality.

The response to the square waves (Fig. 3) on the Folkways test record is very good. The distortion with a pressure of 8 grams is among the lowest I have registered. The tracking ability is very fine, even when the cartridge is used in a changer rather than an expensive independent arm. The output is among the highest but not high enough to overload a good preamp. The cartridge is very well shielded and this, along with its low impedance and high output, results in an extremely good hum figure when used with low-hum turntables.

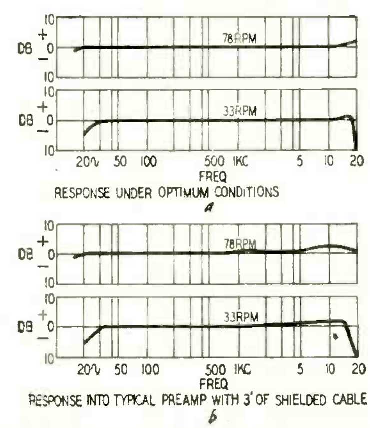


Fig. 2—Miratwin cartridge response.

Fig. 3—Miratwin square-wave response.

The listening quality is very satisfying; the highs especially are clean and sweet. Furthermore, the needle chatter is phenomenally low—almost nonexistent on the best modern classical records—and this seems to make the highs even cleaner. It is one of the two or three wide-range cartridges I have used which seldom requires any rolloff and can, in fact, stand considerable boost above 10 kc. Its wide response therefore, is really useful.

One innovation, long overdue, is that every Miratwin is numbered and tested for response by an independent laboratory and comes with a pen recorder chart of response at 10 frequencies. The frequencies are not specified but the overall curve can be inferred easily.

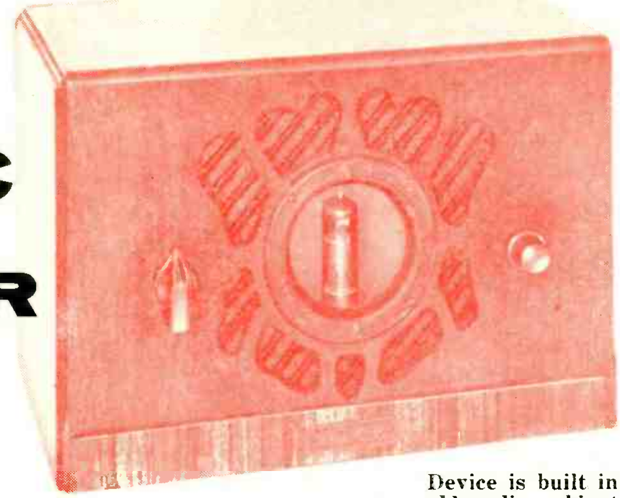
The mechanical design also has some very commendable points. The cartridge consists of two independent movements (similar in appearance to the Pickering 240 series) fastened back to back in a turnover mount. The cartridges can be removed from the mount without any tools and the mount can therefore be used in even the most cramped arm with a minimum of inconvenience. The mount has a grounding lug so that it and the arm to which it is attached can be grounded—if they are not already grounded on the turntable.

An admirable feature is the needle. It can be changed in seconds with only the fingers; this should encourage more frequent change. There is no gap in which dust can clog and spoil compliance. The needle can be wiped of dust with a brush without any danger of removing damping material. The price is moderate—under $25 with sapphire needles. END

A commercial killer that works!

SPEECH-MUSIC DISCRIMINATOR

By EDWARD E. PREDMORE



Device is built in old radio cabinet

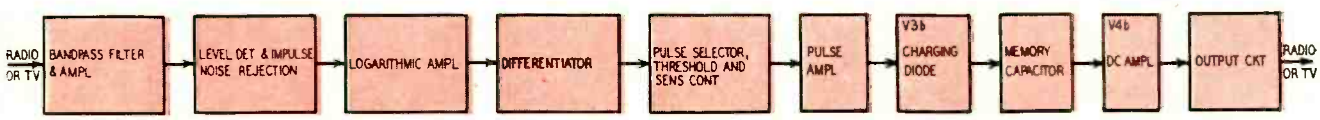


Fig. 1—Block diagram shows sequence of circuits in speech–music discriminator—unit is highly selective.

AN electronic device to discriminate between speech and music (Fig. 1) was described in the August, 1955, issue of RADIO-ELECTRONICS. Unfortunately, the unit fell considerably short of my expectations. After spending considerable time on the circuit, as explained in my letter of January, 1956 (Correspondence, page 16), I was able to obtain excellent results.

The device can be made to work in 1 minute by changing tubes V3 and V4 to type 12AX7. As soon as I did this, it differentiated between a singing commercial and Jimmy Durante "singing" a song. It let 100% of Durante through and rejected 80% of the singing commercial. I believe these are the tubes for which the gadget was originally designed, as the 10,000-ohm threshold resistor is then the optimum value if operated as a fixed resistor.

I now wish to apologize to Genius R. C. Jones, who invented this, for the doubts concerning him expessed in my letter in the January, 1956, issue. It would be very interesting to have Mr. Jones tell how the difference between speech and music was discovered, if he happens to read these lines.

The block diagram shown is the same as the original circuit, made by the Vocatrol Corp., Cambridge, Mass. The circuit (Fig. 2) is the revised one. I used Music Appreciation Record MR18A *Analysis of Beethoven's Fifth Symphony* as a convenient controlled repetitive source of alternate speech and music. It gives an excellent speech–music ratio as measured by the voltages across the 2-μf integrating capacitor C1.

10K and threshold	Sensitivity	Voltage on C1 speech	Voltage on C1 music (max.)
30K	maximum	−5 to −8	−1.0
15K	reduced	−5 to −8	−1.3
15K	maximum	−12 min.	−1.9
10K	reduced	−5 to −8	−2.4

Adding the .001-μf capacitor from the cathode of V2-a to ground improves the speech–music ratio about 10%. This ratio is further improved by having the threshold resistor as a variable control, as shown. The threshold bias rejects pulses whose peak is below the selected voltage and clips the base off larger pulses. The table shows the performance of the device with various threshold control settings, using miniature tubes. The output is flipped when the voltage across integrating capacitor C1 passes −2.8 volts.

Thus, using maximum possible threshold and full sensitivity gives the best speech-to-music ratio. For the 10,000-ohm setting it works but barely. For 15,000 ohms the speech voltage is too high and takes too long to die out after voice ceases, thus losing too much of the following music. Reducing the sensitivity corrects this but raising the threshold to 30,000 ohms does likewise and gives a greater margin for error. This margin is greatly desired for speakers who do not talk crisply and for singers. The performance using 15,000 ohms corresponds to that of about 12,000 ohms using the slightly lower-gain 6SL7 tubes.

Unfortunately, although these changes improve the ratio of voltages developed between speech and music, they do not improve the gadget's IQ very much, for it still has some trou-

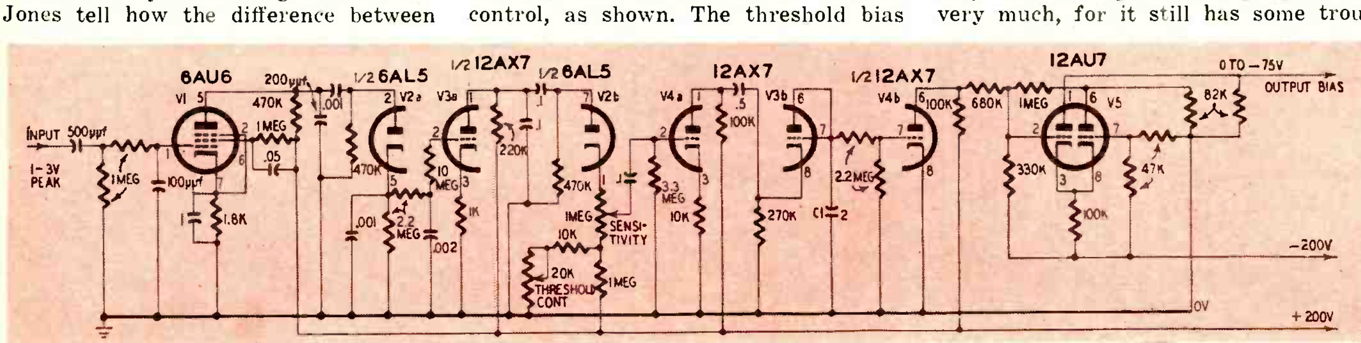
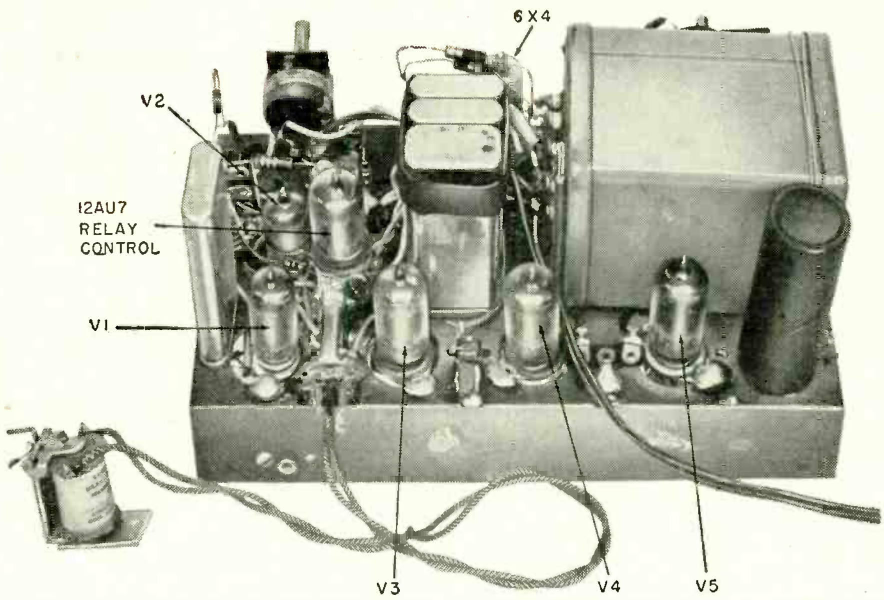
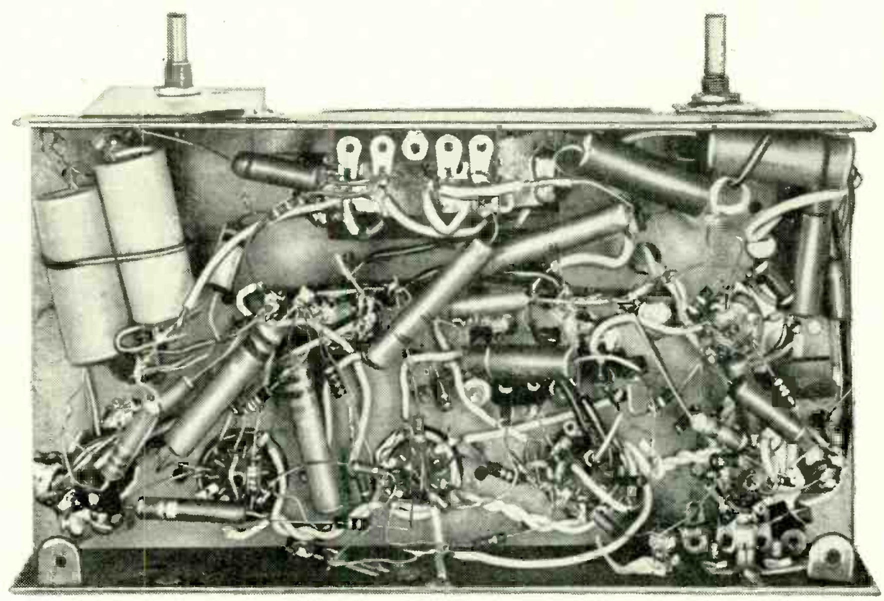


Fig. 2—Schematic diagram of the speech–music discriminator. Device is automatic and contains threshold control.

ble distinguishing between some girl "pop" singers and a singing commercial. Also, I ran across one cornet solo which the gadget insisted was speech, or to put it more correctly, the envelope of this music contained a 10-cycle component large enough to activate the gadget.



Unit is built on a radio chassis, using components author had on hand.


Underchassis layout of discriminator.

Circuit description

The theory of operation given in the August, 1955, issue seems correct and complete. I'll go through the discriminator, making operational and adjustment comments.

The input should have peaks between 1 and 3 volts. This is what the detector of my Craftsman RC10 tuner puts out on both AM and FM, so this is convenient.

Input stage VI is a bandpass amplifier, rolling off at 300 and 1,500 cycles. V2-a is a simple detector or half-wave rectifier giving the positive half envelope of the audio-frequency voltage.

V3-a, the logarithmic amplifier, can be explained as follows (with the help of Vocatrol Corp.): Consider just the grid and cathode as a diode. A positive pulse from the detector V2-a causes the grid to draw current. The positive pulse is then divided between the series grid resistors and the dynamic grid resistance of the tube, the resultant grid voltage being approximately proportional to the log of the applied positive voltage. This is amplified by V3-a as a triode. It certainly needs amplifying at this point, for the grid attenuates the peaks several hundred to one.

The plate circuit of V3-a is a low-pass filter rolling off at 8 cycles. The coupling to the next stage passes above 3 cycles as do the following coupling circuits. The 0.1-μf coupling capacitor in the plate circuit of V3-a differentiates each word pulse, giving a short negative pulse for the start and a short positive pulse for the end of the word pulse. This capacitor seems a bit large for this job but I have not been able to show that a smaller one (.03 or .05 μf) works any better; less works worse.

V2-b is another rectifier used to select only pulses due to the stopping of speech syllables. Positive pulses applied to the plate of V2-b cause the diode to draw current and thus pass these positive pulses. The negative pulses simply cut the tube off further and are lost completely. The threshold resistors—the 10,000-ohm resistor and the 20,000-ohm pot—act as a voltage divider along with the 1-megohm fixed resistor to apply a positive bias on the cathode of V2-b. The positive pulse must rise above this bias (plus contact potential) before it causes the tube to conduct and thus pass the pulse. In this way the bias cuts off the base of a large pulse and eliminates small positive pulses.

Speech generates large pulses and noise and music generate small pulses. I find that for orchestral music I keep the threshold at 25,000 ohms and sensitivity at maximum. This works practically perfectly . . . but some popular female vocalist will flip it at this value (and some announcers who slur their speech will not). Announcers connected with classical music seem to talk crisply, and on a classical music program the speech–music discriminator can be set and forgotten. On a popular music program the controls require adjustment to match the music and the announcer.

V4-a is a simple amplifier which inverts the pulse. This negative pulse applied to diode-connected V3-b causes it to draw current, producing a negative voltage on the 2-μf integrating capacitor. This voltage builds up sharply with each pulse as it is charged through the relatively low-impedance path of V3-b and V4-a. It discharges slowly between pulses as it can only discharge through the two 2-megohm resistors in series, and takes 8 seconds to lose 63% of any voltage left on it.

This voltage is direct-connected to and amplified by V4-b, whose plate is direct-connected to V5, the flip-flop stage. As the plate of V4-b goes more positive, due to the negative voltage on C1, it causes the left side of V5 to conduct and the right side to cut off. The 1-megohm resistor from the grid to plate helps this action to be more abrupt.

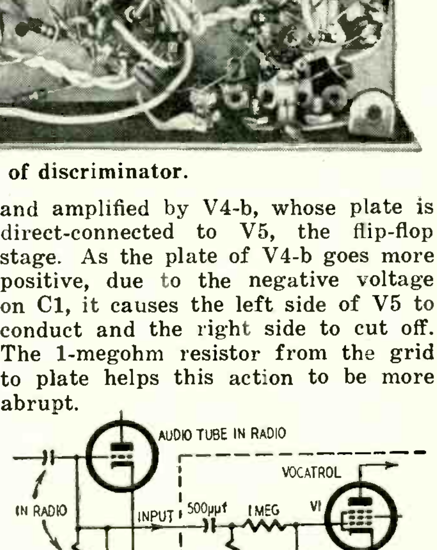


Fig. 3—Circuitry for receiver connection—relay control stage may be used.

As the right side cuts off, its plate voltage rises and this rise partially passes through the 1-megohm resistor to help the left side conduct. The current of the left side conducting passes through the common cathode resistor and the voltage generated tends to cut off the right side. This works in reverse when the voltage across C1 passes −2.8 volts going toward zero.

The output bias varies from zero to −75 volts. There is not much left of this after it passes through the 22-megohm isolating resistor (Fig. 3). It is enough to cut off a 12AX7 in the radio if it has a 2.2-megohm grid resistor. For a 12AU7 the isolating resistor must be greatly reduced.

My hi-fi rig already has a commercial killer that responds to those stations broadcasting 20 kc and 35 kc before and after the commercial and this operates a 1.5-ma plate relay (Fig. 4) across the input to my Williamson type amplifier. I disconnected its coil and

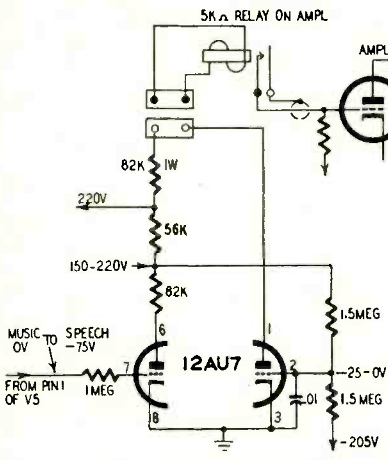


Fig. 4—Relay control stage diagram.

added a connector so it could be used with either commercial killer. I then added a stage to operate this relay. Also, using a shorting relay reduces the range of partial cutoff to zero width. As the speech–music discriminator draws more current from the positive supply during music than speech, I made the balancing half of this tube draw less current than the control half. Also, if the hot line to the relay is accidentally touched while manipulating the plug, you cannot get more than about 2 ma shock current, which is reasonably safe.

The power supply (Fig. 5) was a bit of a nuisance, although with a variable threshold control anything reasonably near ±200 volts will do. However, either the power supply should be

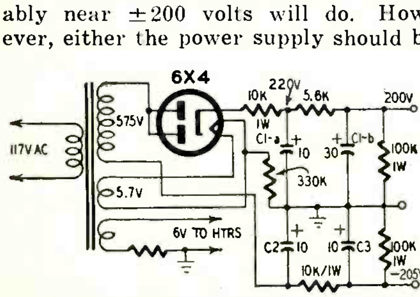


Fig. 5—Discriminator power supply.

low impedance so the voltages do not vary with the load or the load should be made constant. The latter is done when adding the relay control stage.

The power supply was made with parts on hand. A 350-volt transformer would be better as it would permit the dropping resistors to be reduced to the few ohms needed to limit the peak rectifier current and would reduce the power supply impedance. Capacitors C2 and C3 must be separate from C1 and the *negative* side insulated from ground. I ran the 6X4 heater on the 5-volt winding as my 6.3 winding was loaded to capacity, and it does not take much heat to boil out the 4 ma this thing uses for B plus (including relay tube and bleeder). As my line voltage is fairly constant, I design for 6 volts on the heaters. And thinking of heaters, note the 5 volts on the 12AU7 in the vtvm attachment (Fig. 6). This was adapted from the circuit given in the RCA tube manual, which uses 10 volts on the 12.6 connection. The manual uses a 200-μa meter.

Adjustments

As a vtvm is absolutely necessary to measure across C1 (Fig. 2), I include the adapter made for my Triplett 630 meter. You can see the ac pulses with a scope on the cathode of V3-b, but it is the resultant integrated voltage across C1 that is of prime interest.

The cathode resistor (Fig. 6) was chosen so the 5,000-ohm pot adds only a few ohms in series with the meter. The circuit shown gives 0.6, 12 and 72 volts for full-scale deflection, the 0.6 being direct connection to the grid with the 3.3-megohm resistor disconnected. The other two are through the 22-megohm isolating resistor to the top and bottom of the 3.3-megohm resistor, respectively. If you use a multimeter for this, *before disconnecting* it from the circuit, *switch it off* the microamps scale. And when setting it up, switch it on this scale the *last* thing. This is so much easier than straightening out a horrible bend in the meter pointer.

Building this device is a real pleasure for there is not a thing critical about any of the circuits in it, and it uses only standard parts. There is not a single tuned circuit or inductance except the relay, and a ±20% tolerance is more than adequate for any of the circuit elements. Placement or length of leads is almost completely unimportant as V1 is a midrange amplifier with highs and lows not wanted, and the rest of the circuits are designed to pass 10 cycles. The only construction caution is to keep the 2- and 10-megohm resistors close to the grid terminals and the high-voltage ac leads away from them to reduce 60-cycle pickup at these high-impedance points.

The cabinetry

Some time ago I picked up a small discarded table-model radio from a trash can. Its wood cabinet was in fair condition and its 8 x 5 x 2-inch chassis just about holds the components used. The two pots use the original tuning and volume control holes. I covered the speaker cutout on the chassis with a piece of metal from a tin can. It soldered easily to the chassis and my 6X4 is mounted in the center of it (see photo). The 6X4 is visible and replaceable through the hole in the front of the cabinet formerly used by the tuning dial. It is backed up by a piece of black paper and makes a good-looking, out-of-the-ordinary pilot light (and saves buying one).

Parts for discriminator (with power supply)

Resistors: 1—1,000, 1—1,800, 1—5,600, 1—10,000, 2—47,000, 2—82,000, 3—100,000, 1—220,000, 1—270,000, 2—330,000, 3—470,000, 1—680,000 ohms, 5—1, 4—2.2, 1—3.3, 1—10 megohms, ½ watt; 2—10,000, 2—100,000 ohms, 1 watt; 1—20,000 ohms, 1—1 megohm, potentiometers.

Capacitors: 1—100, 1—200, 1—500 μμf; 2—.001, 1—.002, 1—.05, 3—0.1, 1—0.5, 1—1, 1—2 μf; 1—10-30 μf, 2—10 μf, 350 volts, electrolytics.

Miscellaneous: 1—6AU6, 1—6AL5, 2—12AX7, 1—12AU7, 1—6X4, tubes; 3—7-pin, 3—9-pin miniature sockets; 1—power transformer (see text); 1—chassis, approximately 8 x 5 x 2 inches; 1—cabinet.

Parts for relay control stage

1—56,000, 1—82,000, ohms, 1—1, 2—1.5 megohms, ½ watt; 1—82,000 ohms, 1 watt, resistors; 1—.01-μf capacitor; 1—12AU7; 1—9-pin miniature socket. 1—relay, 1.5 ma, 5,000 ohms, spst; 1—set of male and female connectors.

Parts for vtvm adaptor (Fig. 6)

2—12,000, 1—33,000, 1—820,000 ohms, 1—3.3, 2—5.6, 1—22 megohms, ½ watt; 1—5,000, 1—15,000 ohms, potentiometers; 1—12AU7; 1—9-pin miniature socket; 1—60-μamp meter.

I have enjoyed my speech–music discriminator for the past several months, particularly when my favorite station was in the throes of its "American Music Festival" most of which I don't consider to be music. I was forced to another station with good music but many commercials, some of which were highly objectionable. The SMD works perfectly and gives me many pleasant hours of music interrupted by periods of silence rather than by the bleating of commercials. It also frees you from the necessity of listening to the same five minutes of news every hour on the hour. END

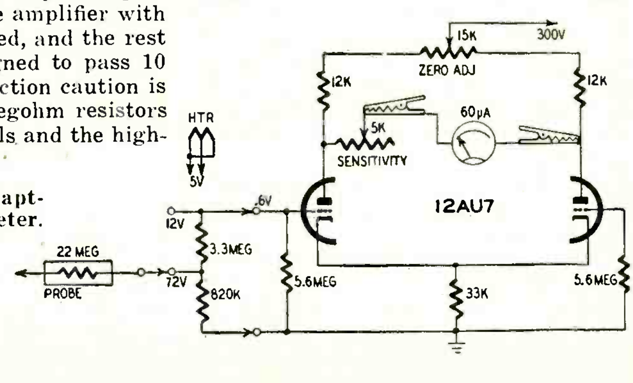


Fig. 6—Vtvm adapter for 60-μamp meter.

New

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* *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5″ Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 1½ DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

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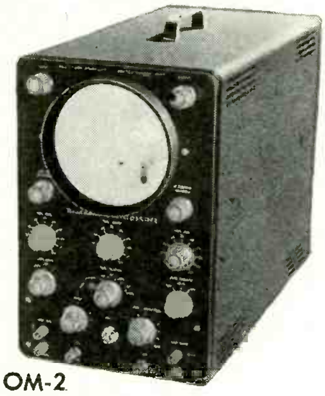
GREATEST SELECTION . . .

Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New **HEATHKIT ETCHED CIRCUIT**

5" Oscilloscope Kit

* *Brand new model with improved performance specifications.*
* *Full 5" scope for service work at a remarkably low price.*
* *Attractively styled front panel in charcoal gray with sharp white lettering.*
* *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*



This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.

MODEL OM-2

$42.50 *Shpg. Wt. 21 Lbs.*

HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

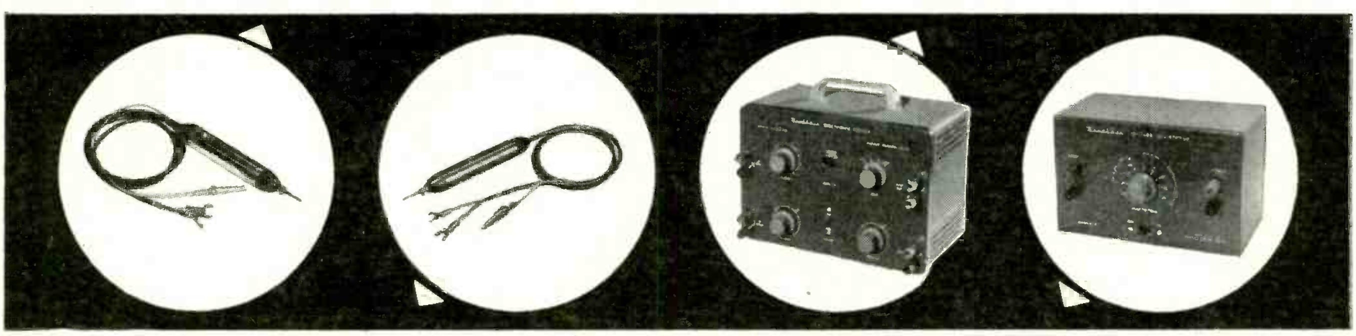
$3.50 *Shpg. Wt. 1 Lb.*

HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

$21.95 *Shpg. Wt. 8 Lbs.*



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

$3.50 *Shpg. Wt. 1 Lb.*

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

$12.50 *Shpg. Wt. 4 Lbs.*

HEATHKIT ETCHED CIRCUIT VACUUM TUBE Voltmeter Kit

MODEL V-7A

$24.50

Shpg. Wt. 7 Lbs.

- * *Easy to build — a pleasure to use.*
- * *1% precision resistors employed for high accuracy.*
- * *Etched circuit board cuts assembly time in half.*

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C **$3.50** Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

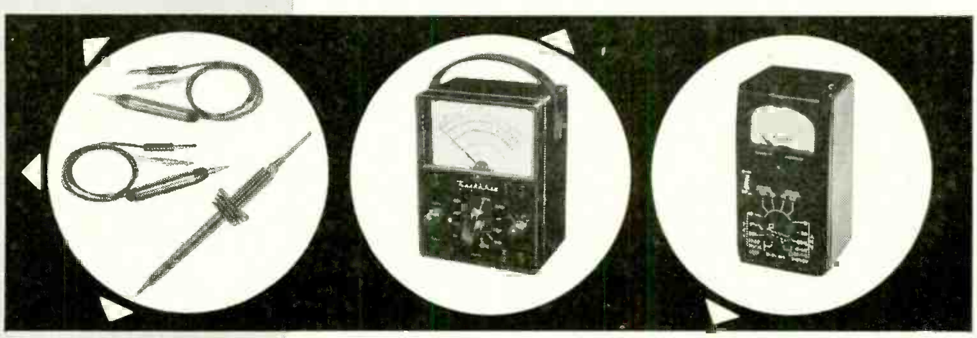
Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1 **$29.50** Shpg. Wt. 6 Lbs.

HEATHKIT SCOPE DEMODULATOR PROBE KIT

This probe functions like an AM detector to pass only modulation of signal and not signal itself. Permits observation of modulation from RF or IF carriers in TV and radio receivers. Extends usefulness of your oscilloscope. Voltage limits are 30 V. rms, and 500 V. DC. Very valuable in service or laboratory applications.

No. 337-C **$3.50** Shpg. Wt. 1 Lb.



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336 **$4.50** Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1 **$14.50** Shpg. Wt. 3 Lbs.

HEATH COMPANY
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BENTON HARBOR 20, MICH.

CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- *Brand new circuit for extended frequency response and added stability.*
- *Ten accurate ranges from 0-.01 to 0-300 volts.*
- *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3

$29.50

Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1

$29.50

Shpg. Wt. 6 Lbs.

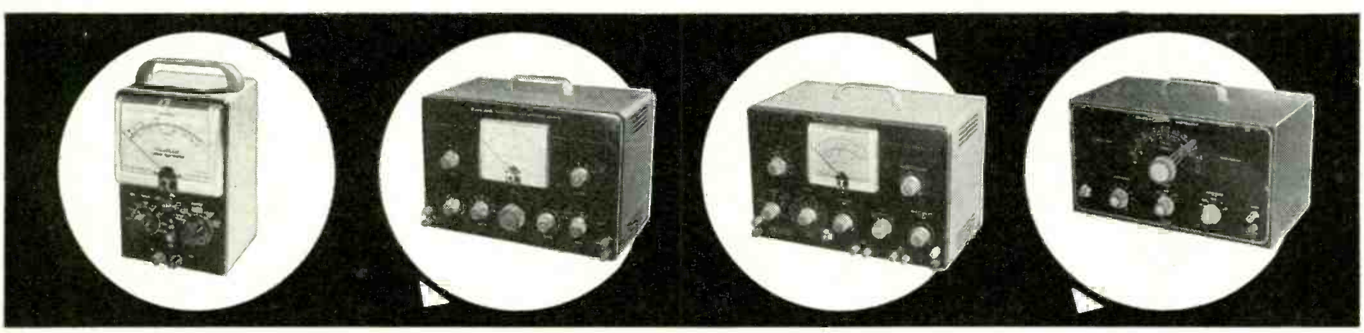
HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1

$59.50

Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1

$49.50

Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1

$24.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Audio Generator Kit

✱ *Less than 0.1% distortion — ideal for hi fi work.*

✱ *Large 4½" meter indicates output.*

✱ *Step-type tuning for maximum convenience.*

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1
$5.50
Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica. or plastic molded.

MODEL CS-1
$5.50
Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8
$29.50
Shpg. Wt. 11 Lbs.

HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1
$16.50
Shpg. Wt. 3 Lbs.

HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1
$19.50
Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3
$35.50
Shpg. Wt. 17 Lbs.

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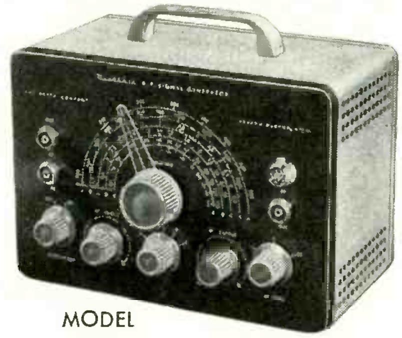
BENTON HARBOR 20, MICH.

BONUS PERFORMANCE . . .
If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

* *No calibration required with pre-aligned coils.*
* *Modulated or unmodulated RF output.*
* *110 mc to 220 mc frequency coverage.*



MODEL SG-8

$19.50 Shpg. Wt. 8 Lbs.

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

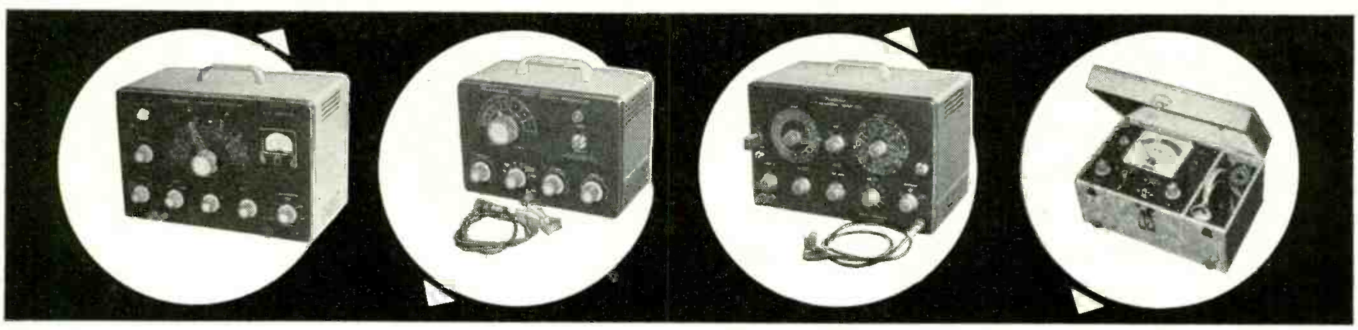
This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1 **$39.50** Shpg. Wt. 16 Lbs.

HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A **$49.50** Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV Service shop.

MODEL LP-2 **$22.50** Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1 **$22.50** Shpg. Wt. 10 Lbs.

HEATHKIT

Tube Checker Kit

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

* *Attractive counter-style cabinet.*
* *Wiring-harness simplifies assembly.*
* *Large 4½" meter with two-color "good-bad" scale.*
* *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355
$4.50
Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P
$34.50 Shpg. Wt. 15 lbs.

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3
$23.50
Shpg. Wt. 9 Lbs.

HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1
$29.50
Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3
$19.50
Shpg. Wt. 7 Lbs.

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BENTON HARBOR 20, MICH.

PIONEER DESIGN . . .

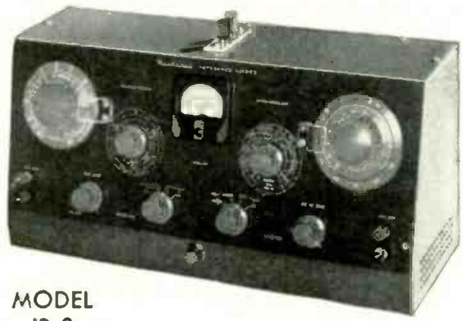
New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- *½% precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.



MODEL IB-2

$59.50 Shpg. Wt. 12 Lbs.

HEATHKIT "Q" METER KIT

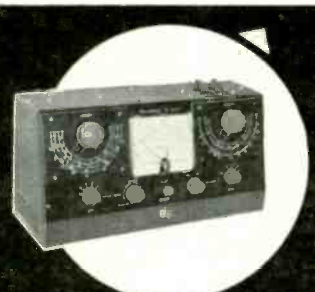
The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "W" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

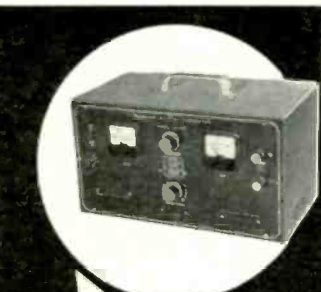
MODEL QM-1 **$44.50** Shpg. Wt. 14 Lbs.

HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1 **$16.50** Shpg. Wt. 9 Lbs.





HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4 **$31.50** Shpg. Wt. 17 Lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1 **$14.50** Shpg. Wt. 6 Lbs.

HEATHKIT DX-100 PHONE AND CW Transmitter Kit

MODEL DX-100
Shpg. Wt. 107 Lbs.

$189.50

Shipped motor freight unless otherwise specified. $50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jacks—and automatic gain control. Has built-in VFO for CW reception.

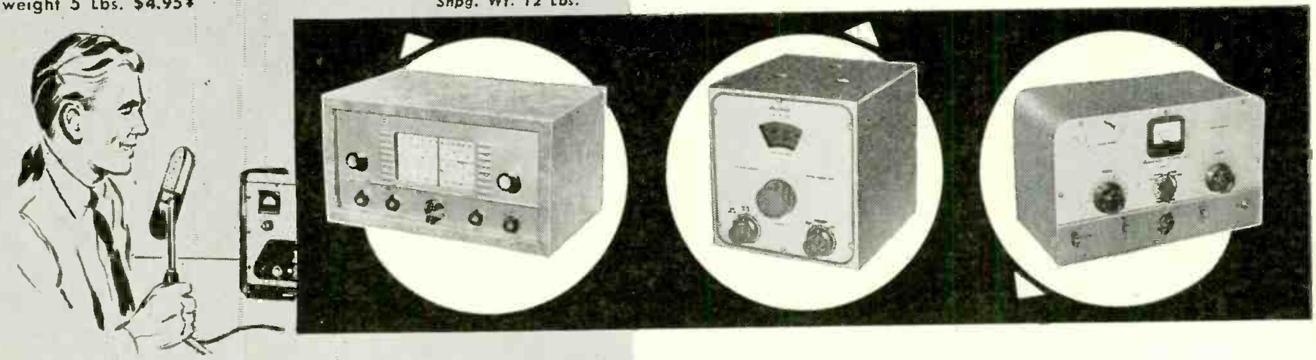
MODEL AR-3 **$30.75** INCLUDING NEW EXCISE TAX‡ (Less Cabinet) Shpg. Wt. 12 Lbs.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95‡

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1 **$19.50** Shpg. Wt. 7 Lbs.



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 20, MICH.

HEATHKIT CW TRANSMITTER KIT

This is the original low-priced Heathkit CW transmitter. Its reliable performance has been proven time and time again on the CW bands. Designed for crystal control, the Model AT-1 covers 80, 40, 20, 15, 11, and 10 meters. May be excited from external VFO. Plate power input up to 30 watts. Power supply built in. Panel meter indicates grid current or plate current for final. Incorporates pre-wound coils, copper-plated chassis, built-in line filter, profuse shielding, and top-quality parts throughout. Crystal socket and key jack on front panel. Built-in key-click filter, and single-knob bandswitching. 52-ohm coaxial output. Uses 6AG7 oscillator-multiplier, 6L6 power amplifier-doubler, and 5U4G rectifier.

MODEL AT-1 **$29.50** Shpg. Wt. 15 Lbs.

DOLLAR-SAVING ECONOMY . . .
There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off—CW—stand-by—phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

MODEL DX-35

$56.95 Shpg. Wt. 24 Lbs.

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

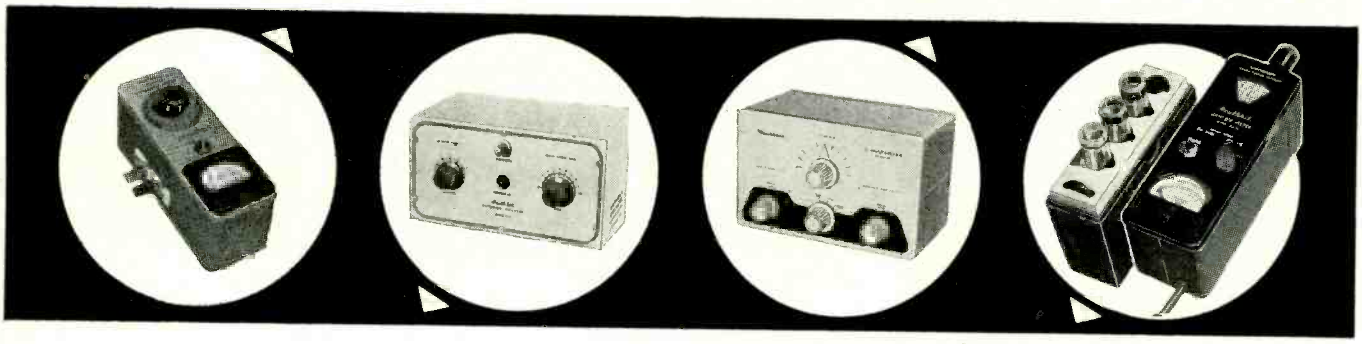
$14.50 Shpg. Wt. 2 Lbs.

HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95 Shpg. Wt. 3 Lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50 Shpg. Wt. 4 Lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GB-1B

$19.50 Shpg. Wt. 4 Lbs.

HEATHKIT BROADCAST BAND Receiver Kit

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$19.25 INCLUDING NEW EXCISE TAX*

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- * *Miniature tubes and high-gain IF transformer.*
- * *Rod-type built-in antenna. Good sensitivity and selectivity.*
- * *5½-inch PM speaker.*
- * *Provision for phono jack.*
- * *Transformer - operated power supply.*

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A $4.95*

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$8.75
INCLUDING NEW EXCISE TAX*
Shpg. Wt. 3 Lbs.

- * *Amazing new circuit for high efficiency.*
- * *Compact, portable and rugged.*
- * *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

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COMPREHENSIVE INSTRUCTIONS . . .

The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.

MODEL WA-P2 *(With Cabinet)* *Shpg. Wt. 7 Lbs.*

$21.75 INCLUDING NEW EXCISE TAX‡

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A

$26.95* INCLUDING NEW EXCISE TAX‡ *(With Cabinet)* *Shpg. Wt. 7 Lbs.*

HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1

$26.95 INCLUDING NEW EXCISE TAX‡ *(With Cabinet)* *Shpg. Wt. 8 Lbs.*

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 35,000 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1

$18.95 *Shpg. Wt. 6 Lbs.*

HEATHKIT ADVANCED-DESIGN HIGH FIDELITY

Amplifier Kit

MODEL W-5M
Shpg. Wt. 31 Lbs.
Express Only

$59.75

MODEL W-5:
Consists of Model W-5M *plus* Model WA-P2 preamplifier.
Shpg. Wt. 38 Lbs.
Express only.... $81.50‡

* *Full 25 watt output with KT-66 output tubes.*

* *All connectors brought out to front chassis apron.*

* *Protective cover over all above-chassis components.*

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only........ $49.75

MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only............. $71.50‡

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 2.7% at this same level. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only....... $39.75

MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only.............. $61.50‡

HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. Shpg. Wt. 10 Lbs.

MODEL A-7D
$18.65
INCLUDING NEW EXCISE TAX‡

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. $20.35‡

HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

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BENTON HARBOR 20, MICH.

All prices marked with a ‡ include a 10% federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,

HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending

SPEAKER SYSTEM KIT

- *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
- *Easy-to-assemble cabinet of furniture-grade plywood.*
- *Attractively styled to fit into any living room. Matches Model SS-1.*

MODEL SS-1B

$99.95 Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY

SPEAKER SYSTEM KIT

MODEL SS-1

$39.95 Shpg. Wt. 30 Lbs.

- *Special design ducted-port, bass-reflex enclosure.*
- *Two separate speakers for high and low frequencies.*
- *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

HEATH COMPANY A Subsidiary of Daystrom, Inc. **BENTON HARBOR 20, MICH.**

ORDER BLANK

NOTE: All prices subject to change without notice.

Enclosed find ( ) check ( ) money order for ________

Please ship C.O.D. ( ) postage enclosed for ________ pounds.

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

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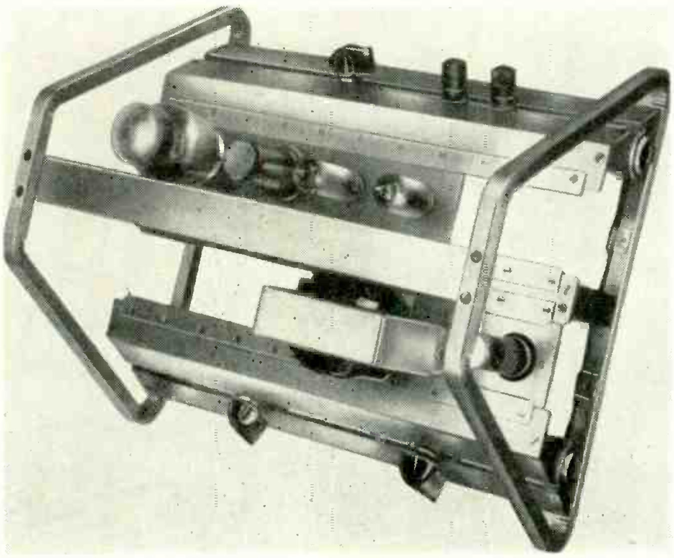
BUILD THIS...

UNIVERSAL EXPERIMENTAL CHASSIS

By KURT FREUND

The breadboard brought up to date, featuring slide-in panels



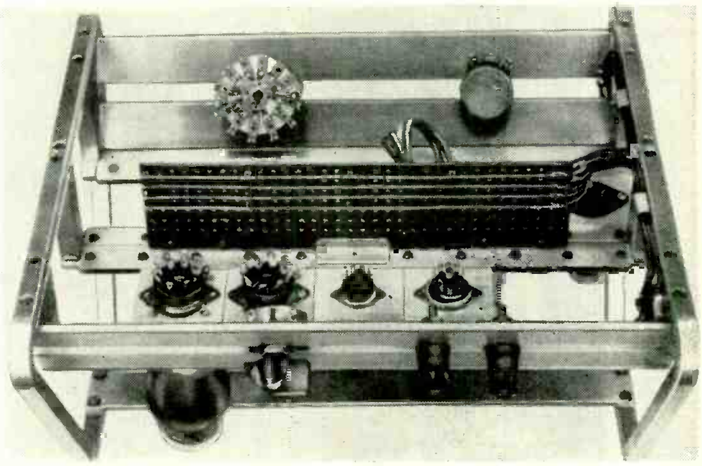


Fig. 1, above—Top view of the universal chassis—some components are mounted.

Fig. 2, right—Underside view shows some components and the power-line distribution.

AN important problem in constructing electronic equipment is to provide a suitable mounting base. This is especially true for experimental work where the number of components and their final arrangements can seldom be accurately predicted. Breadboards, although versatile, are unsuitable for present-day components. Despite frequent improvements they still introduce constructional complexities. In the universal experimental chassis described here, the advantages of earlier breadboards are retained while several other innovations are introduced for assembling temporary and semipermanent circuitry.

Basically, the new chassis (Figs. 1, 2) consists of two spring-loaded gaps into which can be inserted a number of square mounting panels. The end frames have been especially designed to permit tilting the chassis to either side at a convenient working angle. They also serve as carrying handles. Ample clearance from the bench surface protects mounted components. The square slide-in panels, which serve as mounts for tube sockets and other components, can be inserted in any one of four rotational positions for best base-pin arrangement. If necessary, rectangular panels could be used for larger parts.

For easier construction, individual panels can be made to carry complete subassemblies by using socket turrets or by directly suspending components from the tube sockets. Such units can be inserted in their required sequence. When modification or dismantling is required later, they can be removed from the chassis simply by disconnecting the power supply and coupling leads. A small gap between adjacent plates will allow feeding through leads to grid caps. Controls, rotary switches and terminals can be mounted on the sides of the chassis and, like the slide-in panels, placed anywhere along its entire length.

The chassis was designed to be used with external power sources. Power is distributed by bus bars along the center. Each side has its own system separately terminated at one end, permitting construction of two independent circuits. For larger circuits requiring the use of both sides the distribution systems can be strapped and supplied through either of the terminating receptacles.

Construction

Consideration has been given to the availability of materials. The design and construction have been simplified to use only standard semihard aluminum stock and most of the material is used as purchased. There is a minimum of machine work. In fact, the complete chassis can be constructed without the aid of power tools if it is necessary.

The parts and their dimensions are illustrated in Fig. 3. A number of identically dimensioned parts can be clamped together and faced simultaneously. The end brackets are cut from a ⅜-inch square bar. The slots (milled or cut by hacksaw) provide an easy method of making certain that the material bends at the required place with a minimum of bulging. The chassis cross rails are cut from a 1 x ⅛-inch bar and require only facing. Strips of flexible aluminum are used for the springs. Other materials such as tempered brass or phosphor bronze are equally suitable. All six pieces forming the end supports are cut from one 8-inch length of 1½ x ⅜-inch bar.

The triangular supports A can be obtained by two diagonal cuts and the rectangular supports B by a cut along the center of a 2⅛-inch portion of the same material. Holes for the power-supply receptacles can be bored in two of the triangular pieces. The square slide-in plates are cut from a 1¾ x ⅛-inch strip and should be kept to fairly close tolerances to prevent binding when inserting them into the chassis. Examples of slide-in plates are shown in Figs. 3, 4. However, these can be made to suit individual requirements. The bus bars are lengths of 16-gauge tinned copper wire. A punched plastic card

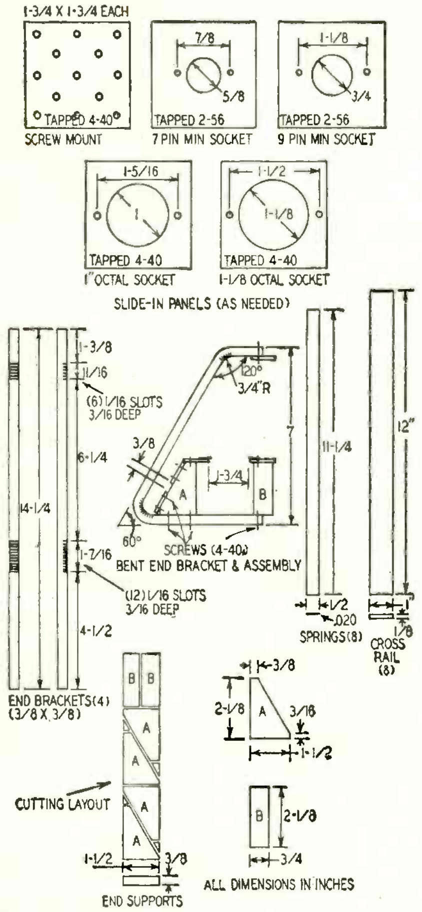


Fig. 3—Diagram shows the parts forming the chassis, and suggested dimensions.

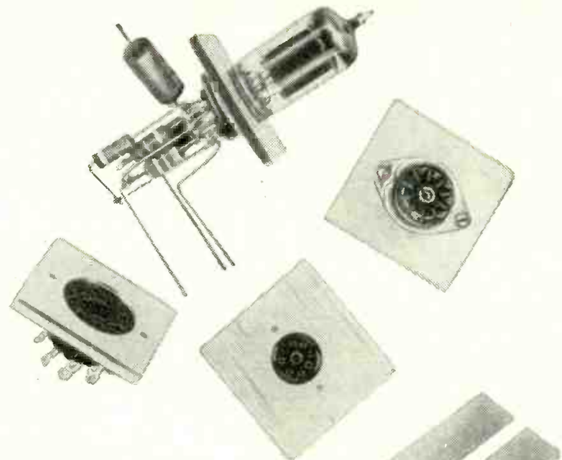


Fig. 4—Examples of slide-in plates and a view of a subassembled R-C oscillator.

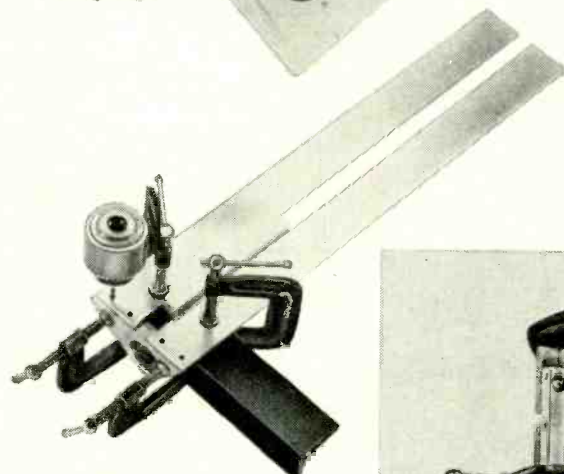


Fig. 5—Method of clamping parts to a portion of angle iron for drilling. A scrap piece of ⅜-inch material is shown being used as a spacer.

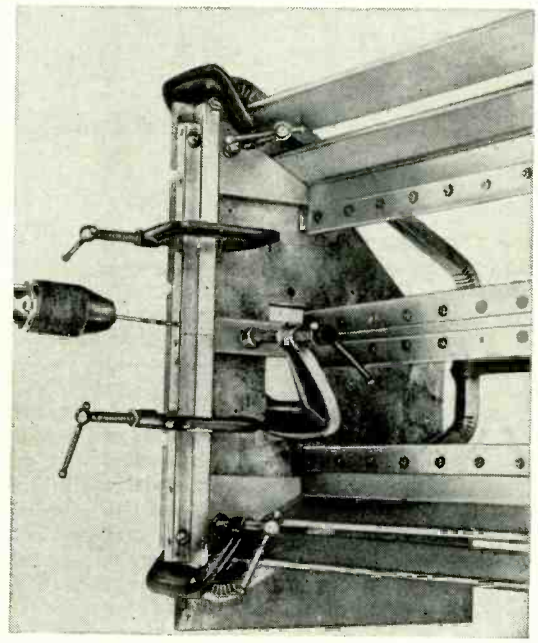


Fig. 6—Assembly of end frame and cross rails. A slide-in plate may be inserted in each gap, serving as a spacer.

(Alden 650 ATMS-D) forms the mounting base for four rows of conductors on each side. The conductors are insulated from each other and each side is separately terminated in a suitable receptacle. The card may be obtained from Alden Products, Brockton, Mass.

In general, all parts, except the springs, are fastened together by flat-headed 4-40 machine screws. Tapped holes, receiving the screws to a depth of at least ¼ inch, are used throughout. The springs can be either riveted or bolted by 2-56 screws. Bolting has the advantage of easier replacement of springs in case of damage.

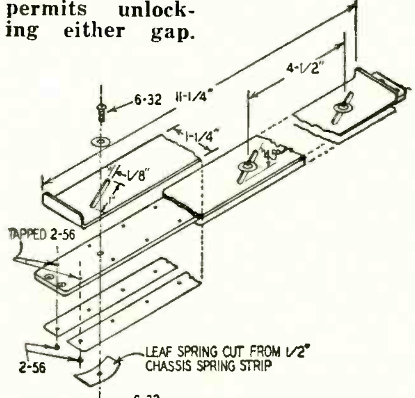
While constructing a number of these chassis, some difficulty was sometimes encountered in aligning separately drilled holes. To avert this, the following practical, even if somewhat unconventional, method was devised:

Components which are to be bolted together are clamped in their required positions on a piece of angle iron or a mounting fixture, as shown in Figs. 5, 6. Tapping holes are then drilled through both parts. Inserting scrap pieces of ⅜-inch material as spacers results in uniform gaps in the chassis sides; slide-in panels may be used in gaps of the chassis top.

Assembly procedure

1. Mount springs to both faces of the cross rails forming the chassis top. Let

Fig. 7—Modification of center rail permits unlocking either gap.



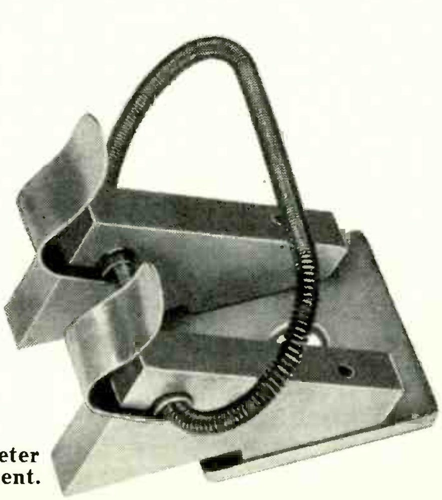


Fig. 8 — A meter holder attachment.

them protrude ⅛ inch beyond each edge. The springs should extend to within ⅜ inch of each end. On the center rail, mount springs to both edges.

2. Attach end supports to their corresponding cross rails, clamping and drilling at both ends as indicated in Fig. 5.

3. Mount chassis on the end brackets, inserting slide-in panels as spacers (Fig. 6).

4. Using the center portion of mounting fixture, attach cross rail to top of end brackets.

5. To complete the chasses, bolt the punched-card assembly to the center cross rail and solder connections to the terminating receptacle.

Modifications and accessories

So far, the construction has been kept to simple cutting and drilling. Where more extensive shop facilities are available the versatility of the chassis can be greatly increased. A disadvantage of the above construction is that centrally located plates cannot be removed without disturbing adjacent ones. This can be overcome by replacing the top springs of the center rail with a solid strip which can be moved sideways so that either chassis gap can be freed. This modification is shown in Fig. 7. A piece of 1/16 inch thick hard aluminum, 12 x 1¼ inches, replaces the top springs. Three angular slots are filed in this strip which is held against the center rail by spring-loaded screws. When the strip is in its central position, both chassis gaps are locked. Pushing or pulling one end tab moves the strip aside, opening either gap and permitting removal or insertion of any of the desired plates.

Meters are best mounted directly on the chassis. A suitable attachment which will accommodate up to a 3½-inch meter is shown in Fig. 8 and affords full protection from all sides. It consists of two A type supports mounted on a slide-in plate. An ⅛-inch clearance is cut into the support. Two spring strips (½-inch chassis spring) and a spiral spring or strong elastic band hold the meter securely.

Materials for experimental chassis

4—end brackets, 4 feet 9 inches of ⅜ x ⅜-inch bar; 8—cross rails, 8 feet of 1 x ⅛-inch bar; 8—springs, 7 feet 6 inches of ½ x .02-inch strip. 4—end supports A, 2—end supports B, 8 inches of 1½ x ⅜-inch bar; slide-in panels, 1¾ x ⅛-inch bar.

Experience has indicated that the structure is sturdy and the all-metal construction has provided adequate shielding up to reasonably high frequencies. The chassis described is both practical and versatile and is proving to be an indispensable unit for the experimenter in the laboratory, lecture room and ham shack.

I wish to express my thanks to Drs. C. C. Lucas and W. G. B. Casselman of the Banting and Best Department of Medical Research, University of Toronto, for their helpful suggestions in preparing this paper. END

10 servicing TIPS for transistor radios

Once upon a time I had
a good transistor that went bad.
Just a little carelessness
Gave me one transistor less.

By STAN SCHENKERMAN

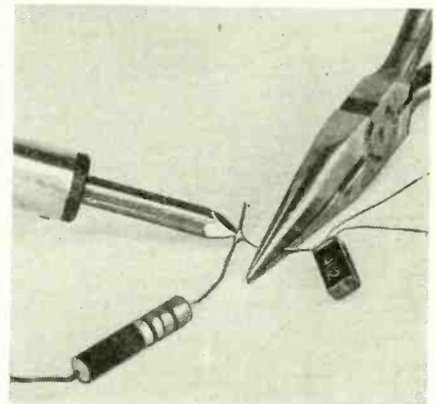


Fig. 3—Using pliers as a heat sink.

THE radio–TV service technician must again cope with the advance of technology! Transistor radios are coming into his shop in increasing numbers. No doubt he will rise above this challenge with his usual proficiency.

But servicing transistor radios requires some modification of the techniques used for tube radios. To aid technicians entering this new field, the following 10 hints will serve as a guide:

1. *Whether a tube or transistor set,*
   A superhet is a superhet.

The block diagram of a transistor radio is the same as for a conventional tube receiver. Fig. 1 shows the schematic of a transistor radio put out by Raytheon. Fig. 2 is a block diagram of the set. Note that it is almost the same as for conventional tube jobs.

2. *In checking transistors you should*
   Replace with ones known to be good.

Substitution is the only reliable check. A transistor may seem good on a transistor checker and still cause poor operation.

3. *Your substitute should be the kind*
   That in the radio you find.

Transistors by different manufacturers may be similar, but they are probably not similar enough, at present, for direct interchange.

4. *A rose is a rose by any name,*
   But tubes and transistors are not the same.

Even with the power switch off, the impedances of the transistor are not infinite as are the tube's. Always remove all transistors when making ohmmeter measurements. If the transistors are in, the ohmmeter current may damage them. Of course, you will also obtain incorrect readings.

5. *Transistors with heat cannot co-exist*
   Protect them from it or they won't transist!

Transistors are very temperature-sensitive and can be permanently damaged by the heat from a soldering iron. Use a pencil type iron of not more than

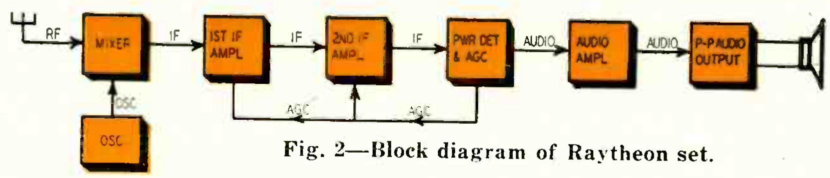
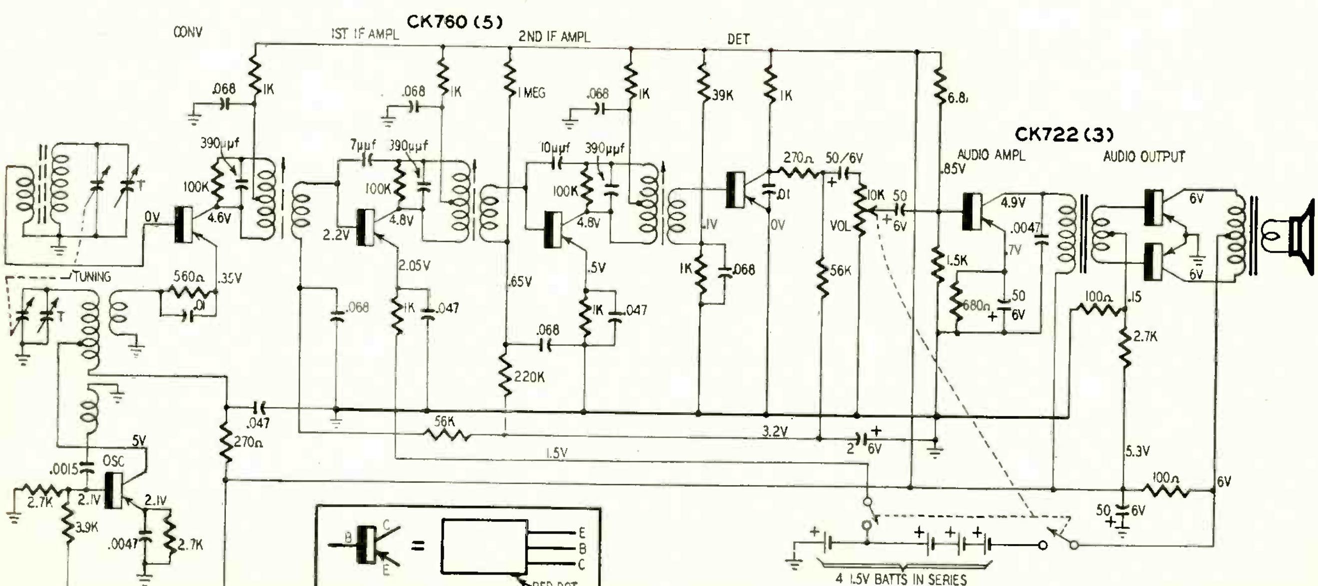


Fig. 2—Block diagram of Raytheon set.



Courtesy Raytheon Mfg. Co.

Fig. 1—Schematic diagram of the Raytheon chassis 8RT1 transistorized portable radio—unit uses eight transistors.

35–40 watts and small-diameter multiple-core 60/40 solder. Remove the transistor when soldering at or near its socket, or use a pair of long-nose pliers as a heat sink. This is done by grasping the transistor electrode to which you are soldering, with the pliers between the soldering point and the transistor body. (See Fig. 3.)

6. *Many transistors have laid down and died*
   Simply because of wrong bias applied.

Be sure that transistors are inserted in their sockets so that the proper polarity bias is applied. There are a

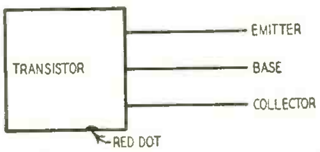


Fig. 4—Identifying transistor leads using a red dot near the collector.

number of schemes used to specify which electrodes are the emitter, base and collector. Fig. 4 shows one method where a red dot is placed near the collector. Fig. 5 shows a pin-spacing method.

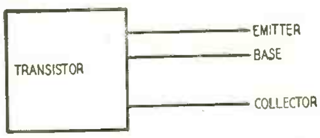


Fig. 5—The pin-spacing method of identifying transistor electrodes.

7. *With a new transistor you may find*
   That the whole set must be realigned.

This is due to the nonuniform transistors produced at the present stage of the art. Even rearranging the original order of the transistors may throw the set out of alignment.

8. *When aligning you should know*
   Enough to keep your signal low.

Transistors, because they work at such low levels, can be easily overloaded by what may be a small signal for a tube. Furthermore, the entire alignment procedure should be repeated two or three times for best results. The input and output circuits of the transistor are not isolated from each other, as they are in tube sets. Tuning one transistor stage affects the tuning of the others and repetition is the only way of insuring perfect alignment.

9. *Transient currents shouldn't be passed*
   Through transistors you want to last.

Have the power switch off when removing or installing batteries or transistors. That way you will never subject the transistors to those damaging transients.

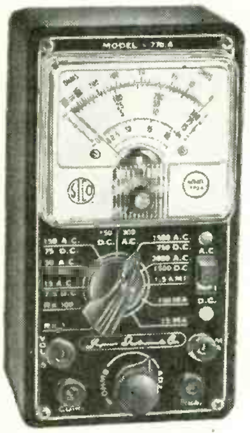
10. *To your customers suggest*
    That mercury oxide cells are best.

Replacement batteries of the mercury oxide type will give about five times the playing life of conventional flashlight batteries. Although initial cost is higher, the long-term cost per playing hour is much less. END

Superior's New Model 770-A

The FIRST Pocket-Sized VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER



71% MORE SCALE AREA!

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain *measurements instead of approximations* on a popular priced pocket-sized V.O.M.

● Compact — measures 3⅛" x 5⅞" x 2¼". ● Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter. ● Housed in round-cornered, molded case. ● Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications

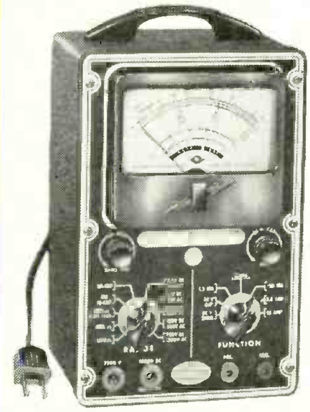
6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts. **6 D.C. VOLTAGE RANGES:** 0-7.5/15/75/150/750/1500 Volts. **2 RESISTANCE RANGES:** 0-10,000 Ohms, 0-1 Megohm. **3 D.C. CURRENT RANGES:** 0-15/150 Ma., 0-1.5 Amps. **3 DECIBEL RANGES:** —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with self-contained batteries, test leads and all operating instructions.

$15.85 NET

Superior's New Model 670-A

SUPER-METER



A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS.

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts. **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 Volts. **OUTPUT VOLTS:** 0 to 15/30/150/300/1,500/3,000 V. **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes. **RESISTANCE:** 0 to 1,000/100,000 Ohms 0 to 10 Megohms. **CAPACITY:** .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad Scale for checking quality of electrolytic condensers). **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. **INDUCTANCE:** .15 to 7 Henries 7 to 7,000 Henries. **DECIBELS:** —6 to +18, +14 to +38, +34 to +58.

ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's New Model TV-60

20,000 OHMS PER VOLT ALLMETER

FEATURES

- A sensitive, accurate Volt-Ohm-Milliammeter with *giant* meter and *mirrored* scale.
- An accurate direct-reading Capacity meter.
- A Kilovoltmeter.
- An R.F. Signal Tracer.
- An Audio Signal Tracer.
- Giant recessed 6½ inch 40 Microampere meter with *mirrored* scale assures accuracy and easy-reading. All calibrations are printed in large easy-to-read type. Fractional divisions are easily read with the aid of the mirrored scale.

Includes services never before provided by an instrument of this type.

- The line cord, used only when making Capacity measurements, need be plugged in only when using that service. It is out of the way, stored in its pliofilm compartment at all other times.
- A built-in Isolation Transformer automatically isolates the Model TV-60 from the power line when the capacity service is in use.
- Selected, 1% zero temperature coefficient metallized resistors are used as multipliers assuring *unchanging* accurate readings on all ranges.
- Use of the latest type of *printed circuit* guarantees maintenance of top quality standard in the production runs of this precise instrument.
- A new *improved* type of high-voltage probe is used for the measurement of high voltages up to 30,000 Volts. This service will be required when servicing color TV receivers.
- Simply plug-in the R.F. probe and convert the Model TV-60 into an efficient R.F. SIGNAL TRACER permitting the measurement of stage-gain and cause of trouble in the R.F. and I.F. circuits of A.M., F.M., and TV receivers.
- Plug in the Audio probe and convert the Model TV-60 into an efficient AUDIO SIGNAL TRACER. Measure the signal levels and comparative efficiency of hearing-aids, public-address systems, the amplifier sections of Radio & TV receivers, etc.

Read and compare features and specifications below!

SPECIFICATIONS

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.

7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.

2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES: : 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES: — 6 db to + 58 db.

R. F. SIGNAL TRACER SERVICE:

Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE:

Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R. F. Signal Tracer Probe and Audio Signal Tracer Probe. Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. Only

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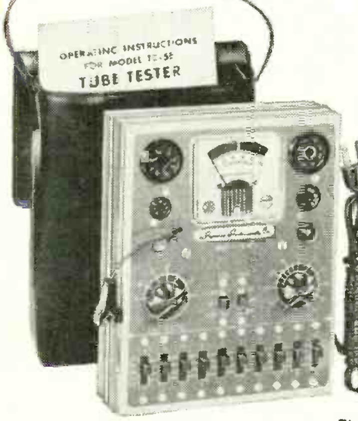
Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary. (See approval form for complete details.)

Superior's New Model TC-55

TUBE TESTER



FOR The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap".

Checks for shorts and leakages between all elements
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench — use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

\$26.95 NET

Superior's New Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system*, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

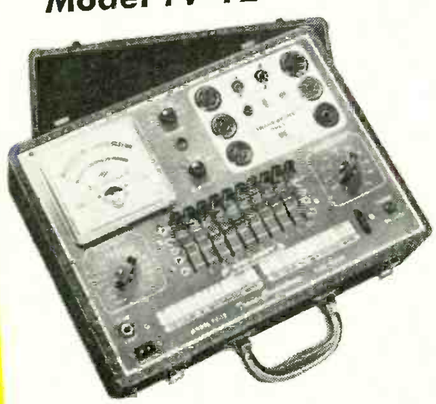
EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover

\$47.50 NET

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER



ALSO TESTS TRANSISTORS!

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

\$72.50 NET

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NO MONEY WITH ORDER — NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment *after* trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary. (See approval form for complete details.)

About Testing Picture-Tubes . . .

Of course you can buy an "adapter" which theoretically will convert your standard Tube Tester into a picture - tube tester. Sounds fine - but - it simply doesn't work out that way!

We do not make nor do we recommend use of C.R.T. adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a make-shift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85. But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensible instrument. Incidentally, the Model TV-40 is the only low-priced C.R.T. Tube Tester, which includes a real meter. Neons are fine for gadgets and electric-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

PICTURE TUBE TESTER

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- ✔ Color Dot Pattern Generator
- ✔ Marker Generator

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

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

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RADIO

SYMMETRICAL VOLTAGE DOUBLER

Analyzing current flow in popular type power supply

By GEORGE P. PEARCE

JUST why is it possible to connect a couple of rectifiers and a couple of capacitors in an alternating current circuit and finish up with over twice the voltage, and direct current at that?

Suppose we have an electronic check valve that will permit current to flow in only one direction and a couple of capacitors. Let us mark the electronic check valve V, the capacitors C1 and C2 and then wire the assembly as shown in Fig. 1. V is connected as a switch between terminals L and P and set so current (electrons) can flow only from

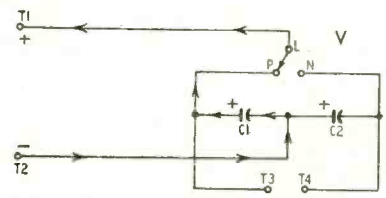
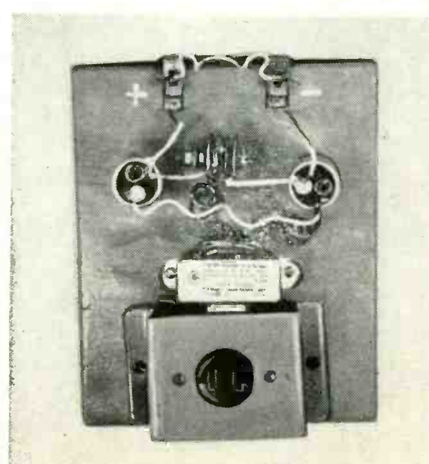


Fig. 1—Diagram shows current flow during first half of input cycle.

P to L. Apply 100 volts (peak) a.c. across terminals T1 and T2. Current will flow as shown, and C1 will charge to 100 volts positive with respect to T2. T3 will also be 100 volts positive since it is connected to the positive side of the capacitor C1.

After the input voltage passes the 100-volt peak and starts to decrease,



Experimental voltage divider.

the capacitor will be prevented from discharging backward because V will not permit current to flow in the reverse direction. Thus, when the line voltage has fallen to zero, there will still be 100 volts across C1.

Suppose that when the voltage reaches zero we instantaneously change the direction of flow through check-valve V, connect from N to L and open-circuit L to P. The line voltage passes zero (current flows in the opposite direction) and continues to fall until it reaches a negative value of 100. This will make the voltage on C2 rise to 100 volts negative with respect to T2. And since T4 is directly connected to this capacitor, the terminal will also be 100 volts negative (Fig. 2). Thus the po-

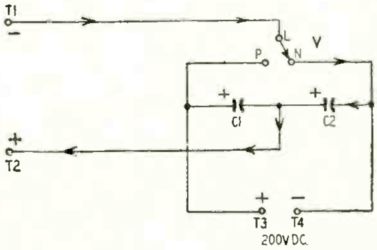


Fig. 2—Direction of current flow during second half of input cycle.

tential drop between terminals T3 and T4 will be from 100 volts positive to 100 negative (with respect to our reference point T2) a 200-volt difference. The line voltage T1 and T2 is 100 volts ac; the voltage between T3 and T4 is 200 dc.

A rectifier such as a selenium type is the same to an electric current as a check valve is to the flow of water. So if we install two rectifiers, each the reverse of the other, we shall then have an arrangement that will accomplish electrically the equivalent switching arrangement as indicated in Figs. 1 and 2. And if the ac line is connected to terminals T1 and T2, C1 and C2 will be continually recharged 60 times per second—on 60-cycle power. If a load is connected between T3 and T4 to permit a current to flow which is in reasonable proportion to the storage capacity of

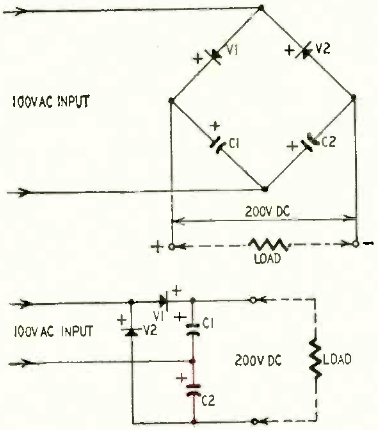


Fig. 3—Above is the symmetrical voltage doubler in the theoretical bridge form; below in the more familiar practical schematic style.

C1 and C2, a voltage will be maintained across the load at approximately twice the line voltage. (The peak ac voltage is equal to the rms voltmeter reading multiplied by the square root of 2 or 1.41.) A typical schematics of this device (both in theoretical form and how it looks in an actual circuit) is shown in Fig. 3.

A handy little voltage doubler is shown in the photo. The transformer voltage output is 6.3 and the dc output of the unit is 13 volts at 50 ma. The capacitors are 100 μf with a working voltage of 50. END

Thirty-Five Years Ago

In Gernsback Publications

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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 ELECTRICAL EXPERIMENTER on file for interested readers.

In September 1922 *Science and Invention* (*formerly Electrical Experimenter*)

The Slot Machine Radio, by H. Gernsback.
Who Discovered Radio? by A. P. Peck.
Radio Set in Pickle Bottle, by Edgar I. Eisenstadt.
Tikker Reception of C. W.
Chopping Bowl Loud Speaker.
Radio Concerts From a Lamp Socket, by A. P. Peck.
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Radio for the Beginner, No. 7, by Armstrong Perry.
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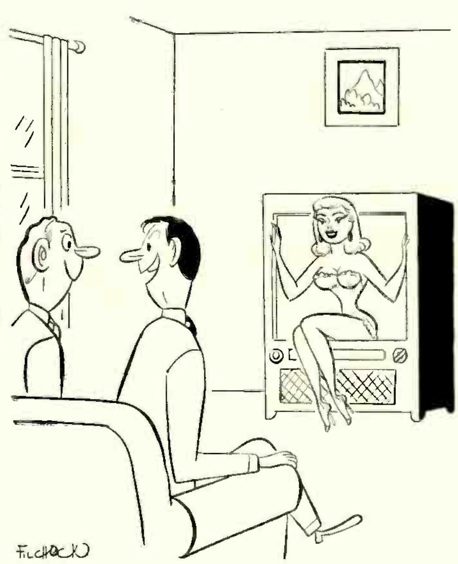

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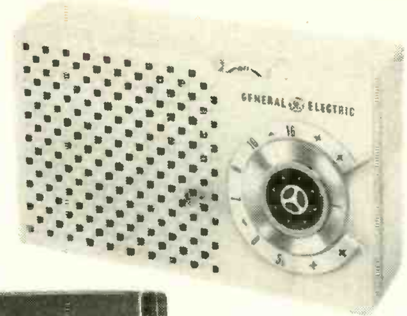
TRANSISTOR RADIOS

Part IV—Some important features of four popular superhets

By I. QUEEN
EDITORIAL ASSOCIATE



The G-E model 676 transistor radio.

Zenith's Royal 500 transistor radio.

EARLY superhet tube receivers used low intermediate frequencies of 175 kc or so. As more broadcast stations went on the air and as they increased their radiated power, a higher if became necessary. Eventually, 455 kc was adopted by most radio manufacturers. The higher if produced less *image* interference.

The design of a transistor superhet with an if of *455 kc* had to await the development of efficient high-frequency transistors and if transformers. Transistor gain falls off with increasing frequency, so only very-high-gain transistors are suitable at high intermediate frequencies. Transistors with a cutoff of at least 2.5 or 3 mc are suitable for use at an if of 455 kc. Among the highest cutoffs now available in junction transistors (RADIO-ELECTRONICS, February, 1956, page 40) are Raytheon 2N113, 2N114 and G-E 2N137. Having cutoff values of 10, 20 and 10 mc, respectively, any of these will give very high gain at 455 kc.

Modern transistors can provide up to 33 db or more gain in a single stage. A gain of 33 db is equivalent to a power increase of 2,000 times. The specified gain of a complete transistor stage usually includes the 3-db *loss* in a matching transformer.

Raytheon FM-101A (modified)

One of the first superhet receivers designed for 455 kc was Raytheon's FM-101A, a modified version which is shown in Fig. 1. It uses p-n-p transistors operating from a 6-volt battery. Three rf transistors are indicated in the schematic: 2N112, 2N113, 2N114. Gain-wise there is about 1-db difference between them, the higher number providing the greater gain. The 2N114 has a frequency cutoff of 20 mc!

The receiver has separate transistors for mixer and oscillator functions to provide maximum stability and gain. The variable tuning capacitor has two 355-$\mu\mu$f sections. The large padder (600–1,250 $\mu\mu$f) tunes the oscillator circuit 455 kc higher than the mixer.

Oscillator V1 is stabilized by an emitter resistor and a voltage divider feeding the base. Bias on each element is about 2 volts. Mixer V2 has zero bias since it must rectify as well as amplify. Note the filter network in the oscillator supply lead—this stage must be decoupled and isolated to prevent feedback through the common battery. A fixed 100-$\mu\mu$f capacitor injects the oscillator voltage into the mixer base.

The two if stages (V3, V4) follow circuit principles previously outlined.

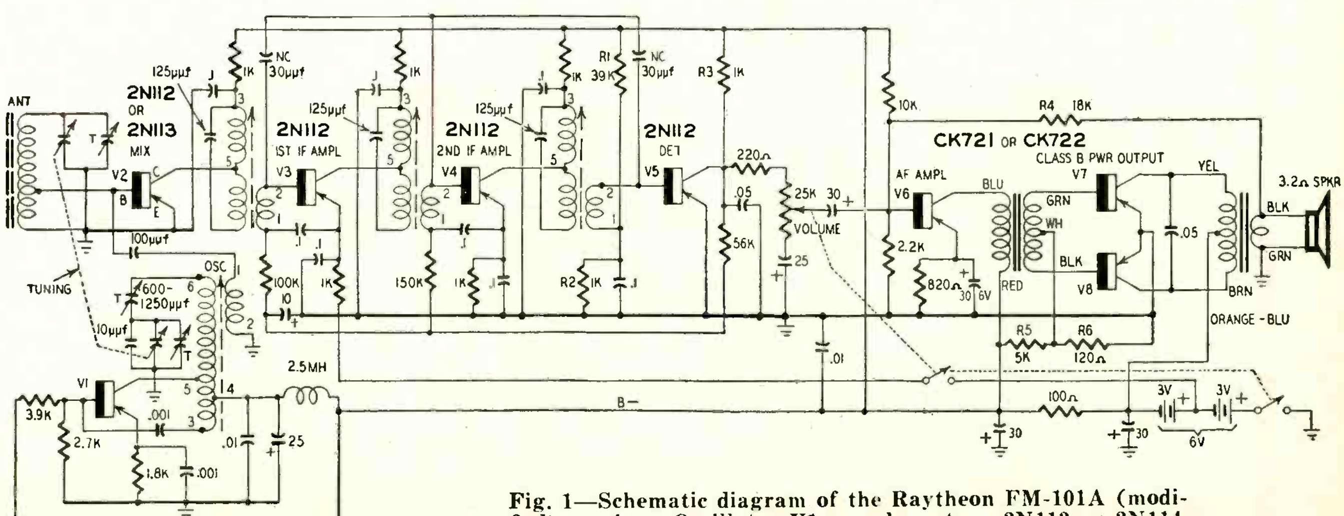


Fig. 1—Schematic diagram of the Raytheon FM-101A (modified) receiver. Oscillator V1 may be a type 2N113 or 2N114.

There are decoupling and stabilizing networks in the collector and emitter leads. Neutralizing capacitors NC are 30 $\mu\mu$f.

The if transformers are No. 3015 (made by Automatic Manufacturing Co.), or their equivalent. The primary has 155 turns with a tap at 55 turns. The secondary has 18 turns. The primary is slug-tuned (from the bottom of the transformer) and is shunted by a 125-$\mu\mu$f capacitor. Each transformer is ¾ inch high by ½ inch square. There are five terminals, of which only four are wired in circuit.

Detector V5 is biased class B. The biasing resistors are R1 and R2. The voltage across R2 is less than 0.15 volt and only a small bias current can flow through the base. Therefore V5 is near cutoff in the no-signal condition. At this time the collector current is about 0.1 ma and the drop across R3 0.1 volt. When an if signal arrives, collector current increases. On a strong station the drop across R3 may reach 1 volt or more. Therefore a voltmeter across this resistor may be used to measure signal strength and indicate alignment.

The variable dc collector voltage is fed back to both if amplifiers to control their gain. This avc drives the if bases more positive with increasing signal, cutting gain and preventing overload. V3 operates from 3 volts rather than the entire battery. This permits greater control of the stage. The second-stage emitter is self-biased.

Audio stage V6 drives a push-pull class-B output amplifier (V7, V8). These transistors are popular low-output types but, when used in class B, they are capable of 100-mw output. The output stage is held near cutoff by voltage divider R5–R6, so that with no signal very little current flows in the collector circuits.

An af signal drives these transistors into conduction, one at a time. Each transistor can conduct only when its base goes negative, therefore V7 conducts on one half of the cycle and V8 on the other. Both halves are combined to re-create the original signal in the output transformer. The stronger the input signal, the greater the conduction of each transistor. A total of about 27 ma flows at maximum signal. This drops to 1 ma in the absence of a signal. Evidently, we pay only for what we use in a class-B amplifier.

About 1.2 ma is lost in divider R5–R6. This loss cannot be reduced simply by using larger resistors. Relatively large peaks of current may flow in this stage, so low resistance is needed in the input and output circuits. The driver transformer has a secondary resistance less than 50 ohms. This transformer matches 10,000 to 2,000 ohms, base to base. The output transformer has a primary resistance of only 20 ohms. It matches the speaker to 500 ohms, collector to collector. Negative feedback (through R4) is used to reduce distortion.

An interesting feature of this receiver is that it uses components now available to experimenters. All parts are available from mail-order houses or stores specializing in transistors and parts. This circuit is adequately decoupled, filtered and operated well within all ratings. Of course, the home builder cannot make such a circuit as light and compact as the commercially built, printed-circuit receiver with specially manufactured components to fit a small case.

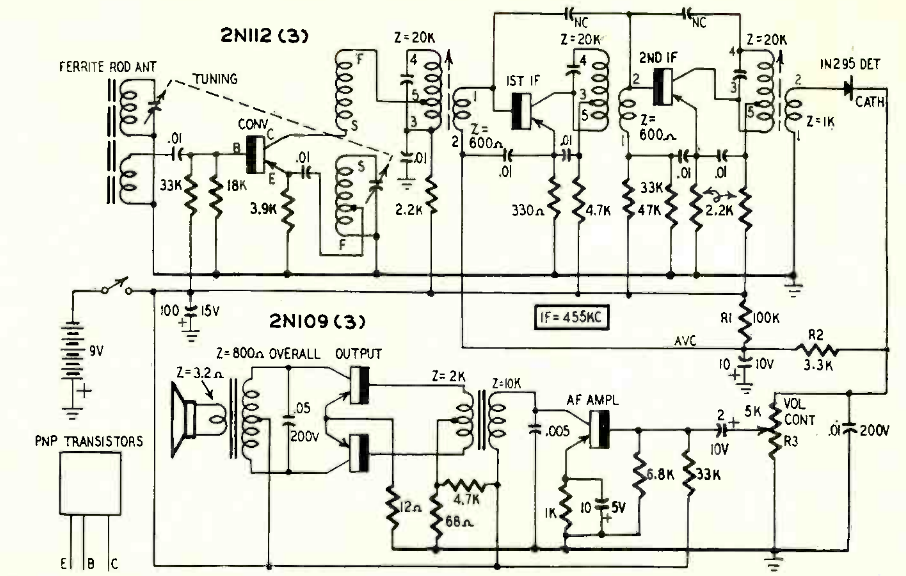


Fig. 2—Schematic diagram of the six-transistor model K-701 DeWald receiver.

Dewald K-701

This receiver (Fig. 2) uses six transistors of the p-n-p type. It is powered by a 9-volt battery (Eveready 276 or equivalent) which can give about 500 hours of service.

The first transistor oscillates and converts to if. Oscillations are generated by coupling the collector and emitter windings. As in any tickler arrangement, the polarity of each coil is important. In the diagram, *s* shows the start and *f* the finish of each winding. To maintain high Q, reduce antenna capacitance and at the same time match the low input impedance, the base is fed from a secondary rather than the antenna coil itself.

The if strip uses the same transistors and neutralizing arrangement shown in the previous receiver. Voltage divider R1–R2–R3 supplies no-signal bias to the first if, and positive bias is supplied by the avc lead. The stronger the signal, the more positive this control voltage and the lower the if gain. Because of the larger voltage supply, it is possible to use larger decoupling resistors here than in the previous circuit.

The secondaries of each of the two if transformers are wound to match 600 ohms, the transistor input. The secondary of the third transformer matches a higher impedance, the crystal diode. This detector supplies positive avc voltage and also feeds the rectified if to the volume control.

The af is fed to a conventional audio circuit. Each stage is fixed-biased. The push-pull stage is biased to near cutoff by a 70-to-1 ratio voltage divider. Output is about 75 mw maximum.

Fig. 3 shows the parts layout. Set dimensions are 8½ x 6½ x 2½ inches. This cabinet permits inclusion of a 4-inch speaker, much larger than in tiny pocket sets, and is nonbreakable.

Zenith Royal 500

This receiver uses seven transistors, all n-p-n type. The battery is 6 volts, which may be four penlight (size AA) cells in series. These will supply the set for approximately 50 hours at an operating cost of about 1 cent an hour. If longer life is desired, mercury cells (Zenith Z9) may be substituted. Conelrad frequencies 640 and 1240 kc are

(*Continued on page* 99)

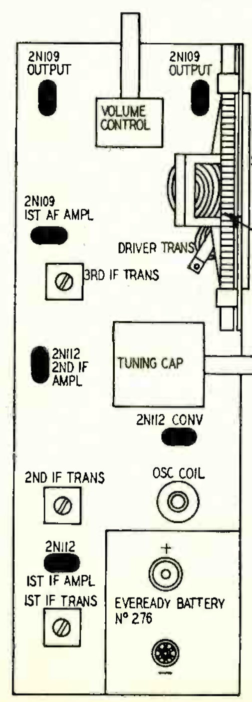


Fig. 3—Parts layout for DeWald K-701.

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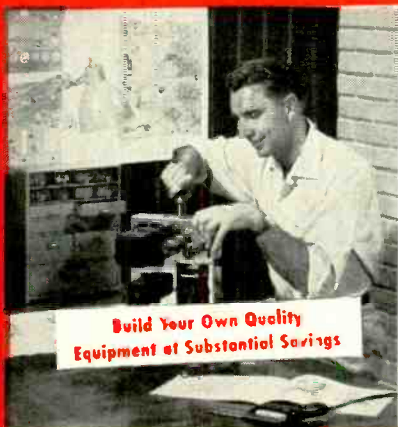

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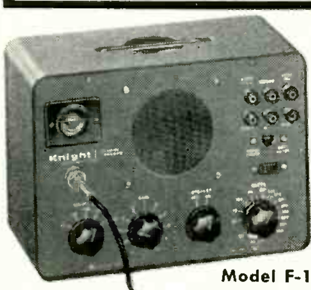
Build this wide-range extremely stable RF signal generator and save two-thirds the cost of a comparable wired instrument. Ideal for alignment of RF and IF stages in radio and TV sets, and for trouble-shooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 110 mc; useful harmonics to 220 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit with precision-wound coils—no calibration necessary. Has input for external modulator. Maximum audio output, 10 volts. RF output, over 100,000 micro-volts. Step and continuous-type output attenuators. With all parts, tubes, wire and solder. Portable case, 7 x 10 x 5″. Shpg. wt., 10 lbs.

Model F-145. RF Signal Generator Kit. Net only **$19.75**



Model F-135

$26.50

knight-kit VISUAL-AURAL SIGNAL TRACER KIT

A remarkable value in an instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits—*has highest gain in its price class.* Traces the signal from the antenna to the speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of 91,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4″ PM speaker; single probe with plug-in head gives instant choice of RF or audio tracing. Provides noise test; built-in watt meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Blue-finish steel case. Shpg. wt., 13 lbs.

Model F-135. Signal Tracer Kit. Net only **$26.50**

Model F-129

$37.95

NEW knight-kit 6-12 VOLT BATTERY ELIMINATOR KIT

A valuable new unit for servicing auto radios, mobile gear, etc. Delivers continuously variable filtered DC output from 0 to 15 volts. Provides DC output at 0-8 volts or 0-15 volts. Continuous current rating: 12.5 amps at 6 volts, 10 amps at 12 volts. Can also be used as battery charger. Oversize rectifiers and transformer for better regulation and long life. Two meters provide simultaneous current and voltage readings; ranges: 0-15 volts DC: 0-20 amps DC. Doubly protected: fused primary and automatic-reset overload relay for secondary. Heavy-duty binding posts. Blue-finish steel case with "disappearing" handle. With all parts, solder and pre-cut wire. 9 x 12⅛ x 7¾″. Shpg. wt., 20 lbs.

Model F-129. Power Supply Kit. Net only **$37.95**

knight-kit AUDIO GENERATOR KIT

Model F-137

$37.50

An ideal audio frequency source for checking audio circuits and speaker response. Covers: 20 cps to 1 mc in 5 ranges. Output voltage: 10 volts into 600 ohms impedance. *Offers the flat response of a lab standard*—±1 db to 1 meg. Generator imp., 600 ohms. Less than .25% distortion from 100 cps through the audible range; less than .5% when driving 600 ohm load at maximum output. Cont. var. step-attenuated output. 17 lbs.

Model F-137. Audio Generator Kit. Net only **$37.50**

knight-kit RESISTANCE SUBSTITUTION BOX KIT

Model F-139

$5.95

Simplifies determination of resistor values needed in a circuit. 36 standard 1 watt resistance values between 15 ohms and 10 megohms with an accuracy of 10%. 18-position switch; also slide switch for multiplying values by 1000. Extra switch wafer serves as tie points, eliminating buss bar. 5 x 3 x 2″. Complete with test leads and clips. 2 lbs.

Model F-139. Resis. Sub. Box Kit. Net . **$5.95**

knight-kit CAPACITANCE SUBSTITUTION BOX KIT

Model F-138

$5.95

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard capacitor values from .0001 mfd. to .22 mfd., ±20%. Values are 600 volts, except .15 and .22 which are 400 volt. 18-position switch selects all values quickly and easily. In bakelite case, 5 x 3 x 2″. Complete with all parts, test leads and clips. 2 lbs.

Model F-138. Cap. Sub. Box Kit. Net . . **$5.95**

QUALITY ELECTRONIC TEST EQUIPMENT IN MONEY-SAVING KIT FORM

...easiest to build...you get more...YOU SAVE MORE

4½" Meter

Model F-128 **$16.95**

knight-kit

1000 OHMS/VOLT VOM KIT

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4½" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, —20 to +69 in 6 ranges. *Uses 1% precision resistors.* 3-position function switch and 12-position range switch. Complete kit with bakelite case, (6¾ x 5¼ x 3¾"), battery, pre-cut wire, solder and test leads. Shpg. wt., 2½ lbs.

Model F-128. 1,000 ohms/volt VOM Kit. Net only **$16.95**

Model F-140 **$29.50**

knight-kit

20,000 OHMS/VOLT VOM KIT

Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½" meter; accuracy ±2% of full scale; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust" Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-.1-10-100; DC amps, 0-1-10; Decibels, —30 to +63 in 6 ranges. Uses precision 1% multipliers. Moisture-resistant film-type resistors. Complete kit with bakelite case (6¾ x 5¼ x 3¾"), batteries, pre-cut wire, solder and test leads. Shpg. wt., 5 lbs.

Model F-140. 20,000 ohms/volt VOM Kit. Net only **$29.50**

knight-kit VTVM KIT with Printed Circuit Board

Model F-125 **$24.95** An extremely stable, and highly accurate VTVM. Greatly simplified wiring—entire chassis is a printed circuit board. Maximum convenience in arrangement of scales; 3X AC and DC scale design permits utilization of best portion of each scale for most accurate readings. Also measures peak-to-peak for FM and TV work. Ranges: AC P-P volts, 0-4-14-40-140-400-1400-4000; AC rms volts and DC volts, 0-1.5-5-15-50-150-500-1500; resistance, 0-1000-10K-100K ohms and 0-1-10-100-1000 megohms; db scale, —10 to +5. AC response, 30 cycles to 3 mc. Low-leakage switches and 1% precision resistors. Balanced-bridge circuit. 4½" meter, 200 microamp movement. Polarity reversing switch. Input res., 11 megs. Shpg. wt., 6 lbs.

Model F-125 Printed Circuit VTVM Kit. Net only . . **$24.95**

F-126. Hi-Voltage Probe; extends DC to 50,000 Volts **$4.75**

F-127. Hi-Frequency Probe; extends AC to 250 mc. . **$3.45**

PORTABLE MODEL

knight-kit RESISTOR-CAPACITOR TESTER KIT

Model F-124 **$19.50** Measures capacitance and resistance by accurate bridge method; checks for opens and shorts in paper, mica and ceramic capacitors; shows power factor of electrolytics. Large dial shows capacitance and resistance at a glance; balanced-bridge circuit with "magic eye" null indicator measures power factor from 0-50%. Tests capacitors with rated voltages applied. 5 test voltages: 50, 150, 250, 350, 450. Capacity ranges: 10 mmf to 1000 mfd in 5 ranges. Resistance ranges: 100 to 50,000 ohms and 10,000 ohms to 5 megs. Accuracy, ±10%. Automatic discharge feature prevents after-test shock. Blue-finished steel case, 5 x 3 x 2". With tubes and all parts. Shpg. wt., 8 lbs.

Model F-124. Resistor-Capacitor Tester Kit. Net only **$19.50**

knight-kit LOW-COST TUBE TESTER KIT

Model F-143 **$29.75** Offers high accuracy, top versatility and convenience at lowest cost. Tests 4, 5, 6 and 7-pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. *Features test for new 600 ma series string tubes.* Tests for open, short, leakage, heater continuity and quality (by amount of cathode emission). 4½" square meter with clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 14 filament voltages from .63 to 117 volts. Blank socket for future type tubes. Universal-type selector switches for any combination of pin connections. *Single-unit, 10-lever function switch.* Entire switch assembly is installed as a single unit—saves time and greatly simplifies construction. Illuminated roll chart lists over 600 tube types. Shpg. wt., 14 lbs.

Model F-143. Counter Model Tube Tester Kit. Net only . . . **$29.75**

Model F-142. Portable Model Tube Tester Kit. Net only **$34.75**

F-141. TV Picture Tube Adapter for above. Net only **$3.75**

NEW knight-kit TRANSISTOR & DIODE CHECKER KIT

Model F-149 **$8.50** Checks leakage-to-gain ratio and noise level of all junction, point contact and barrier transistors. Also checks diodes, forward and reverse current conduction of selenium rectifiers; useful for continuity and short checks. Easy-to-read meter. Features: spring-return leakage gain switch; calibration control; separate sockets for PNP and NPN transistors. Headphones or signal tracer may be used with checker for noise measurements. Case, 5 x 3 x 2". With 22½ volt battery. 2½ lbs.

Model F-149. Transistor Checker Kit. Net **$8.50**

EASY PAYMENT TERMS: If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan —only 10% down. Write for application blank.

ALL PRICES NET F.O.B. CHICAGO

knight-kit LOW-COST "IN-CIRCUIT" CAPACITOR CHECKER KIT

Tests capacitors while they are still wired in the circuit! Saves time and bother; an essential instrument for the service technician. Just press a button and the "magic eye" instantly shows opens and shorts (not leakage). Tests opens and shorts on any capacitor of 20 mmf or greater capacity, even if it is in parallel with a resistance as low as 50 ohms. Tests for shorts may be made on any capacitor even when it is shunted by as low as 20 ohms. Blue-finish steel case, 7¾ x 5¼ x 5". With tubes, all parts, wire and solder. Easy to assemble. Shpg. wt., 5 lbs.

Model F-119 **$12.50**

Model F-119. Cap. Checker Kit . . . **$12.50**

order from ALLIED RADIO 100 N. WESTERN AVE., CHICAGO 80, ILL. →

ALLIED'S *own MONEY-SAVING* knight-kits

FAMOUS knight-kits FOR HOBBYISTS & EXPERIMENTERS...FASCINATING, INSTRUCTIVE...

knight-kit "SPACE SPANNER" BAND SWITCHING RECEIVER KIT

Model S-243 $15^{95}

Thrilling Short Wave and Broadcast

Famous 2-band AC-DC receiver in easy-to-build kit form at a very low price. Pulls in thrilling short-wave (6 to 17 mc) and standard broadcast. It's fun listening to amateur, aircraft, police and marine radio. Features highly sensitive regenerative circuit. Bandswitch selects broadcast or short wave. Has 4" PM speaker and beam-power output tube for plenty of volume; headphone connectors for weak signal listening; slide switch cuts out speaker. Uses 12AT7 regenerative detector and audio amplifier, 50C5 power output, 35W4 rectifier. Six controls: Bandspread; Main Tuning; Antenna Trimmer; Bandswitch; Regeneration; Audio Gain. Includes tubes and all parts. 7 x 10½ x 6". Shpg. wt. 4½ lbs.

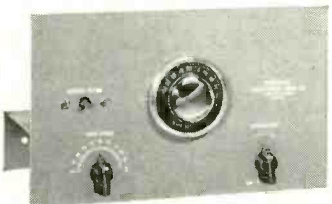
Model S-243. "Space Spanner" Receiver Kit. Net only..... **$15.95**
S-247. Matching Cabinet for above. 2 lbs. Net............. **$2.90**

Model S-295 $14^{75}

NEW knight-kit TWO-WAY INTERCOM KIT

New low-cost, easy to build intercom system kit. Ideal for use in home or office. Consists of Master unit and Remote unit, each with press-to-talk switch. Remote unit may be left "open" for answering calls from a distance, for "baby-sitting", etc. Remote may also be connected for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier; each unit has 4" PM dynamic speaker. Complete with Antique White cabinets (4¾ x 6½ x 4⅜"), all parts, tubes and 50 feet of cable (up to 200 feet of cable can be added). For AC or DC. Shpg. wt., 7 lbs.

Model S-295. Two-Way Intercom Kit. Net only ..**$14.75**



Model S-740 $11^{75}

knight-kit "OCEAN HOPPER" RECEIVER KIT

Tops for exciting broadcast, long wave and short wave reception. Highly sensitive regenerative-type circuit. Excellent headphone reception; can be used with 3-4 ohm PM speaker on strong broadcast band stations. Supplied with plug-in coil for standard broadcast; covers long wave and popular short wave bands with coils below. Pulls in thrilling foreign broadcasts, police, amateurs and aircraft. Controls: Main Tuning, Band-spread, Antenna Tuning. Off-On-Regeneration. With all parts and tubes (less extra coils and headset). AC or DC. Shpg. wt., 5 lbs.

Model S-740. "Ocean Hopper" Kit..... **$11.75**

EXTRA PLUG-IN COILS

S-741. Long Wave, 155-470 kc. Net....... 79¢
S-742. Short Wave, 1.65-470 kc.
S-743. Short Wave, 2.9-7.3 mc.
S-745. Short Wave, 7-17.5 mc.
S-744. Short Wave, 15.5-35 mc.
(S-742 to S-744) Net each..... 65¢

Model S-735 $17^{25}

knight-kit "RANGER II" SUPERHET RADIO KIT

Thousands have built and enjoyed the "Ranger" Broadcast Band Receiver. Carefully engineered for easy construction and powerful, sensitive performance. Latest Superhet circuit; tunes 540 to 1680 kc; covers entire broadcast band and exciting police calls. Features automatic volume control, built-in preformed loop antenna, ball-bearing tuning condenser. Develops excellent tone quality from Alnico V PM dynamic speaker. Supplied with following tubes: 12SA7GT converter; 12SK7GT IF amp.; 12SQ7GT det.-AVC-audio; 50L6GT audio output; 35Z5GT rect. Complete with handsome brown plastic cabinet (6 x 9 x 5) tubes, speaker, all parts, and instruction manual. AC or DC operation. Shpg. wt., 8 lbs.

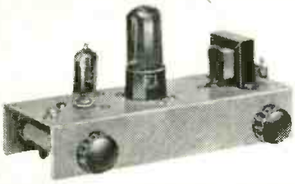
Model S-735. "Ranger II" Superhet Radio Kit. Net only.............. **$17.25**

Model S-730 $19^{95}

knight-kit 3-WAY PORTABLE RADIO KIT

A low-cost portable radio covering the full standard broadcast band from 535 kc to 1650 kc. Delivers excellent reception on AC or DC current or from self-contained batteries. Sensitive Superhet circuit features automatic volume control, economical operation. Includes powerful 5" Alnico PM dynamic speaker, efficient ferrite loop-stick antenna. Supplied with following tubes: 1R5 converter; 1U4 IF amplifier; 1U5 detector-AVC-audio; 3V4 audio output. Complete with attractive portable case (7⅝ x 10 x 5¼"), tubes, speaker, all parts and instruction manual. Shpg. wt., 6 lbs.

Model S-730. 3-Way Portable Radio Kit (less batteries). Net. **$19.95**
J-651. Battery Kit for above..... **$2.50**



knight-kit LOW COST PHONO AMPLIFIER KIT

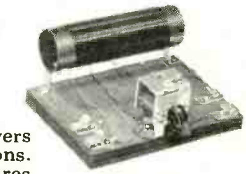
Model S-790 $8^{95}

It's easy to build this fine-performing, low-cost compact phono amplifier. Ideal for use in a portable phonograph—simply add any record player and a 3 to 4-ohm speaker. Amplifier works with crystal or ceramic cartridges. Inverse feedback circuit for rich, clean tone quality. Delivers full 1½-watt output with less than .25 volt input. Includes efficient tone control; has AC outlet, controlled from amplifier switch. Complete with tubes and all parts. Size only 4½ x 7 x 4"—fits into almost any portable phono case. Shpg. wt., 3 lbs.

Model S-790. Phono Amplifier Kit. Net only............... **$8.95**

FAMOUS knight-kit CRYSTAL SET KIT

Model S-261 $2^{15}



Thousands of beginners have started in radio and electronics by building the KNIGHT-KIT crystal set. This feature-packed set delivers loud, clear reception of local broadcast stations. A germanium crystal diode detector assures high sensitivity and simple operation—no crystal adjustment required. "Hi-Q" coil boosts sensitivity. Ball-bearing variable capacitor for easy tuning. With all parts and simple-to-follow instructions. Shpg. wt., 1 lb.

Model S-261. Crystal Set Kit. Net only.................. **$2.15**
S-267. Accessory Kit. 2000-ohm headphones and all parts for outdoor antenna............................... **$2.95**

Buy with confidence from ALLIED—America's Pioneer in Electronic Kits

finest quality electronic equipment in lowest-cost kit form

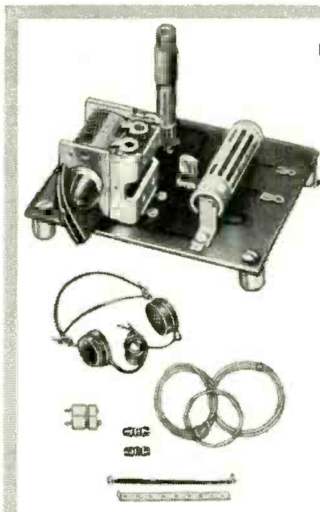
EASY-TO-BUILD HIGH PERFORMANCE KITS • WIDELY USED BY MANY LEADING TRAINING SCHOOLS

NEW knight-kit ELECTRONIC PHOTOFLASH KIT

Model S-244 **$28.50**

New feature-packed photoflash kit—designed for top quality dependability—available at a money-saving low price. Ideal for black and white or color photography. Xenon-filled reflector-bulb assembly gives over 10,000 flashes at less than ½¢ each! 1/700-second flash freezes the fastest action. Has 50 watt-second output. Provides light approximating daylight in spectral quality; permits the use of outdoor-type film indoors. Film guide number for color (ASA10) is 45. Designed for "X" or "O" shutters only. Requires sync cable (available from any photo supply dealer) and either battery or AC supply listed below. Complete outfit with battery weighs only 3½ lbs. Kit includes all parts, carrying case and easy-to-follow instructions. Shpg. wt., 3 lbs.

Model S-244. Electronic Photoflash Kit. Net.... **$28.50**
S-246. AC Power Supply Kit. Easy to assemble.... **$3.75**
J-626. Battery for above (Burgess U-200)......... **$8.47**



knight-kit TRANSISTOR RADIO KIT

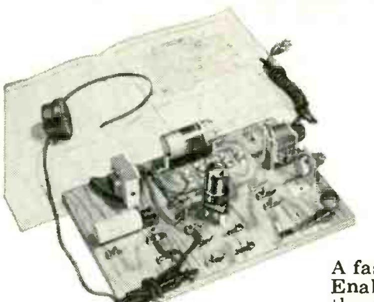
Printed Wiring • Works from Penlight Cell

Model S-765 **$4.35** **Smooth Variable Capacitor Tuning**

Experiment with the marvel of transistors! Printed circuit requires no wiring—just assemble with a few solder connections and enjoy excellent reception over the full AM broadcast band. No tubes to burn out—no crystal. Compact—fits in the palm of your hand—operates for months from a single penlight cell. Transistor provides plenty of power for strong headphone reception. Complete with all parts, transistor and penlight cell. Shpg. wt., 8 oz.

Model S-765. Transistor Radio Kit **$4.35**
S-266. Accessory Kit. 4000-ohm headphones and all parts for outdoor antenna........................ **$3.15**

FAMOUS knight-kit LAB KITS

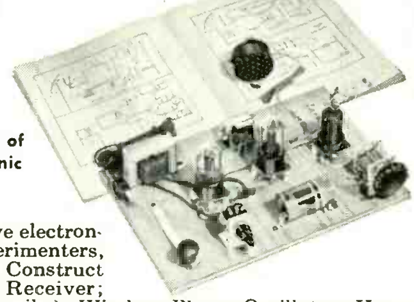


6-IN-1 RADIO LAB KIT

Model S-770 **$7.95** **Build Any of 6 Electronic Projects**

A fascinating and instructive kit. Enables you to build any one of the following projects: Standard Broadcast Receiver; Wireless "Home Broadcaster"; Code Practice Oscillator; Code Practice Broadcaster; Signal Tracer; Sine Wave Generator. Perfect for beginners. Once basic wiring is completed, circuits may be changed without soldering. Safe to build and operate; only tools needed are screwdriver, pliers and soldering iron. The ideal kit for students and beginners in electronics. Kit includes mounting board, tube, all parts and easy-to-follow instruction manual. Less headphone (also serves as mike). Shpg. wt., 6 lbs.

Model S-770. "6-in-1" Lab Kit. Net only................ **$7.95**
J-112. Single 1000-ohm headphone for above.............. **$1.05**
C-100. Antenna kit for above............................ **$1.05**

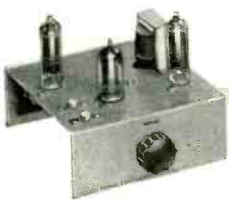


10-IN-1 LAB KIT

Model S-265 **$12.65** **Build Any of 10 Electronic Projects**

A wonderfully instructive electronics kit. Ideal for experimenters, beginners—fun to build. Construct a sensitive Broadcast Receiver; Amplifier (for phono or mike); Wireless Phono Oscillator; Home "Broadcast Station"; Code Practice Oscillator; Capacity-Operated Relay, or any one of *four* other fascinating projects. Low voltages; safe to build and operate. Only tools needed are soldering iron, screwdriver and pliers. Perfect for self-instruction in circuit fundamentals, and packed with practical applications. Kit includes mounting board, tubes, all parts, hardware, microphone, and 12-page builders' manual. Shpg. wt., 10 lbs.

Model S-265. "10-in-1" Lab Kit. Net only.............. **$12.65**
J-112. Single 1000-ohm headphone for above.............. **$1.05**
C-100. Antenna Kit for above............................ **$1.05**

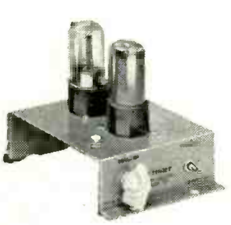


knight-kit WIRELESS BROADCASTER KIT

Model S-705 **$9.50**

This fascinating unit makes it possible to "broadcast" witn phonograph or microphone through any standard radio receiver up to 50 feet away—without any connection to the set. May be used with crystal or magnetic cartridge, or with microphone. Broadcasts a clear, full-toned signal. High-gain stage permits using magnetic cartridge without need for external preamp. Complete with all parts, tubes, wire and solder (less microphone). 4½ x 5 x 6". Easy to assemble. Shpg. wt., 3 lbs.

Model S-705. Wireless Broadcaster Kit. Net only....... **$9.50**
S-556. Microphone for above with 5-ft. cable........... **$3.95**



knight-kit PHONO OSCILLATOR KIT

Model S-760 **$5.85**

This low-cost phono oscillator may be used with any crystal phonograph for "broadcasting" recorded music through any standard radio receiver up to 50 feet away. Requires no direct connection to radio set. Operates on any frequency between 600 and 800 kc. Has controls for adjustment of modulation level and selection of clear frequency on radio receiver. Uses 50L6GT tube and 35Z5GT rectifier. Complete with all parts, tubes and instructions. 4¼ x 4¼ x 4½". Shpg. wt., 1 lb.

Model S-760. Phono Oscillator Kit. Net only.......... **$5.85**

knight-kit CODE PRACTICE OSCILLATOR KIT

Model S-239 **$3.95** **Transistor Circuit—Powered by Penlight Cell**

An ideal code practice oscillator. Uses transistor circuit. Extremely low current consumption—powered by single penlight battery. Provides crisp, clear tone (400 to 600 cps). Has input jack for earphone; screw-type terminal strip for key. In compact bakelite case (2⅜ x 3¾ x 1½") with anodized aluminum panel. Complete with all parts, transistor, battery and easy-to-follow instructions. Shpg. wt., 1 lb.

Model S-239. Code Practice Kit.... **$3.95**

See Next Page for Amateur Kits

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***order from* ALLIED RADIO 100 N. WESTERN AVE., CHICAGO 80, ILL. →**

ALLIED'S own knight-kits give you the most for your money

BUILD YOUR OWN QUALITY HI-FI AMPLIFIER!

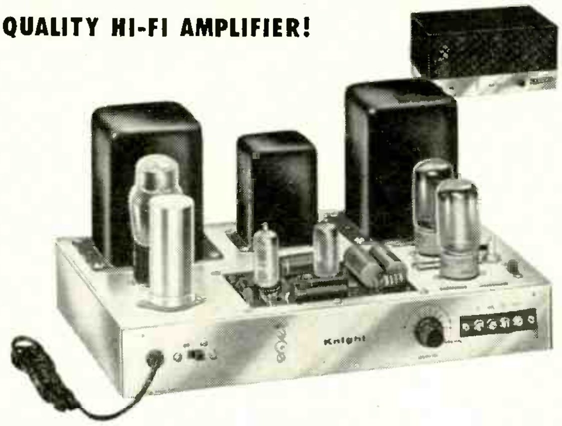
knight-kit

BASIC 25-WATT LINEAR-DELUXE HI-FI AMPLIFIER KIT

Model S-755

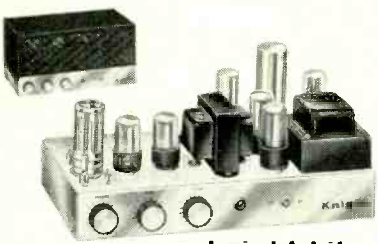
$44.50

Williamson-Type Circuit
Printed Circuit Board
Chrome-Plated Chassis



This super-quality hi-fi basic amplifier is designed to satisfy the most critical listener. Intended for use with tuners incorporating built-in preamp or with separate preamp. Incorporates latest Williamson-type circuit and has potted matched transformers. Delivers maximum output of 45 watts. Frequency response is: ±0.5 db. 10 cps to 120 kc, *measured at 20 watts*. Harmonic distortion is only .15% right up to 30 watts. Intermodulation distortion is only .27% at 10 watts and only .4% at 20 watts, using 60 cps and 7 kc, 1:4 ratio. Hum level is —85 db below full rated output. Output impedance, 4, 8, 16 ohms. Input voltage for 25-watt output is 1.8 volts. Uses two 12AU7's, two 5881's, and a 5V4. Etched circuit is utilized in voltage amplifier and phase inverter stages to speed assembly. Has output tube balancing control, variable damping control, and on-off switch. Handsome chrome-plated chassis, 14 x 9 x 2". Overall height, 7". A deluxe true hi-fi amplifier equal in performance to amplifiers selling at over twice the price. Complete with all parts and tubes. Easy to assemble. Shpg. wt., 27 lbs.

Model S-755. Basic 25 Watt Hi-Fi Amplifier Kit. Net only **$44.50**
S-759. Metal enclosure for above; black finish. 3 lbs. Net **$4.25**



knight-kit

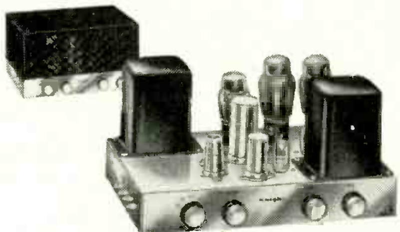
10-WATT HI-FI AMPLIFIER KIT

Model S-753 — Chrome-Plated Chassis

$23.50

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ±1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chromed chassis; punched to accommodate magnetic cartridge preamp. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-753. Amplifier Kit. Net... **$23.50**
Model S-235. Preamp Kit for above ... **$3.10**
S-757. Metal Enclosure. 3 lbs. **$3.95**



knight-kit

20-WATT HI-FI AMPLIFIER KIT

Model S-750 — Chrome-Plated Chassis

$35.75

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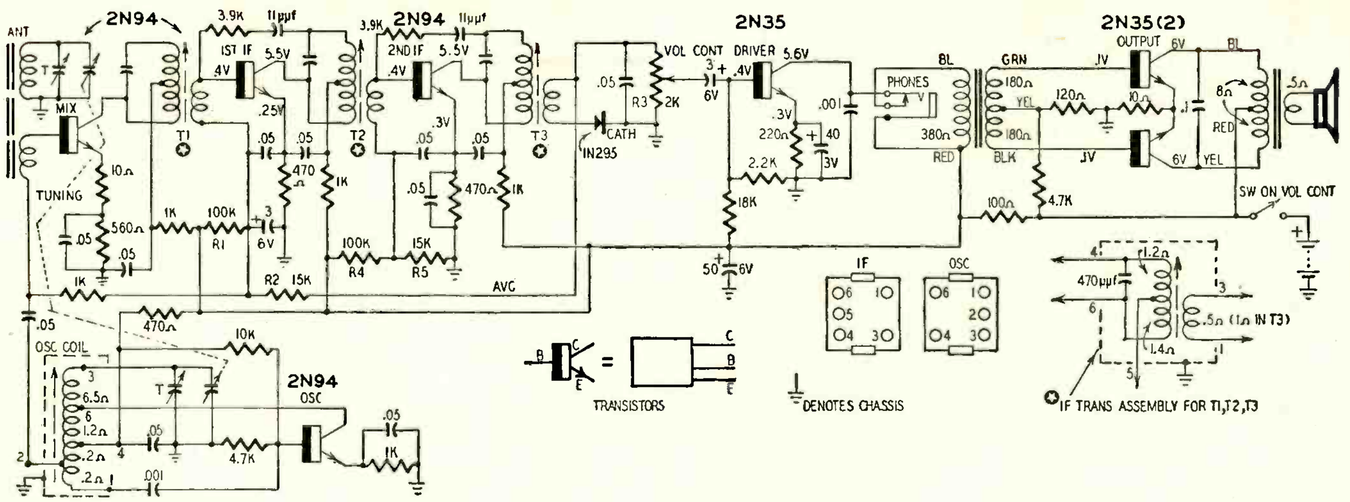


Fig. 4—Zenith model 500 Royal is a seven-transistor superheterodyne.

(*Continued from page* 92)
plainly marked on the dial. The case has a three-position handle. It can swing up for portable use, slide down to serve as a table support or hug the bottom of the case when placed in a pocket or purse.

Fig. 4 shows the schematic, with voltages indicated on if and af transistor elements. Note that the voltage on each n-p-n type reads higher on the base than on the emitter to permit conduction.

Separate transistors function as mixer and oscillator. The oscillator tuning capacitor is across the upper portion of the coil. Tap 4 (of the coil) is grounded for rf, placing it at emitter potential. Tap 6 connects to the collector. Terminal 1 connects to the base through a capacitor. This arrangement may be recognized as equivalent to a tapped Hartley which oscillates because it feeds base and collector out of phase; the intermediate tap is for the emitter.

The converter and first if are gain-controlled. In the absence of signal, both stages are biased from voltage divider R1–R2–R3 (volume control). On arrival of a signal, *negative* avc voltage is fed into the base of each stage to reduce gain and prevent overloading. The second if stage is fixed-biased by R4–R5. Both if stages are neutralized, using both resistance and capacitance. Neutralization is between collector and base of the *same* stage.

A 1N295 diode detects and furnishes avc (negative) voltage. The audio channel uses three 2N35 high-gain transistors. A jack provides an outlet for an earphone for private listening. There is no need to disconnect the output stage during this time because there is negligible drain by a class-B stage operating at zero signal.

Undistorted power output is 100 mw, with a maximum of 180 mw. The receiver has a sensitivity of 500 microvolts per meter for 50-mw output.

G-E models 675, 676

Both of these sets use five transistors, all of which are p-n-p except the detector. A single transistor operates as an oscillator–mixer. Another is the audio output stage which can deliver up to 40 mw at 10% distortion and an audio peak of 60 mw. The receivers (Fig. 5) are plate-wired.

V1 is the converter transistor. Mixing is done by a series connection of T1 (the antenna loop) and T2 (the oscillator coil). Inductive coupling between the base and collector windings generates the local oscillations. V1 is biased for detection (otherwise it cannot produce the desired if beat). This bias is set by voltage divider R1–R2–R3. A blocking capacitor prevents the coils from shorting R1.

Note the absence of neutralization. To make this possible V2 is operated at less than maximum voltage (13.5 volts) to stabilize it. The emitter is returned to a −4.5-volt tap rather than to ground directly or through a resistor. A nearly equal voltage drop is needed at the base, and this is generated in the larger series resistor R4 and the drop across R5. Some degeneration is introduced by omitting bypass capacitance across the 4.5-volt tap of the battery. In other words, collector current is bypassed to ground through C1. To return to the emitter it must flow *through the battery* to the −4.5-volt tap. There is no bypassing through this portion of the battery.

V3, also unneutralized, receives nearly full voltage since its emitter is directly grounded. In this stage regeneration is lowered by resistor R6 shunting the transformer secondary. R6 is normally 470 ohms. However, if regeneration occurs in spite of it, damping may be increased by using a still lower resistance; it should be as large as possible without producing instability.

V4 is biased for detection by the voltage divider, 47,000 and 220 ohms. High frequencies are bypassed through a .05-μf capacitor, but audio appears across the volume control. Note the direct coupling to the output stage. While this means less than optimum matching, it is a convenient coupling method, and eliminates power losses in a transformer.

When V4 delivers greater output (as it does when the signal is stronger), a larger *negative* drop appears across the volume control since the detector is n-p-n. Thus V5 (a p-n-p type) is driven to greater conduction so it can handle the greater signal impressed on it.

Tuning and alignment are as specified on the diagram. First, adjust the if transformers, starting with the last and working forward. Couple the signal generator loosely to the high end of the antenna loop. Now the high-frequency end of the broadcast band may be aligned, then the low-frequency end. Repeat the alignment if it proves necessary.

TO BE CONTINUED

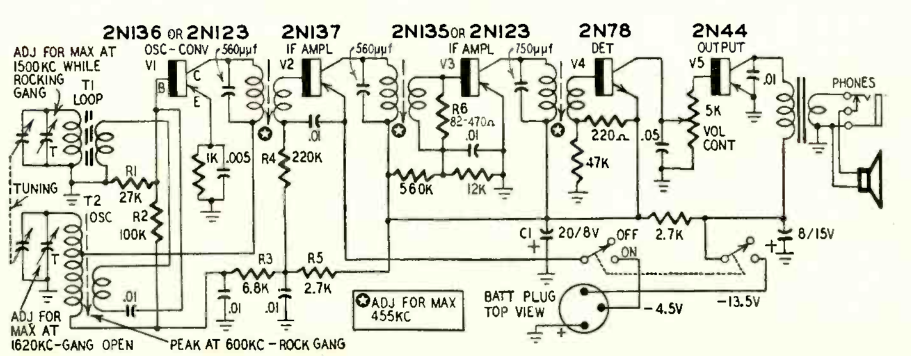
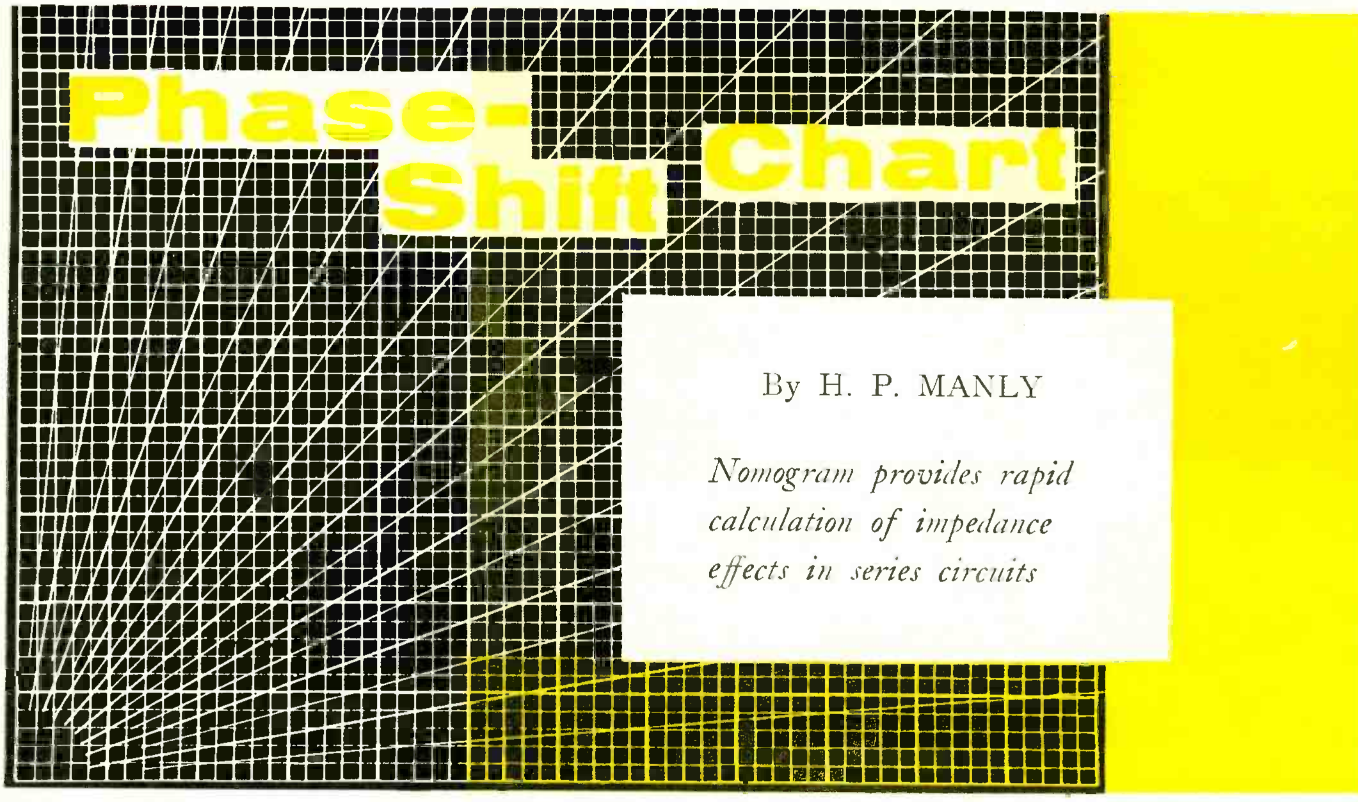


Fig. 5—General Electric models 775 and 676 use five transistors.



Phase-Shift Chart

By H. P. MANLY

Nomogram provides rapid calculation of impedance effects in series circuits

PHASE shift is important in automatic frequency control, synchronized sweep, tone correction, chrominance and color oscillator sections—to mention only a few of its applications in modern electronics. Phase-shift circuits consist of capacitors or inductors or both, and usually resistors, in series or parallel combinations.

The number of degrees by which volttage across a series resistor is shifted with reference to the source voltage varies with the amounts of resistance, capacitance or inductance and operating frequency. Problems are simplified by combining capacitance or inductance, and frequency, in a single term —reactance, at the operating frequency. Knowing ohms of reactance and ohms of resistance we may read phase shifts in degrees for any series circuit on the chart of Fig. 1.

On the chart are sloping lines for phase shifts of 0 to 90° at intervals of 5°. The resistance and reactance scales may be multiplied or divided by any number, but both by the *same* number, to bring them into a range for any resistance and reactance in a problem. Reactance for any capacitance and frequency may be read directly from alignment charts in the December, 1955, issue of RADIO-ELECTRONICS or both capacitive and inductive reactances may be computed from formulas at the end of this article.

Here are the rules:

1. Phase difference between voltage across a resistor and voltage across either a capacitor or inductor in series always is 90°.
2. With only capacitance and resistance in series the resistor voltage *leads* source voltage, capacitor voltage *lags* source voltage.
3. With only inductance and resistance in series the resistor voltage *lags* and inductor voltage *leads* source voltage.
4. With capacitance, inductance and resistance in series it is necessary to determine the separate capacitive and inductive reactances, then take their difference as the net reactance for use on the chart. Consider the net as capacitive if capacitive reactance is the larger, inductive if inductive reactance is the larger.

To illustrate how phase shift is read assume, as in Fig. 2, 5,000 ohms resistance and 1 μf capacitance in series, at 60 cycles. Capacitive reactance may be determined from an alignment chart as about 2,600 ohms. Mentally we multiply the resistance and reactance scales of the phase-shift chart by 100, then go to 5,000 ohms along the resistance scale and down to a point opposite 2,600 ohms on the reactance scale.

At the intersection for resistance and reactance we read on the angle lines and their scale that voltage across the resistor leads the source voltage by about 27°. Since the difference between resistor and capacitor voltages always is 90°, the capacitor voltage in this problem must lag the source voltage by $90-27°$ or 63°.

In Fig. 3 we have a fixed resistor of 1,000 ohms, an adjustable resistor of 10,000 ohms and a capacitor of .033 μf in series, at 1,000 cycles. What will be the limits of phase shift when adjusting the 10,000-ohm resistor through its range? From an alignment chart we read about 4,800 ohms capacitive reactance for .033 μf on 1,000 cycles. Spotting the intersections for 1,000 ohms minimum resistance and for 11,000 ohms maximum resistance along the reactance line for 4,800 ohms on the phase-shift chart shows the total shift will be from about 23.5 to 78°.

Voltage phase across a resistor may be shifted with respect to source voltage by a variable capacitor in series with the resistor. In Fig. 4 we assume a 150–650-$\mu\mu$f mica trimmer in series with a 47,000-ohm fixed resistor and a 10-kc source. From the alignment chart for capacitance we read reactance of about 100,000 ohms for 150 $\mu\mu$f at 10 kc, about 25,000 ohms for 650 $\mu\mu$f. On the phase-shift chart we spot intersections for these two reactances along a vertical line for resistance of 47,000 ohms and on this line read the limits of phase shift as 28° for maximum and 65° for minimum capacitance.

In Fig. 5 we have 250 mh inductance and .01 μf capacitance in series with a 10,000-ohm resistor at 5 kc. This requires determining both kinds of reactance and taking their difference. From an alignment chart we read capacitive reactance as about 3,100 ohms for .01 μf at 5 kc. Computing the inductive reactance from a formula gives 7,860 ohms for 250 mh at 5 kc. The difference is 4,760 ohms of net reactance, inductive because the inductive reactance is greater than the capacitive reactance.

Spotting the intersection for 10,000 ohms resistance and 4,760 ohms reactance on the phase-shift chart indicates a shift of slightly more than 25°. Voltage across the resistor lags source voltage because the net reactance is inductive.

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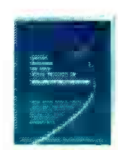

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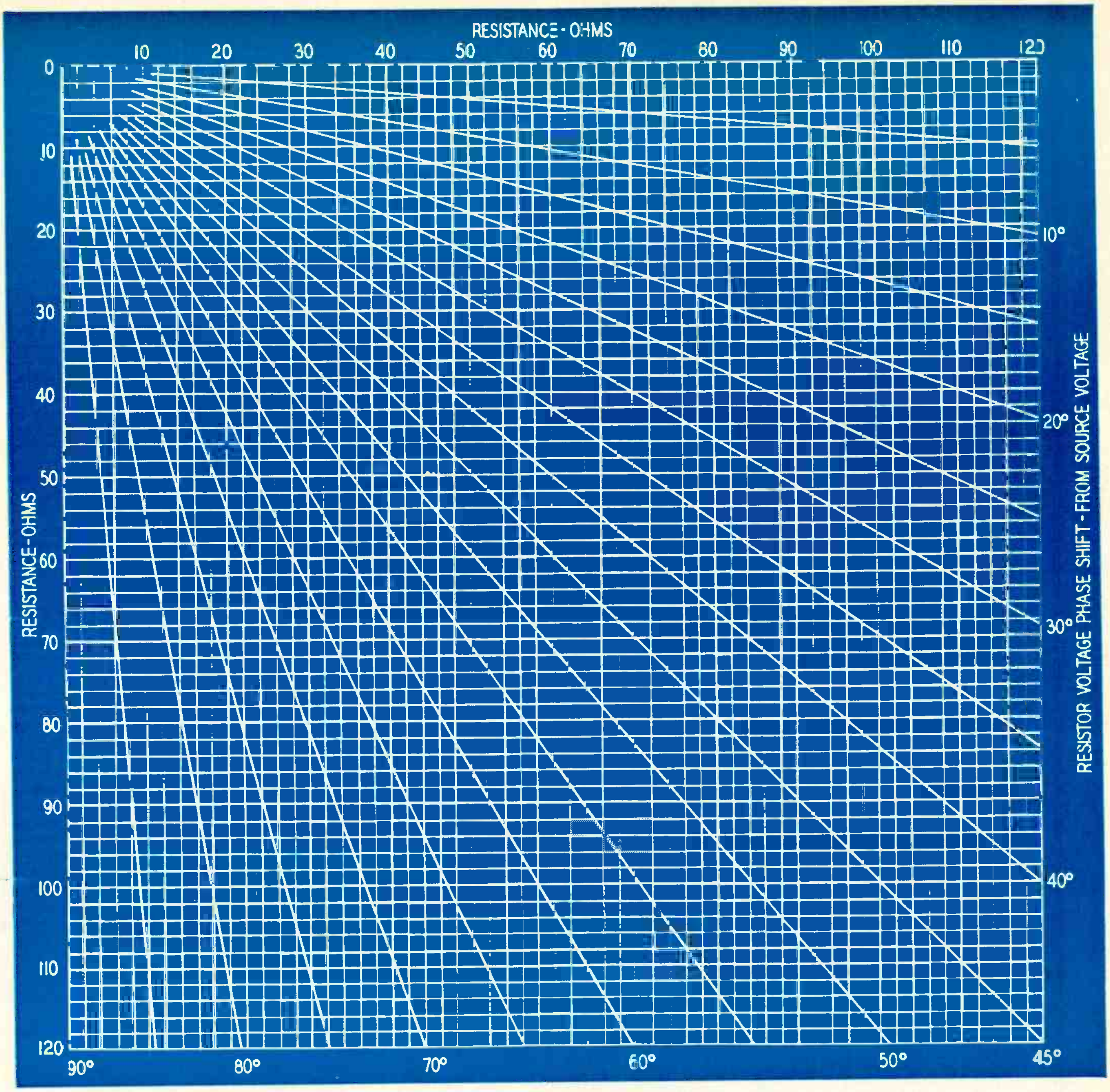


Fig. 1—Phase-shift chart for computing voltage lead or lag in circuits containing resistance, inductance and capacitance.

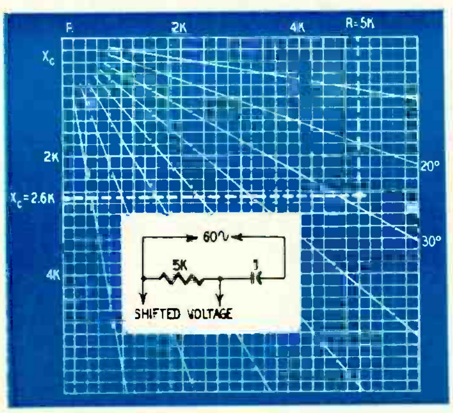
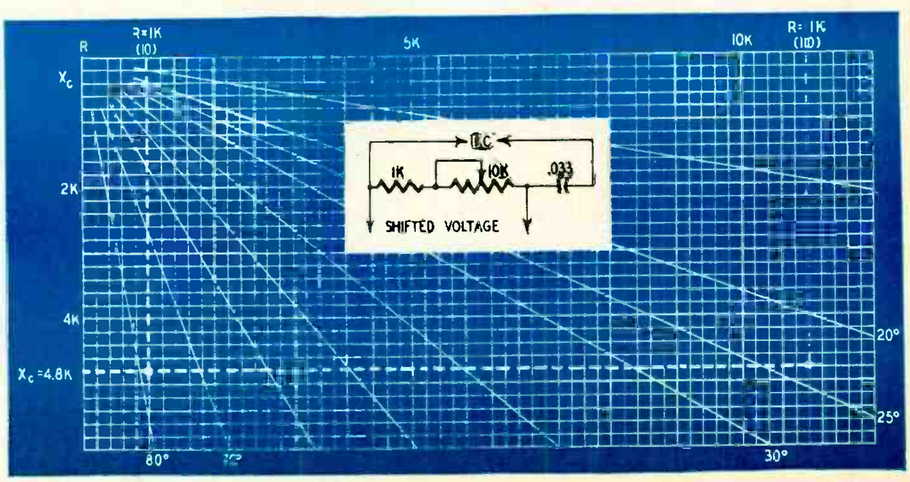


Fig. 2, above—A simple R-C series circuit.
Fig. 3, right—R-C circuit with potentiometer.



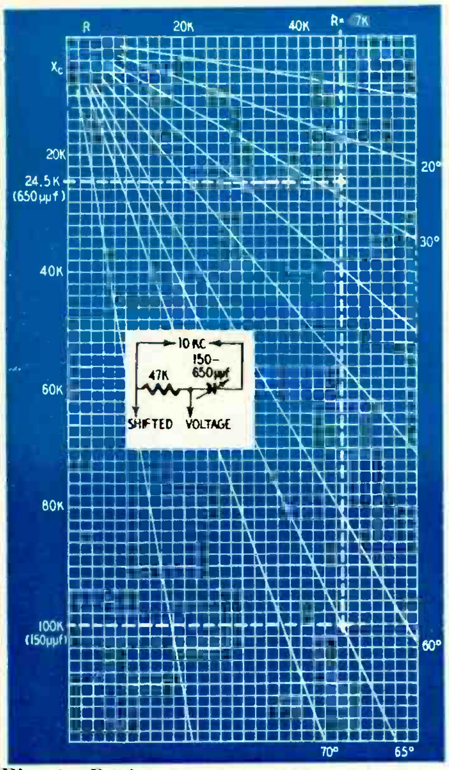


Fig. 4—Resistor and variable capacitor.

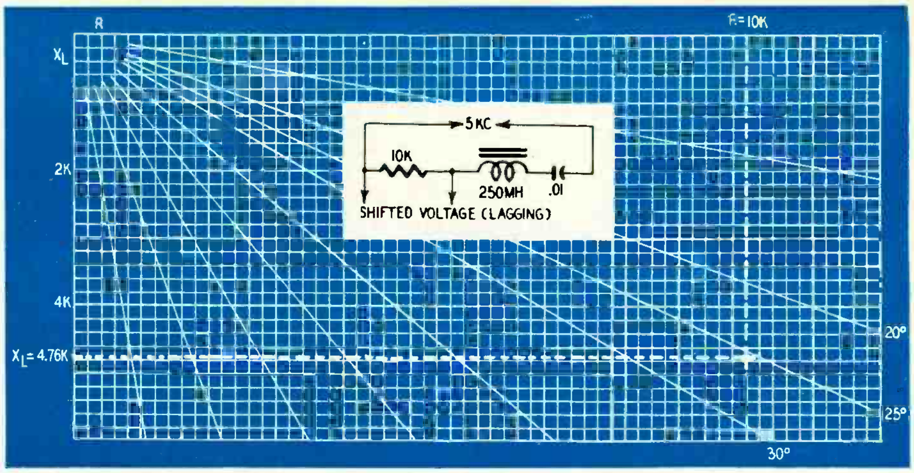


Fig. 5—Graph of circuit containing inductance, capacitance and resistance.

whether one voltage leads or lags some other voltage, look at it this way. The resistance line across the top of the phase-shift chart represents voltage across the resistor. The reactance line down the left-hand side represents voltage across a capacitor or inductor. Any diagonal line drawn from zero to an intersection represents source voltage.

As in Fig. 6, all these lines are to be considered as rotating together counterclockwise around the zero point as a center, but without changing their relative positions. If, during this rotation, some voltage line would arrive at any given point around the circle before another voltage line, the first voltage is leading the second—it gets there first. Of course, the second voltage is lagging the first one—it gets there later.

Color problems

The phase-shift chart may be used for solving problems in chrominance and color oscillator sections of color TV receivers. Chrominance signals, their components and phase relations often are shown as in Fig. 7, where are marked the values for two problems to be solved with the phase-shift chart.

The first problem (Fig. 8) is to put together two color-difference signals and find the resultant chrominance signal. The color-difference signals consist of 51.5 voltage units of $-(R-Y)$ and 28.5 voltage units of $-(B-Y)$. Since color-difference signals are in quadrature (separated by 90°) we may place them on our phase-shift chart as shown. The resultant is a line drawn from zero to the intersection. This line lags the $-(R-Y)$ voltage by about

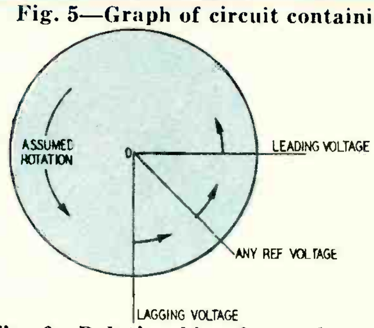


Fig. 6—Relationship of ac voltages.

29° and, of course, leads the $-(B-Y)$ signal voltage by the difference between 90° and 29°, 61°. On a color-phase chart such as that of Fig. 6 we would identify this resultant as a chrominance signal for green.

Reversing the procedure, we may commence with a chrominance signal voltage for some known color and determine the color-difference signals from which it is formed. Fig. 9 represents an orange chrominance signal of 60 voltage units strength lagging the $-(B-Y)$ signal or reference phase by 50°. On the phase-shift chart we spot a point which is 60 units distant from zero and on the 50° radial line. Following upward from this point we come to 38 units on the $-(B-Y)$ axis, and following to the left we come to 46 units on the $R-Y$ axis. Thus we learn that the orange chrominance signal is the resultant of 38 units of $-(B-Y)$ voltage combined with 46 units of $R-Y$ voltage.

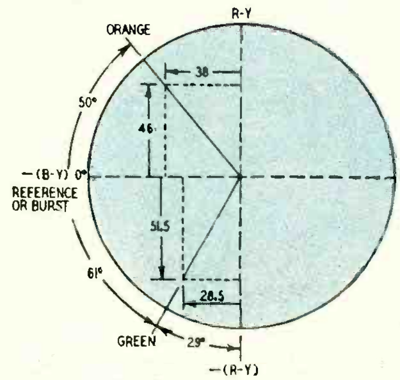


Fig. 7—Color TV phase relationships.

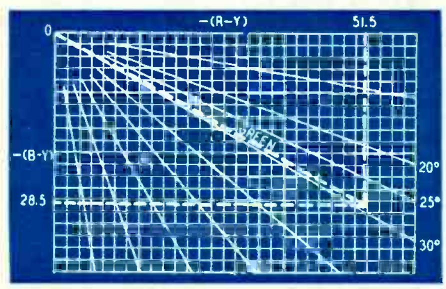


Fig. 8—Finding resultant color signal.

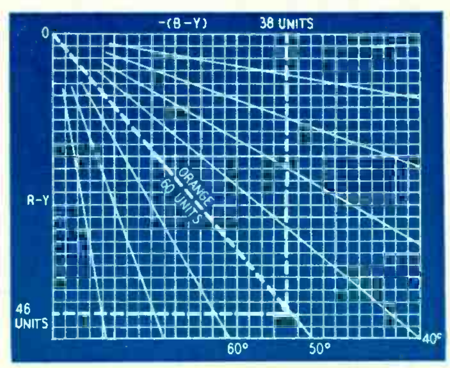


Fig. 9—Finding components of signal.

Reactance Formulas

Capacitive reactance, ohms

$$X_c = \frac{160{,}000}{\text{cycles} \times \mu f}$$

$$X_c = \frac{160}{\text{kc} \times \mu f}$$

$$X_c = \frac{160{,}000{,}000}{\text{kc} \times \mu\mu f}$$

$$X_c = \frac{0.160}{\text{mc} \times \mu f}$$

$$X_c = \frac{160\,000}{\text{mc} \times \mu\mu f}$$

Inductive reactance, ohms

X_L = cycles × h × 6.28
X_L = cycles × mh × .00628
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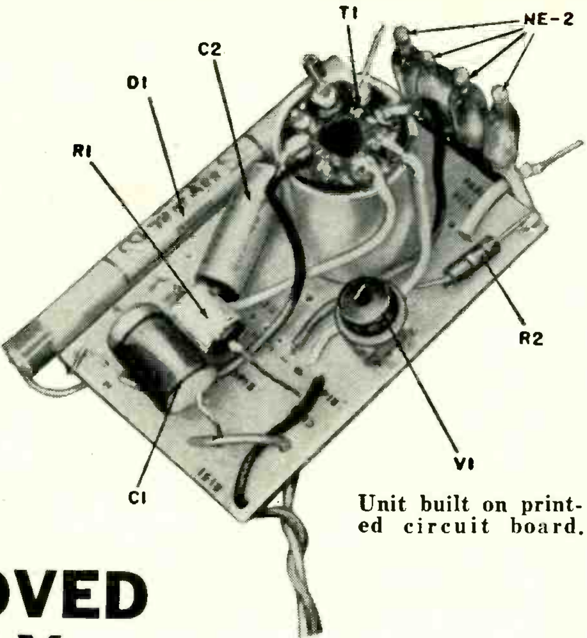

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IMPROVED SUPPLY POWERS G-M COUNTER

By THOMAS G. KNIGHT

HERE is an improved version of the power supply used in the Transistor-Operated Geiger Counter (RADIO-ELECTRONICS, April, 1956).

Improvements include much smaller physical size, increased power efficiency and replacement of the vacuum-tube diode by a selenium rectifier. An off-the-shelf transformer eliminates hand winding required in the original. The present low cost of transistors makes construction of this power package even more attractive than when the original model was devised.

Fig. 1 is a schematic of the unit. A tapped primary winding on the high-voltage stepup transformer is used instead of a separate feedback winding. The transformer is a UTC Ouncer type O-2 (line to grid) with only half of the primary used. Oscillation is guaranteed with the connections shown, there being no ambiguity as to the polarity of feedback pulses. If the primary terminals are not connected as shown, the unit will not oscillate and the transistor may be damaged. If the secondary output connections are changed from those shown, capacitive loading of the output voltage (by the internal winding capacitance of the transformer) will lower the voltage.

The selenium-rectifier polarity must also be correct to rectify the highest-amplitude pulses. The selenium rectifier (type S3Y30PL) is manufactured by and available from the Union Switch & Signal Co., Swissvale, Pa., at a cost of $1.05. It is a very small (¼-inch diameter) high-efficiency type. Extremely high back (inverse) resistance and good forward conductance result in very efficient operation.

Four NE-2 neon bulbs in series with a 4.7-megohm resistor make up the voltage regulator; filtering is handled by a .01-μf capacitor.

Any high-voltage half-wave rectifier, including vacuum diodes or selenium rectifiers, will work with the improved high-voltage power supply, provided the peak inverse voltage rating is high enough (at least 1,000). If selenium rectifiers are used, their reverse current must be very low, about 1 microampere or less, for the power supply to deliver peak voltage. This requires a good-quality selenium stack of at least 30 cells in series. Of course, vacuum diodes such as the Victoreen 5799 or Sylvania 5785 may also be used with practically zero reverse current. However, the necessity for heating the filament is a real disadvantage. Cold-cathode gas diodes such as the 5517 or CK1013 are not recommended due to a 100-volt drop across the diode which lowers the available useful voltage output of the power supply.

High-voltage low-current selenium rectifiers are the best choice due to their small size, efficient operation and long life. I have found that selenium stacks of 30 (or more) 26-volt cells and 2.5-ma current rating are best. More than 30 cells in series reduces the reverse current and raises the useful output voltage. However, a penalty is paid in longer length and higher cost.

Conventional 135-volt 50- to 75-ma selenium rectifiers may work but six or more are needed in series (increasing cost) and their distributed capacitance and size are excessive.

The S3Y30PL symbol represents a ¼-inch-diameter Bakelite tube 1 11/16 inches long containing 30 2.5-ma cells in series. An axial wire lead 1½ inches long extends from each end of the tube. This rectifier is rated at 390 volts rms for a capacitor-input filter and has a 1,080 peak inverse voltage rating. It will deliver 2.5 ma of dc. However, in in this power supply it is called upon to deliver only 3 or 4 microamperes.

Primary power may be drawn from any 6-volt source. Current drain at 6 volts input is under 2 ma. At this rate 4 penlight cells (size AA) will operate the unit continuously for well over 200 hours. For normal field use, as in a Geiger counter, say for 6 hours of operation per day 5 days a week, these same 4 cells should provide over 10 weeks of operation. And batteries can be replaced for only a few pennies! Mercury batteries or larger dry cells will provide even longer operation. This power unit is constructed on a printed-circuit card.

The transistor–oscillator type power source has many advantages over conventional types such as 300-volt dry batteries (too expensive) and vibrators (too inefficient besides generating radio-frequency interference). In fact, I have this power pack with a Geiger tube built into a portable radio–Geiger counter combination. Both functions may be performed at the same time, the output of the Geiger tube being fed into the antenna of the portable receiver (Fig. 2)! This feature may also be used with a car radio (any radio in fact), thus permitting testing of rock samples for radioactivity.

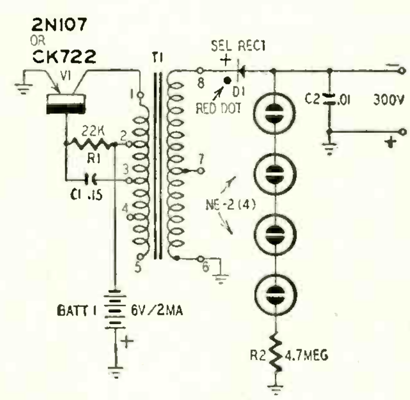


Fig. 1—The high-voltage power supply.

After the unit is wired up, correct operation will be indicated by a steady or flashing glow of the neon bulbs a few seconds after power is applied.

Power output, though minute, is sufficient to operate from one to a dozen or more 1B86 counter tubes in parallel.

The case of the transformer may be grounded if necessary. However, it is

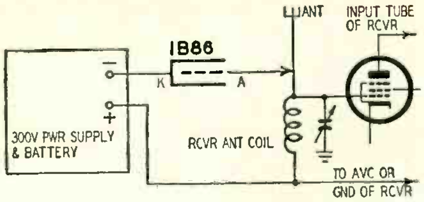


Fig. 2—Setup for feeding signals from geiger tube to receiver antenna circuit.

best left floating with respect to ground to minimize capacitance to ground.

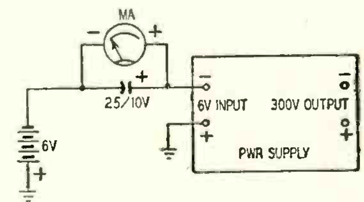


Fig. 3—Measuring the current gain.

The only problem that may confront the constructor is the choice of R1 and C1 in the oscillator circuit. The values shown should operate in most cases. Slight variations in transformer characteristics may make it necessary to use other values. If the output is too low at 6 volts, 2-ma input, increase or decrease the value of C1.

Incidentally, when inserting a meter in the battery leads to measure current drain, it is necessary to bypass the meter with a 25-μf (or larger) electrolytic capacitor to neutralize the meter inductance (Fig. 3). If the input current is not between 1½ and 2 ma, increase R1 if current is low and decrease it when current is high. Where necessary choose values of C1 and R1 so that with 2-ma battery input current, the neon bulbs emit a steady light or fast flashing rate (approximately 10 or more flashes per second).

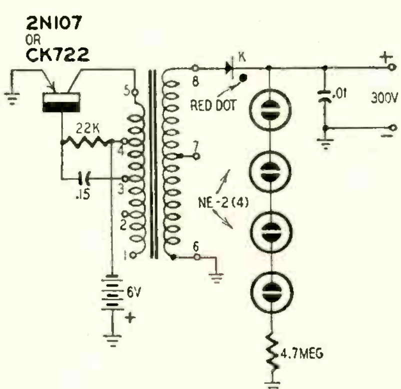
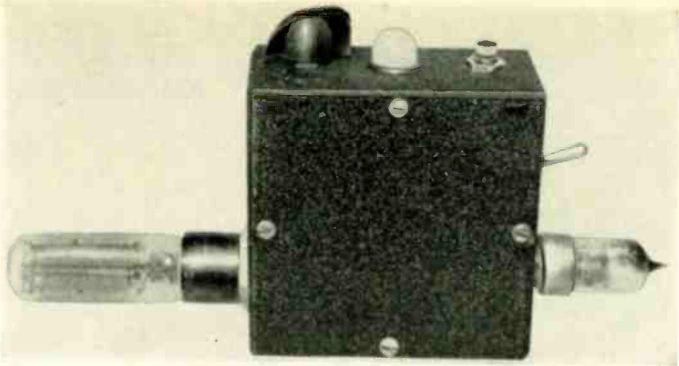


Fig. 4—A positive-voltage supply.

Parts for power supply
R1—22,000 ohms, ½ watt (see text); R2—4.7 megohms, ½ watt; C1—0.15 µf (see text); C2—.01 µf, 600 volts. V1—2N107 or CK722 transistor; BATT 1—4 penlight cells or equivalent; T1—UTC O-2 ouncer; D1—selenium rectifier (see text); 4 NE-2 neon lamps; 1 sheet of Bakelite or insulating board.

This particular circuit generates the high voltage with the positive side grounded. To furnish a negative high-voltage ground it is necessary to connect the transistor, rectifier and transformer as in Fig. 4. END

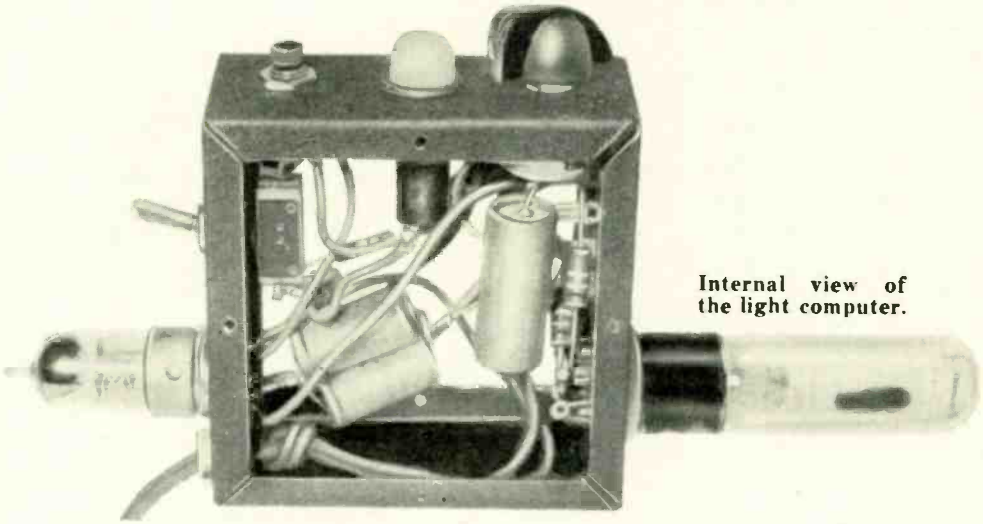
PHOTOELECTRIC LIGHT COMPUTER



The complete photoelectric unit.

By JOHN R. SATTER

Handy device for photographic darkroom use



Internal view of the light computer.

THE most time-consuming part of darkroom work is making test strips to find the proper exposure time for each negative. With this computer, test strips are banished forever from your darkroom. It will, at the flick of a finger, let you determine exactly how much light is striking your enlarging easel, regardless of negative density or the size of the enlargement.

By using a high-gain vacuum tube this instrument is much more sensitive than light meters available for general use. And, since no expensive microammeter is necessary, the cost of parts is limited to approximately $10—less if the constructor has an electronic junkbox available. Eyestrain is at a minimum since the indicator is an illuminated bulb rather than a meter, most difficult to read by the light in a darkroom during enlarging operations.

To keep the weight of the computer to a minimum, no filament transformer is used. Instead, a 3-μf paper capacitor is the filament dropping reactor. Consuming no power in itself, there is no heat generated as with a resistor, and power consumption of the instrument is limited to approximately 2 watts. Layout of parts and the method of wiring is not critical.

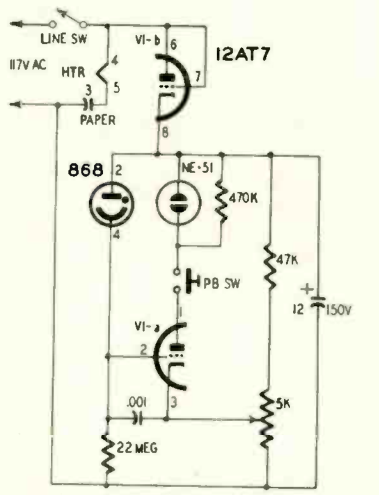
Operation and application

When the pushbutton switch is depressed, plate voltage is applied to V1-a, causing plate current to flow. The magnitude of the plate current depends upon the bias, set by the potentiometer in the cathode circuit. If the potentiometer is set so that the neon bulb across the plate load resistor is just extinguished in total darkness, the unit will be most sensitive. The phototube conducts more current as the light falling on its cathode becomes brighter, thereby reducing the bias and allowing more plate current to flow in V1-a. More current flow produces a larger voltage drop across the plate load resistor. This continues until the voltage drop is great enough to fire the neon lamp.

To calibrate, make an enlargement at some convenient exposure time in the usual way. Then, with the phototube placed on the easel under the darkest portion of the projected negative image, adjust the potentiometer so that the neon bulb is just extinguished. Thereafter it is necessary only to place the phototube over the darkest portion of any projected image and close the enlarging lens diaphragm until the neon bulb is just extinguished. With the same predetermined exposure, all the brightest portions of the positive prints will have the same tone.

The light computer may also be used to judge the contrast of paper required for a given negative by noting the difference between positions of the bias adjustment for the lightest and darkest portions of a projected negative image. The greater the bias difference needed to extinguish the lamp, the greater is the contrast of the negative and the softer the paper contrast required.

Exposure time may also be indicated using the same principles set forth above.



Schematic of the light computer.

Parts for light computer

1—47,000, 1—470,000 ohms, 1—22 megohms, ½ watt, resistors; 1—5,000-ohm potentiometer, 2 watts; 1—.001, 1—3 µf, paper capacitors; 1—12-µf 150-volt electrolytic capacitor; 1—12AT7 and socket; 1—868 phototube and socket; 1—NE-51 and socket; 1—spst pushbutton switch; 1—spst switch; 1—metal box, approximately 4 x 4 x 2 inches; 1—line cord; 1—knob.

The pushbutton switch should never be operated with normal room lights on; doing so will overload the neon bulb. The darkroom light should also be shaded from the enlarging easel or erroneous readings may result. After an evening of use this instrument will become an indispensable part of your darkroom equipment. END

Technicians' News

GUILD PLANS EXHIBIT

A brochure issued by the Radio & Television Guild of Long Island (N. Y.) indicates that plans for the Long Island Electronics Fair have reached the concrete stage. Exhibitors are offered an unobstructed space of 90 x 130 feet in a building which forms part of the State University of New York at Farmingdale. Fifty-one booths are planned for the hall, and an antenna system covering all local TV channels is being set up for exhibitors as well as a closed-circuit system which will carry color signals during exhibit hours. Plans for technical lectures and other activities are being made but had not been published at the time of writing.

TV SERVICING ENDED

A new circular slide-rule type of device (see photo below) makes the set owner his own troubleshooter, according to a New Jersey company selling the device. Prepared for the man who found the fix-it-yourself books popular a few years ago too difficult, it has a number of pictures showing screen defects. These are distributed around a revolving outer dial, and it is necessary only to turn the picture with the fault to the index point to establish the tubes at fault and the adjustments to be made. To aid in adjustments, the rear of a "typical" chassis is shown so Mr. Set Owner will know where to reach for his width control and where for the centering or focus. There is even a drawing to drive home the point that miniature tube pins should go in the corresponding socket holes when replacing tubes.

The owner then "removes the tubes, has them tested and replaces them and his set is working like new again."

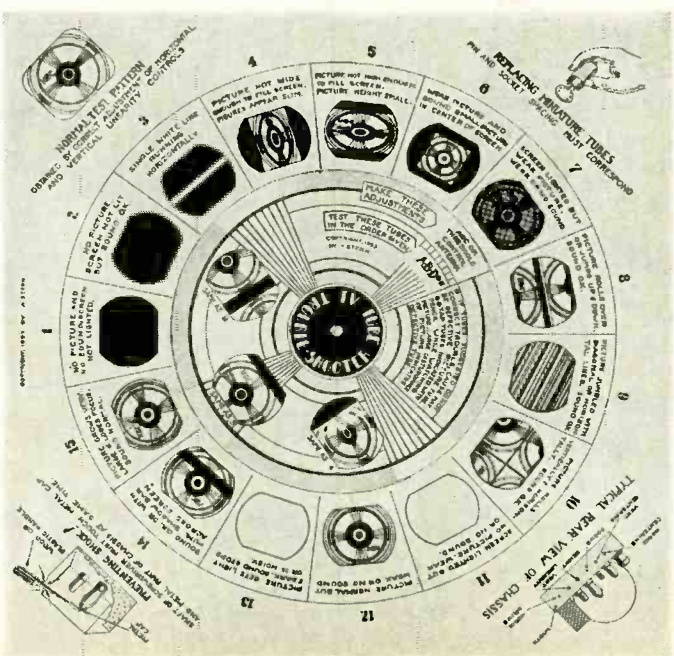
100 FIRMS SUPPORT CODE

A nine-point code to govern TV service companies' advertising tactics has been subscribed to by more than 100 firms in the Memphis, Tenn., area, according to George V. Morse, Jr., manager of the Memphis Better Business Bureau.

Firms are pledged, among other things to: make no extremely low-price quotations on service calls, make no discount offers for a first service call, to issue no coupons entitling the holder to special service discounts, to avoid underselling or underpricing claims and to make no statements disparaging to competitors.

Some 300 complaints and inquiries on TV service have been received by the Memphis BBB during the first five months of this year, Mr. Morse said. Most of the complaints were based on the cut-price call, which economical set-owners found extremely expensive in the long run.

Mr. Morse stated radio and TV were in seventh place among the categories most active from the standpoint of the BBB.



NATESA CONVENES SEPT. 14

The annual convention of the National Alliance of Television & Electronic Service Associations will be held at the Sheraton Hotel, Chicago, Sept. 14–16. It will undoubtedly be the largest NATESA has held and the business to come before the delegates will include some of the most important the organization has ever handled.

A full program of lectures and demonstrations—so timed as to be compatible with the business meetings—will cover both the technical and business problems of the service operator. Entertainment has not been overlooked and an interesting time is promised to all.

NEW MID-STATES GROUP

Technicians from High Point, Greensboro and Winston-Salem, N. C., met June 14 to lay the groundwork for an association of TV-radio service shops in the central part of the state. The group will be known temporarily as the Tri-City Technicians' Association. Officers elected for a three-month period are Jim Hornaday, High Point, president; Van Sickles, Winston-Salem, vice president; Joe Woods, Greensboro, secretary; C. B. Steele, Greensboro, treasurer. It is hoped that the group may serve as the basis for a state-wide organization, and to that end all full-time shops in the area—not merely the three cities—have been invited to join and a monthly schedule of meetings has been set up. All interested are asked to communicate with Joe Woods, 1708 Spring Garden St., Greensboro, N. C.

12% OF SERVICE IN N. Y.

Preliminary reports of the census of business conducted by the U. S. Bureau of the Census, indicate that as of 1954, 12% of the nation's radio and TV repair shop income was being earned in New York. Illinois received 9.1%, California 9%, Pennsylvania 6.7% and Ohio 6%. Unfortunately the report did not give any data later than 1954.

The report brought out the further interesting fact that the income of radio and TV shops increased more than 200% between 1948 and 1954, the 1948 receipts being $100 million and the 1954 income $313 million.

DETROIT APPOINTS BOARD

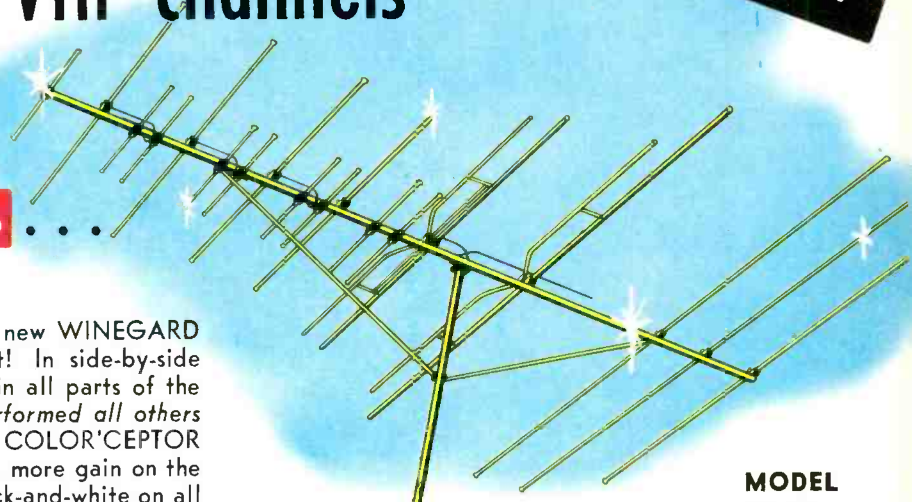
The committee to enforce Detroit's new TV servicing ordinance has been appointed by the Mayor. It consists of Alexander Weiss, G and G Radio and Television; Ralph Carew, University Radio; Lawrence Howard, Radio Electronic Television Schools; Patrick Brennan, Independent Television Repairmen's Association; Edgar Love, chief engineer WWJ-TV; Edwin C. Denstaedt, director of communications for the Detroit police department, and Heilborn B. Love, chief of the bureau of electrical inspection of the city's department of buildings and safety engineering. END

COLOR'CEPTOR®

Designed for Perfect Color Reception on all 12 VHF channels

Sensationally New!

New WINEGARD Engineering Development Increases Antenna Sensitivity 47% . . . Doubles Front-to-Back Ratios!



MODEL CL-4X List Price $44.90

MODEL CL-4 List Price $29.95

If awards were given for antenna performance, the new WINEGARD COLOR'CEPTOR would *win them all!* That's right! In side-by-side field tests, competing with other types of antennas in all parts of the United States, the amazing COLOR'CEPTOR *outperformed all others* tested. These tests included *sensitivity* (where the COLOR'CEPTOR averaged 47% more gain on the high band and 30% more gain on the low band**) . . . *picture quality* (both color and black-and-white on all 12 VHF channels) . . . *ability to reject co-channel interference* . . . *consistency* of reception in fringe areas under changing atmospheric conditions . . . and *horizontal directivity* (the ability to reject multi-path signal reflection and ghosts).

These tests were conducted by fifty independent servicemen selected at random throughout the country, whose final decisions were in no way influenced by the Winegard Company. However, Winegard did furnish non-reactive 300 ohm line pads, into which test lines were terminated to insure accurate gain test results.

Besides being an outstanding antenna electrically, the new COLOR-'CEPTOR is unmatched in quality of materials and workmanship. It comes in a beautiful gold anodized finish at *no extra cost.*

WINEGARD COLOR'CEPTOR Gives You *Clear--HIGH DEFINITION* Pictures in

COLOR **BLACK & WHITE**

**Model CL-4X with Power-Pack (see reverse side)

Here are the FACTS!

FIRST high gain all-VHF channel antenna expressly designed for Color TV!

FIRST with POWER-PACK. Gives exceptional signal boost on all 12 VHF channels!

FIRST all-channel 18-element yagi. Extra elements that give extra performance!

FIRST gold anodized aluminum antenna at no extra cost! (salt-spray tested for corrosion resistance)

FIRST dual-spaced Electro-Lens* director system (ask for Bulletin CL-1000 on engineering specifications)

*Patent No. U. S. 2700105 and Canada No. 511984 Other Patents Pending

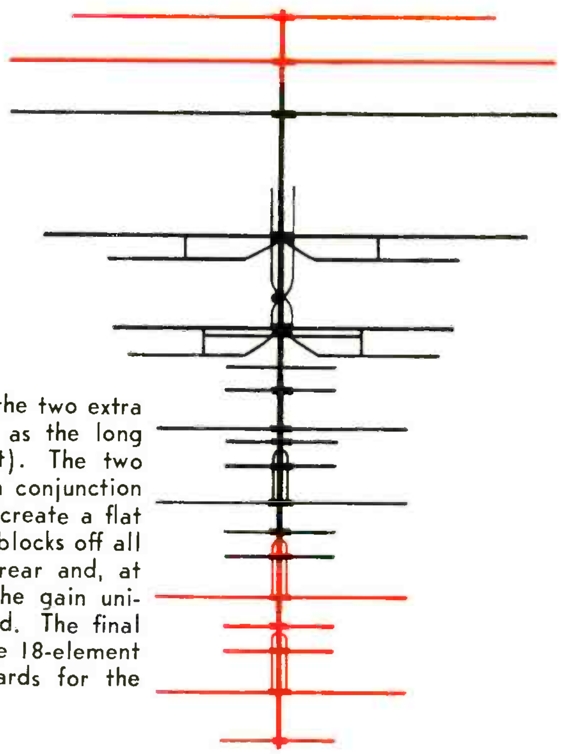
NATIONALLY ADVERTISED

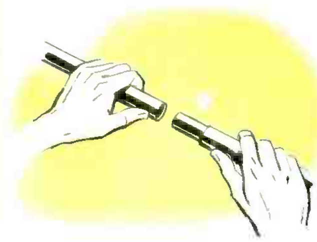
WINEGARD COMPANY
3000 Scotten Blvd. BURLINGTON, IOWA

(see details on reverse side)

"Power Pack" gives Big Power Boost to COLOR'CEPTOR

The exclusive Winegard POWER-PACK converts the regular 11-element model CL-4 COLOR'CEPTOR into an *ultra-sensitive, super-powerful* 18-element all-channel yagi. The Power-Pack consists of three separate parts — the front five-element Electro-Lens director system (shown outlined in red) that gives a tremendous gain boost on both VHF bands . . . plus the two extra reflector elements (shown as the long red elements at the right). The two extra reflector elements, in conjunction with the regular reflector, create a flat tuned screen that literally blocks off all signals arriving from the rear and, at the same time, increases the gain uniformly across the low band. The final result is a high performance 18-element yagi that sets new standards for the industry!





Power-Pack plugs in easily.

COLOR'CEPTOR CL-4	**$29.95 list**
POWER-PACK (PK)	**14.95 list**
COLOR'CEPTOR with POWER-PACK CL-4X	**44.90 list**

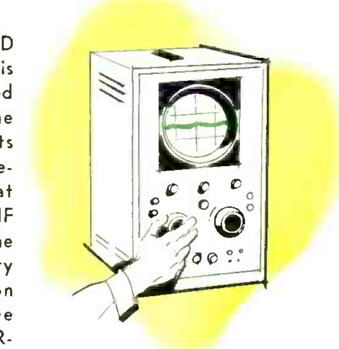
(NOTE: Standard gold anodized finish unless otherwise specified. Available on special order only in green or blue anodized finish or standard aluminum at same prices as above.)

STACKING BARS (SB-4C)		**2.20 list**
WEIGHT (Model CL-4)	Net	4 lbs. 14 ozs.
	Shipping	7 lbs. 8 ozs.
(Model CL-4X)	Net	7 lbs. 14 ozs.
	Shipping	10 lbs. 8 ozs.

OVERALL DIMENSIONS	**WIDTH**	**LENGTH**
CL-4	110"	78"
CL-4X	110"	122½"

WHY COLOR'CEPTOR IS FIRST CHOICE FOR COLOR TV RECEPTION

The fact that the antenna you are now using gives satisfactory black-and-white reception is no guarantee that this same antenna will give equally satisfactory performance on all 12 VHF channels in color. Even though you are located in a strong signal area . . . you need the COLOR'CEPTOR for perfect color reception.



The WINEGARD COLOR'CEPTOR is precision engineered and meets *all* the rigid requirements for perfect color reception, such as flat gain on *all* 12 VHF channels. In fact, the gain does not vary over ±1.2 DB on *any* channel. The Winegard COLOR'CEPTOR also assures 300 ohm impedence match . . . unmatched front-to-back ratios, not on just a few channels, but on all of your stations . . . plus the *highest average gain of any all-channel VHF antenna.*

So, if you want the finest color reception possible, use the Winegard COLOR'CEPTOR. If you want crisp, *high definition* black-and-white pictures, use the COLOR'CEPTOR. If you want an antenna you can install with confidence of tested performance and unequalled results, you want the Winegard COLOR'CEPTOR by all means! No matter how close or how far you are from your TV stations . . . no matter what your reception problems may be . . . the new WINEGARD COLOR'CEPTOR guarantees you the very finest TV pictures possible.

ATTENTION, Service Dealer!

Here's a chance for you to get a gleaming gold super DeLuxe 18-element COLOR'CEPTOR antenna . . . absolutely FREE . . . for your personal use or for set demonstration. See your nearest Winegard jobber, or send coupon for complete details — today!

WINEGARD COMPANY
3000 Scotten Blvd., Burlington, Iowa

Please rush me the following:

- ☐ How to get *free* COLOR'CEPTOR Antenna
- ☐ Name of nearest distributor
- ☐ Engineering specifications, catalog sheet and other promotional material available to help me sell COLOR'CEPTOR Antennas

FIRM NAME

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MY NAME

WINEGARD

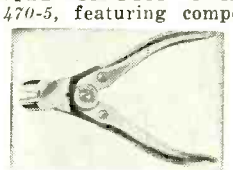
COLOR'CEPTOR for PERFECT COLOR RECEPTION

new Devices

HAND-OPERATED NIBBLING TOOL, *Model NT-1* cuts any shape of opening in sheet metal without distorting edges. Cuts holes any size or shape over

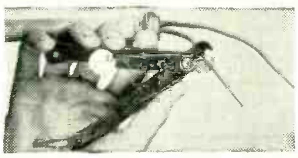
7/16 inch. Cuts in all directions. Capacity: steel, 18 gauge (.046 inch) maximum; aluminum, copper, plastic, etc., 1/16 inch.—**Harrison Radio Corp.,** 225 Greenwich St., New York 7.

PRINTED-CIRCUIT PLIERS, *No. 470-5,* featuring compound



leverage for easier cutting and one-operation cutting and crimping to prevent cut wire from sliding back through hole of printed-circuit board.—**Utica Drop Forge & Tool Corp.,** Utica 4, N. Y.

POCKET TOOL. Pocket-size wire cutter and stripper. Wire-size adjustment for easy stripping. 5-inch blades. For wire stripping, set adjusting stop to

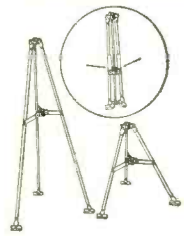


wire size, close jaws of tool around wire and strip with straight pull. Weighs 2 ounces. —**Jo-El Co.,** 14209 Leroy Ave., Cleveland, Ohio.

½-INCH CAPACITY HAND REAMERS, *No. 39.* 3/16-inch hole in shank where 3/16-inch screwdriver or pin may be inserted for leverage on extra-

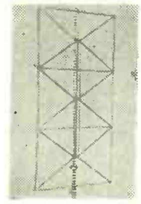
heavy work. Chrome plating for lasting cutting edge and rust resistance; straight fluted blades. In plastic 1-inch-diameter handle or detached.—**Xcelite Inc.,** Orchard Park, N. Y.

ROOF TOWERS: *Model TRT 120,* 10-foot triangular roof tower with multiple cross-bracing forming ladder on one side. *Model TRT 60* 5-foot triangular roof tower, cross-braced. *Model TRT 36* 3-foot triangular roof tower, cross-braced. *Model TRT*



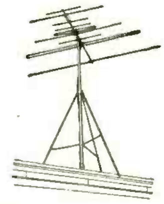
30 similar to above, 2½ feet. *Model TRT 6 AG 4* special 7½-foot top section of *No. 6G* tower with three 2½-foot legs which can be inserted into tower. All towers galvanized, collapsible. Fit roofs with rafters 16 inches on center.—**Rohn Mfg. Co.,** 116 Limestone, Bellevue, Peoria, Ill.

TV ANTENNA, *Ground-Master,* to eliminate roof-top installations in primary signal areas and to provide performance superior to indoor types. Mounts on ground and resembles trellis. Attractive addition to house when planted with rose or climbing vine. Active elements insulated to minimize effects of moisture. Kit complete with antenna trellis, mounting post, lead-in



and hardware.—**Trio Mfg. Co.,** Griggsville, Ill.

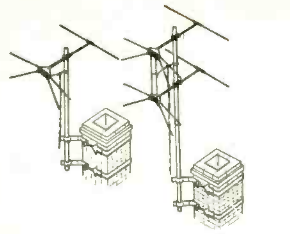
TRIPOD TOWER AND ANTENNA. *Minute-Mount,* 10-foot factory-assembled noncorrosive aluminum foldout assembly



mast with high-gain antenna. Attached lead-in, 7 insulators, lightning arrester, ground wire and ground rod. Designed for fringe areas.—**Winegard Co.,** Burlington, Iowa.

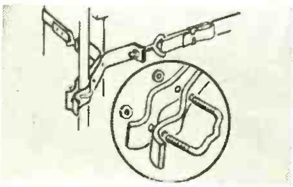
CONICAL ANTENNA KITS, 16 models ranging from 6 to 10 elements, packaged with such needed accessories as chimney mounts or swivel base, guy wire, standoffs, stacking bars, lead-in, etc. Antennas are all-aluminum, completely preassembled and ready to open like an umbrella.—**Tenna Mfg. Co.,**

(Continued)



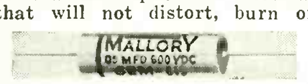
7580 Garfield Blvd., Cleveland 28, Ohio.

ANTENNA MOUNTINGS, *Snap-In,* with U bolt permit one-hand Spintite fastening of antenna mast. After mast is snapped



into spring-tension mast retainers, insert U bolts and tighten. —**South River Metal Products Co., Inc.,** South River, N. J.

PLASTIC TUBULAR CAPACITORS, *Gem,* for bypass, coupling and buffer applications. Seamless case made of high-grade mineral-filled phenolic material that will not distort, burn or



soften when heated. Rated at 600 volts or higher and impregnated with mineral oil; lower-voltage units, with wax. Leads won't loosen under soldering-iron heat.—**P. R. Mallory & Co., Inc.,** Indianapolis 6, Ind.

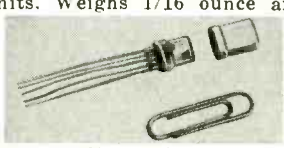
TRANSISTOR TRANSFORMERS, flexible coded leads. Open type mountings. Series of five

includes one input, two output and two interstage.—**Merit Coil Products Co., Inc.,** 4427 North Clark St., Chicago, Ill.

SINGLE-UNIT RESISTOR–CAPACITOR *Tube-R-Cap,* standard size tubular ceramic capacitor incorporating a ceramic-base

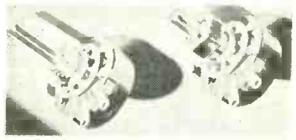
resistor in parallel. Length 0.9 inch, diameter 0.28 inch. 470 μμf, 1,500 volts ac; ½ megohm, ½ watt. **Centralab Div., Globe-Union Inc.,** 900 E. Keefe Ave., Milwaukee 1, Wis.

ELECTRONIC SWITCHING DEVICE, *Neomite* relay, for airborne computers and control units. Weighs 1/16 ounce and



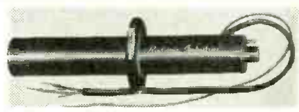
measures ⅓ by ½ inch. Available with 2,000-ohm coil and 1,000-, 500-, 200- and 50-ohm coils with 100-mw sensitivity.—**Elgin National Watch Co.,** Elgin, Ill.

RADIOHMS ¼-watt miniaturized controls. Completely closed, can be sealed or potted. 28 selections, 20% tolerance, 1,000 ohms to 2.5 megohms. *Model JP:* plain round shaft, ⅛-inch diameter and ½ inch long. *Model JL:* screwdriver-



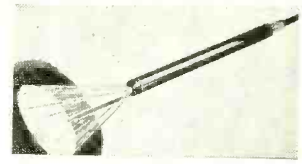
slotted shaft. — **Centralab Div., Globe-Union Inc.,** 900 E. Keefe Ave., Milwaukee 1, Wis.

PIC PROBE checks operation of TV receiver—any section of set seen on picture tube. Two coils and network of resistors, capacitors and diodes. Induced into



these windings are horizontal and vertical deflection currents. Integrating circuits form a sawtooth wave from the sweep signal picked up in windings. Sawtooth waves are than fed to horizontal and vertical inputs of oscilloscope, giving a raster. Intensity terminal of the scope is fed with video information from TV set, producing on scope a picture identical to that on TV set screen.—**Radionic Industries,** 3215 W. North Ave., Chicago 47.

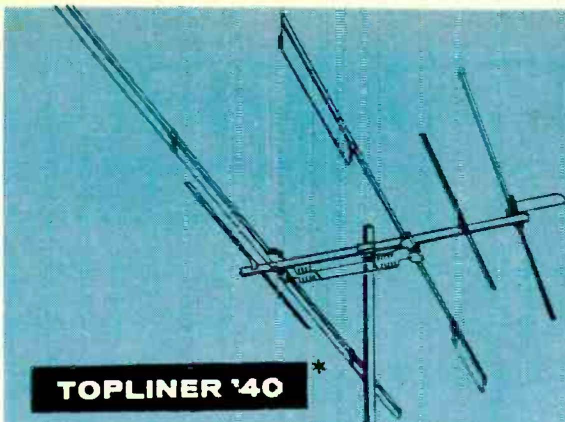
ILLUMINATED PROBE, *Probe-Lite,* combines probe and illumi-



nation source. Tip of cord set inserts in probe jack. Brilliant prefocused light. Long, slender probe tip for difficult areas.—**Phaostron Instrument & Electronic Co.,** 151 Pasadena Ave., So. Pasadena, Calif.

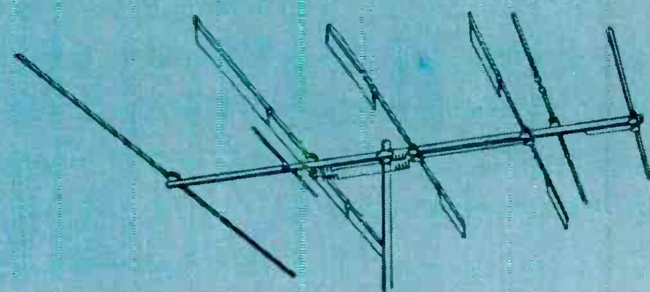
CAPACITOR–RESISTOR ANALYZER, *CRA-2,* for use in industrial and military electronics, black-and-white and color TV. Leakage current values read directly from meter while rated

operating voltage is applied to capacitor. Accurate insulation–resistance values for many types of capacitors. Power-factor measurements of electrolytics rated as low as 6 volts dc, as high as 600 volts dc. "In circuit" tests for short, open, intermittent high-rf impedance and high power factor.—**Pyramid Electric Co.,** 1445 Hudson Blvd., North Bergen, N. J.



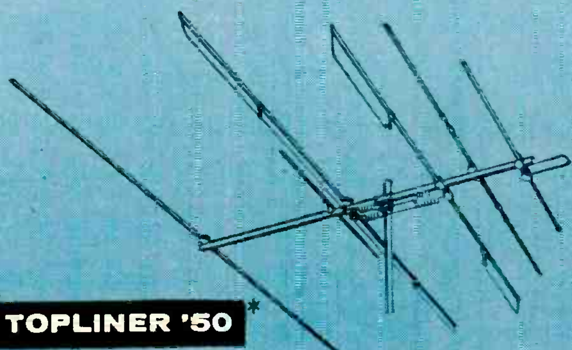
TOPLINER '40*

Cat. No. 2540. 3 working elements on low band. 9 working elements on high band.



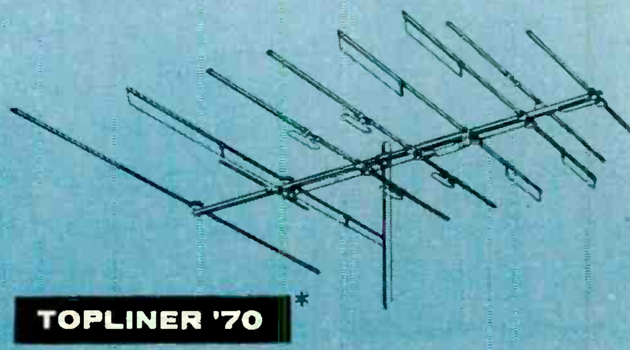
TOPLINER '60*

Cat. No. 2560. 6 working elements on low band. 13 working elements on high band.



TOPLINER '50*

Cat. No. 2550. 5 working elements on low band. 10 working elements on high band.



TOPLINER '70*

Cat. No. 2570. 8 working elements on low band. 19 working elements on high band.

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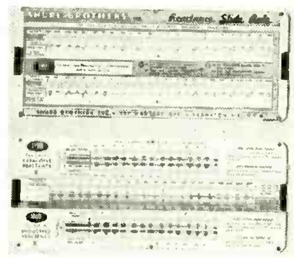
TECHNICAL APPLIANCE CORPORATION, SHERBURNE, N. Y.
IN CANADA: Hackbusch Electronics, Ltd., Toronto 4, Ont.

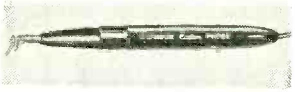
* Pat. Pending

REACTANCE SLIDE RULE, for technicians and students. Re-



issue of well known Shure rule for simplifying reactance, resonance and dissipation calculations. Covers frequency range from 5 cycles to 10,000 megacycles.—**Shure Brothers Inc.**, 222 Hartrey Ave., Evanston, Ill.

TEST PROBE, *E-Z Hook Probe* simplifies electrical connections. Clamps on to any shape con-

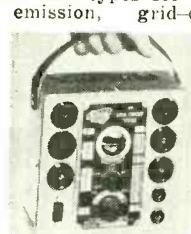


ductor; spring-loaded. Isolation resistor or capacitor may be inserted in probe.—**E-Z Hook Test Products**, 1536 Woodburn Ave., Covington, Ky.

INDUSTRIAL OSCILLOSCOPE, low-frequency type. Sensitive to ac and dc. Identical horizontal

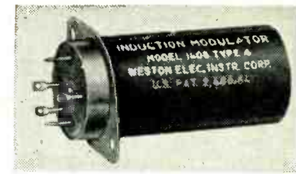
and vertical amplifiers for accurate phase-angle measurement, built-in calibration voltage. Can mount in 19-inch relay rack. Response to 500 kc and flat within 3 db from 0–200 kc.—**Hycon Mfg. Co.**, Pasadena, Calif.

KITESTER, *model GCT-5*, tests over 125 tube types for control grid emission, grid–cathode



shorts, gas and cathode–heater shorts. 7 wired sockets and 1 spare. Replaceable panel etched with tube lists. Sensitivity: grid emission 0.35 microwatt; grid–cathode leakage 125 megohms; grid–plate or screen 125–250 megohms; cathode–heater leakage 1 megohm; plate or screen to suppressor 0.1 megohm. Can be used as capacitor leakage checker. Dc voltmeter with range to 500 volts.—**Seco Mfg. Co.**, 5015 Penn Ave. S., Minneapolis.

INDUCTION MODULATOR operates on different principle than choppers and other transducers; has no contacts. Coil positioned by dc signal current through it; ac field coils mounted on magnets induce ac voltage in moving coil proportional to position as determined by dc



signal. Constant resistance to dc signal input; output waveform sinusoidal. Conversion gain 28 db. Capacitors can be used to make output in quadrature with input.—**Weston Electrical Instrument Corp.**, 614 Frelinghuysen Ave., Newark 5, N. J.

ELECTRONIC CROSSOVER KIT, *model XO-1*, designed to operate ahead of main power amplifiers. Independent electronic filters, one high pass and one low pass, each with rotary

switch for selecting cutoff frequency. Single input divided into high- and low-frequency portions of spectrum, available at outputs to feed separate amplifiers. No audio power consumed by crossover. Does not affect amplifier damping factor. Each channel has level control. Crossover frequencies 100, 200, 400, 700, 1,200, 2,000 and 3,500 cycles. Attenuation 12 db per octave with sharp knee at cutoff frequency.—**Heath Co.**, Benton Harbor, Mich.

LO-PASS LINE FILTER for use with tape and wire recorders, phonos and playbacks. Eliminates noises picked up through line from motors, ignition, neon, diathermy, lighting and heating

equipment and electrical home appliances. Plugs into ac or dc receptacle; instrument being used plugs into filter. Ground cable attached, its use optional. 3 x 4 inches.—**Dynamic Electronics**, 73-39 Woodhaven Blvd., Forest Hills, N. Y.

DYNAMIC MICROPHONE, *model 124*, for broadcast, recording or public address. Instant disconnect feature good for use as

hand microphone. Output −58 db, response 50–13,000 cycles. Three impedances: high, 200 or 50 ohms. 12-foot removable cable, single-conductor shielded on high-impedance models. 2-conductor shielded on low-impedance models. 6½ inches long, 15/16-inch diameter. — **Turner Co.**, Cedar Rapids, Iowa.

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To produce subminiature paper capacitors free from any possibility of latent defects, for use in the most critical applications, the Sangamo Electric Company has recently intensified its high reliability program of fabrication and inspection methods.

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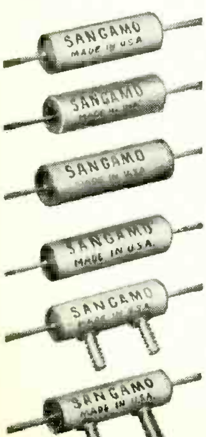
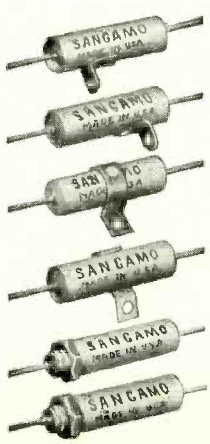
Mail the coupon below for Sangamo's *NEW Engineering Catalog TS-105A.* It contains full information, including an easy-to-follow cross reference showing each variation listed in MIL-C-25 versus the comparable Sangamo unit.

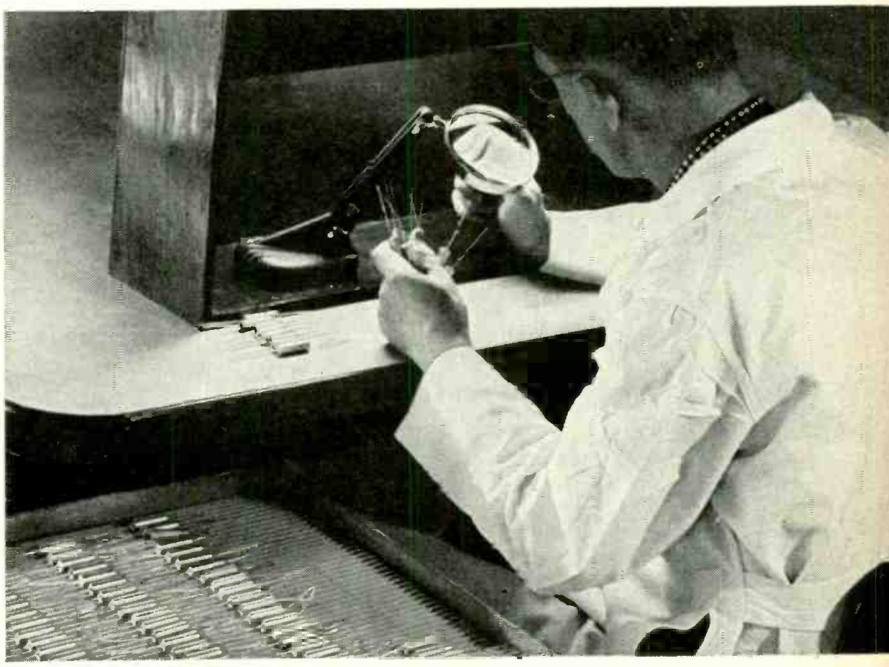


For your design convenience, an exceptionally wide choice of styles — twelve in all — is available with regard to tolerances, circuit assembly, lead styles, mounting brackets, insulating sleeving, and inductive or non-inductive sections.



SC56-7

SEPARATE FACILITIES are maintained for the exclusive processing and manufacture of high reliability capacitors. Only specially trained, highly skilled operators, who wear special clothing to prevent any possible source contamination, work here.



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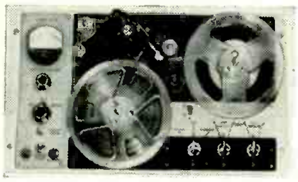
HI-FI TAPE RECORDER, *SRT-2*, for simple plug-in use. Uses transistors and printed circuitry. Nonmicrophonic, hum-free, 30–15,000 cycles. Takes all types of standard magnetic tapes in 5- and 7-inch reels. Installed either vertically or horizontally. Re-



cords and reproduces at 7½ and 3¾ ips. Fast forward-and-rewind speed, 1,200 feet in 45 seconds. Only one mechanical linkage: a cam action which operates pressure roller on capstan. VU meter recording-level indicator, installed in standard 10½-inch mounting rack. Automatic tape lift during fast winding; monitor jack for plug-in earphones. 10½ x 19 x 8½ inches, 35 pounds.—**Radio Corp. of America**, Camden, N. J.

BIAXIAL HI-FI SPEAKER, *RCA-501S1*, combines 12-inch low-frequency woofer, 3-inch hi-fi tweeter and crossover network. Handles 12 watts continuously with uniform response 40–18,000 cycles. 8-ohm aluminum voice coil and 14.5-ounce Alnico V magnet. Tweeter unit mounted off-axis for smooth acoustical crossover. — **RCA Tube Div.**, Harrison, N. J.

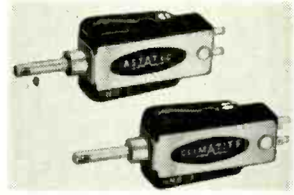
EXPLOSION-PROOF SPEAKERS for hazardous service. Type HLE-1-30 (see photo) for paging and talk back; HLE-1-42 for maximum sound coverage. Built-in line-matching trans-

formers available.—**Atlas Sound Corp.**, 1451 39 St., Brooklyn 18, N. Y.

ANTISTATIC MAGNETIC CARTRIDGE, *B&O A+ Special*, single stylus (diamond, sapphire), for professional arms with ½-inch center-spaced mounting holes or standoffs. *B&O 350 A+ Special*, 350-ohms,

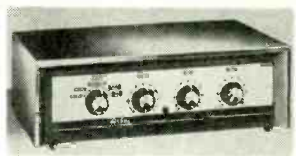
30-μv output at 4.4 cm/sec for use with high-level magnetic input professional amplifiers; *B&O 72 A+ Special*, 72-ohms; 15-μv output at 4.4 cm/sec for use with amplifiers having only low-level magnetic input.—**Fenton Co.**, 15 Moore St., New York 4, N. Y.

PHONO CARTRIDGES, *Climatic* series, weatherproofed. *Model 420ts* high output, high compliance, wide-range turnover containing separate removable, 1- and 3-mil synthetic sapphire needles. *Model 310T*, 3 volts output, compliance of 0.7, frequency response 50–12,000 cycles. Turnover contains separate 1- and 3-mil synthetic sapphire-tipped needles. *Model 312T*, 0.8 volt output, high com-



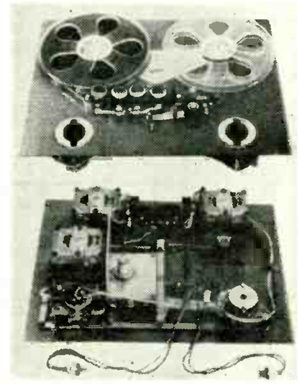
pliance of 2, frequency response 30–15,000 cycles. Turnover contains separate 1- and 3-mil synthetic sapphire-tipped needles. *Model 414-1* for 45-rpm changers. Same as *model 310T*, only 1-mil sapphire-tipped needle.—**Astatic Corp.**, Conneaut, Ohio.

AMPLIFIER – PREAMPLIFIER KIT, *model FL-10.* Tape output unaffected by loudness and tone controls. Williamson type amplifier and built-in preamp. Ultra-linear output circuit uses 2 6V6-GT's. Power output 12 watts at



1% IM; peak power 19 watts; output impedances 4, 8 and 16 ohms; response ±1 db 10–40,000 cycles, ±½ db 40–15,000 cycles below 10 watts. Hum: minimum volume 80 db below 10 watts, aux and tuner −65 db below 10 watts, phono hum −55 db below 10 watts. Tone controls ±16 db at 50 and 10,000 cycles. Input levels: aux 0.3 volt, phono 6 mv. Record equalization—LP, RIAA and Eur. 12½ x 4 x 8½ inches.—**Radio Kits Inc.**, 120 Cedar St., New York, N. Y.

HI-FI 3-SPEED DECK *Fen-Tone Brenell MARK IV* for stereo record playback. Incorporates many improvements over former *Mark II* deck. *Model Bren IV:* upper-track monaural heads (1 R/P and 1 erase), 4 pressure pads and mounting



holes for two additional heads *Model Bren IV/B:* 4 staggered stereo heads (one pair each upper and lower tracks). 3 motors—capstan, feed and take-up, instantaneous mechanical braking, 3¾- and 7½- or 7½- and 15-ips operation. — **Fenton Co.**, 15 Moore St., New York, N. Y.

END

All specifications given on these pages are from manufacturers' data.

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RADIO-ELECTRONICS is continually alert to maintain a high level of integrity in our advertising columns. In the case of tube advertising—which has suffered special abuses—we insist that all advertisers must warrant that their tubes are:

New and unused
Not mechanical or electrical rejects
Not washed or rebranded
(See page 57 of the January, 1956, issue)

We investigate carefully when we have grounds to suspect that any advertiser is not living strictly up to these rules.

new Records

MONITOR

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

BRUCH: *Violin Concerto No. 2*
WIENIAWSKI: *Violin Concerto No. 2*
Heifetz with RCA Victor Symphony conducted by Izler Solomon
RCA Victor LM-1931

No record library could be complete without a Heifetz recording and this one provides an excellent sample of his violin mastery. The Bruch No. 2 is less familiar than his No. 1 and not as melodic. The second and third movements of the Wieniawski, however, will be familiar to all who love the fiddle for they are often performed individually as encores or concert selections. The Heifetz fiddle is warm and has a beautiful tone but the recording is possibly not as clean as Capitol's Milstein records and with some wide-range cartridges it may be advisable to roll off above 10 kc. The definition is very good and the detail of the music and instrumentation is clear and sharp. Beside the excellent fiddle in the Wieniawski there is a nice middle bass throughout, good plucked bass in portions and fine big brass choirs.

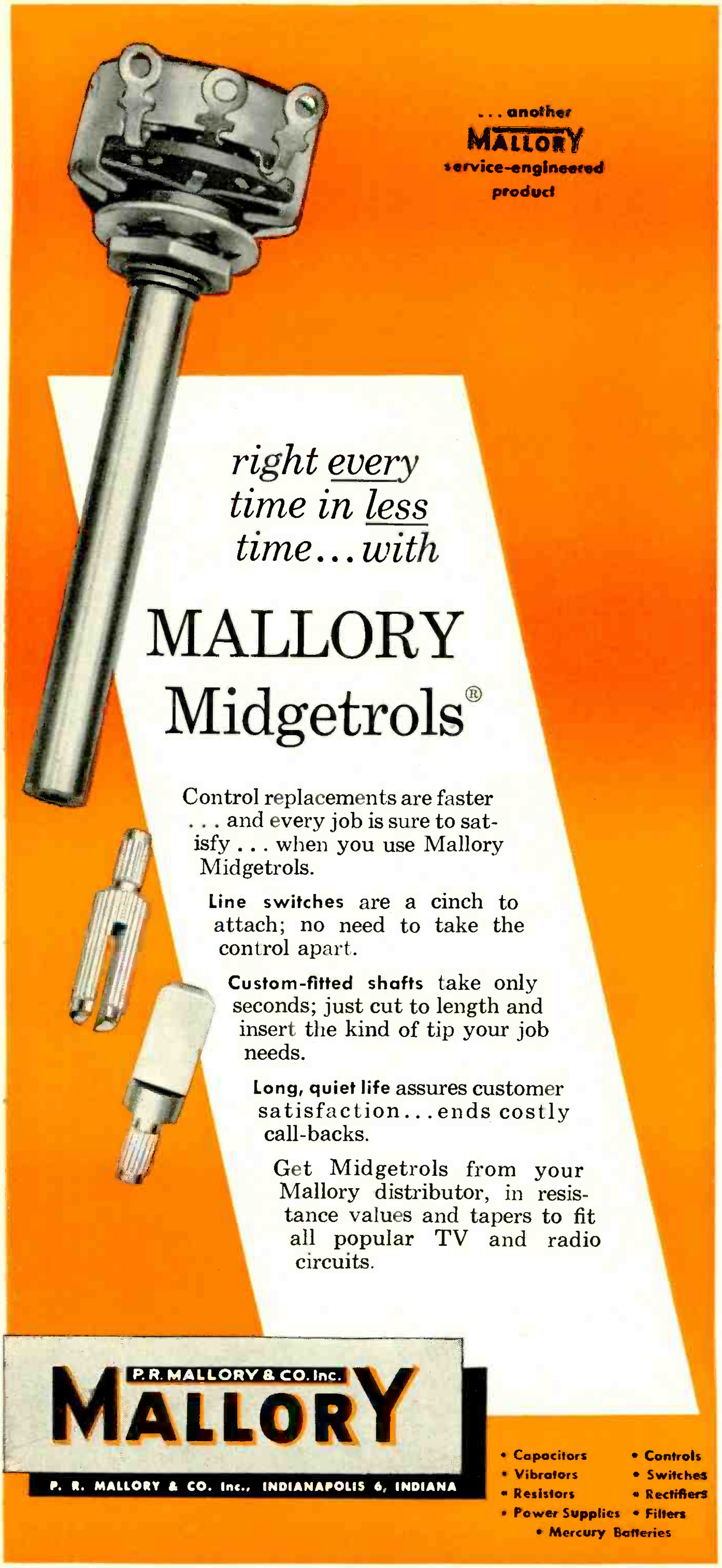
BRAHMS: *Hungarian Dances* (Complete)
Vienna State Opera Orchestra conducted by Mario Rossi
Vanguard VRS-473

If I were limited to four or five test and demonstration records, this would certainly be one. I know of no record which presents a greater variety of test and demonstration material or a more spectacular sound. It has a real gypsy brightness, an exemplary acoustic liveness, superb definition, lovely high highs, a good bass, a very great variety of instrumentation and orchestration, big attacks and sharp stops, and some of the sprightliest music ever written. The first band on each side is particularly spectacular but each of the some 20 dances has its own worth-while qualities as music, sound or test material. I cannot recommend this too highly and can practically guarantee that the rest of the family will like it as well as you do.

JANACEK: *Sinfonietta*
Taras Bulba
Jascha Horenstein conducting Pro Musica Symphony of Vienna
Vox PL-9710

The best test record I have received for some time, this is not especially useful for routine demonstration or showoff but it will do a fine job of testing the real mettle of the finest hi-fi equipment. *Taras Bulba's* programmatic music expressing three deaths is very violent in spots, with a great deal of complex and subtle instrumentation in the peaks which are unusually clean except in the final band. The system which can reproduce the music with all the detail should be good enough for anybody.

The elaborately orchestrated *Sinfonietta* also presents a severe test of definition. Aside from this there is a notably fine low bass; in portions the organ pedal underlies the tympani and basses for some especially gratifying low lows. The tympani are excellent, especially in the third movement. The strings are very loud and pickups which reproduce their high end without roughening the tone can safely be presumed to be both good and in good condition. There are some good highlights in spots as well. In short, there is a little of everything and a lot of it



demanding enough to winnow the superb systems from the merely adequate. The music is interesting and grows with repeated playing. Congratulations to Vox for a good job of recording a difficult subject.

GRIEG: *Peer Gynt Suites 1 and 2*
IPPOLITOFF–IVANOFF:
Caucasian Sketches
Felix Slatkin conducting
Hollywood Bowl Orchestra
Capitol P-8329

If you have one of the few superlative speaker systems capable of doing drums real justice, this recording is for you. The two sides have as interesting a variety of tone, size and damping of drums as I know of, and in *Arabian Dance* of the *Peer Gynt* they are recorded practically life-sized. But this could well be also one of the most popular of all demonstration records on any system, even the moderate ones. The music is popular, played with spirit and with a bright bandshell liveness. Ranging all the way from soothing mood music to spectacular fortissimos, it has a little of just about everything including some very nicely damped plucked basses. There are plenty of high highs to go with the big drums and the middle highs are very sweet. *Arabian Dance*, *Anitra's Dance* and *Procession of the Sardar* are fine demonstration pieces, and the first of these is, in my opinion, absolutely top-drawer.

SMETANA: *"From My Life" Quartet*
GLAZOUNOV: *Five Novelettes*
Hollywood String Quartet
Capitol P-8331

Chamber music not only provides a good change of pace for the listener but also sounds much more natural in most living rooms than a full orchestra. This is an exceptional offering of unusual string quartet music. *Five Novelettes* particularly is very different, delightful music which manages within the limited means of the four instruments to get an amazing variety of tonal color. But the Smetana quartet, too, is novel within its more conventional framework. The recording is excellent and the sound has a notable presence.

BARTOK: *Concerto for Orchestra*
Reiner conducting Chicago Symphony
RCA Victor LM-1934

Though modern in date (1943) this will not offend the ear of classicists. Nor will it offend the hi-fi ear. It is one of RCA Victor's best recordings. Very little spectacular material here, it is fairly typical of the opulent yet well-balanced sound currently most popular with recording engineers. There is an excellent and pretty heavy bass, good drums, very nice traps and some brassy brass in spots. As good a way to start learning to like Bartok as any I know of.

SURINACH: *Hollywood Carnival*
GLANVILLE-HICKS: *Sinfonia Pacifica*
Three Gymnopedies
Surinach conducting MGM Chamber Orchestra
MGM E-3336

What the hi-fi world has needed for some time is a percussion record with some amusing music to string the drums, etc., on. Carlos Surinach has filled this order in the *Hollywood Carnival* which offers some highly satirical impressions of the movies. Three separate percussion sections present no fewer than 18 percussion instruments in superlative renditions of their gamuts. They are contrasted with the typically sharp brasses familiar from previous works of this composer, and a string background. The record is rather dead acoustically but this produces in the normal living room a very fine illusion of closeup presence and realism—something not always achieved.

For dessert, as it were, Peggy Glanville-Hicks provides some additional percussive material in the *Sinfonia Pacifica*. Section, or movement, three has some especially fine drums in a jazzy impression of Hindustani music. The *Gymnopedies* are a mood-music change of pace.

A Hi-Fi Frolic with Strauss
Paulik conducting Vienna State Opera Orchestra
Vanguard VRS-476

Another superb presentation of the music of the several Strausses in the authentic Viennese style, with superb recording quality and very hi-fi throughout but without any exaggeration of tonal balance. That great big drum is here very dull and highly damped, just barely audible but gratifyingly so on systems which reproduce it at all. There are fine kettle drums, fine double basses, lovely high highs and all sorts of percussive rattlers, janglers, etc., including the water whistle.

There are innumerable sharp attacks and stops to test stability and hangover characteristics. The definition is superb. The music, with the *Blue Danube* thrown in for lagniappe, should delight just about everybody. All you need to enjoy the illusion of being right in the Brahmsaal in Vienna, besides a first-class hi-fi system is a big stein of beer.

WEBER: *Oberon, Der Freischuetz, Euryanthe*
SCHUBERT: *Rosamonde*
MENDELSSOHN: *Fingal's Cave, Ruy Blas*
Perlea conducting Bamberg Symphony
Vox PL-9590

Six favorite overtures played with characteristic bravura and well recorded with a nice auditorium aliveness, sharp strings, good basses and drums and an overall big sound which should provide a good test for stability when played loudly and will show off good systems nicely at any levels.

FRESCOBALDI: *Toccata in G Minor*
12 Partitas on Aria Ruggeria
Capricco on Battle Air known as Frescobalda
SCARLATTI: *Six Sonatas*
Sylvia Marlowe, Harpsichord
Capitol P-8336
BACH: *15 Two-Part Inventions*
Concerto in D Minor
Wanda Landowska, Harpsichord (plus orchestra)
RCA Victor LM-1974

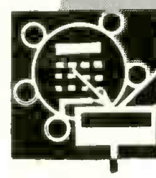
Master and pupil, and the Capitol recording does far better for the pupil. In fact, Marlowe's disc is one of the best harpsichord recordings, most faithful to tone. The contrast between damped and undamped strings is especially well indicated: the variety of harpsichord stops is greater, the tone is more resonant and sharper and better defined to my ear. But the *15 Two Part Inventions* in the Landowska disc present more of the "accompanying" transients. The concerto was recorded in 1938 and presents a rather pathetic contrast. I know of no better example showing the progress made in 20 years. The distortion is almost unendurable on a fine system (though I don't remember that it bothered me at all on the original shellacs) and the harpsichord is a mere shadow of its real self. I recommend the Marlowe for those who want harpsichord music for pleasure both in music and tone; the other for collectors and merely for demonstrating progress and showing what distortion sounds like.

MOZART: *Musical Joke (K522)*
Divertimento No. 11 (K251)
Reiner conducting Members of NBC Symphony
RCA Victor LM-1952

Another offering for the Mozart birthday celebration and this one presenting two lesser known works. *Musical Joke* is amusing and has some divertingly different effects. The *Divertimento* is soothing. The sound is excellent. END

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

new Tubes Transistors



New releases this month run the gamut from improved image orthicons to silicon diodes. Transistor-wise, this month's feature is a unit capable of delivering 3 amperes.

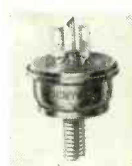
Image orthicons

The 5820, for black-and-white, and the 6474, for three-tube color cameras, are improved image-orthicon television camera tubes produced by RCA. A Micro-Mesh screen, a 750-mesh unit, replaces the 500-mesh screen heretofore standard in both tube types.

The mesh of 750 lines per inch eliminates all traces of moire patterns and is "more than adequate" for the present 525-line TV system. So fine is the grid forming the mesh that the minute openings represent more than 60% of total screen area.

Power transistors

The H5, H6 and H7 have been announced by Minneapolis-Honeywell Regulator Co. These germanium p-n-p alloyed junction power transistors (see photo) are hermetically sealed and designed for operation on 28-volt systems where they can deliver 3 amperes.



They are capable of dissipating 10 watts at a case temperature of 158° F. Maximum emitter current is 3.5 amperes rms; maximum base current 500 ma rms. Maximum power conductance ratings are: H5, 35 mhos; H6, 71 mhos; H7, 141 mhos. Average cutoff frequencies are: H5, 12.5 kc; H6, 10 kc; H7, 8.5 kc.

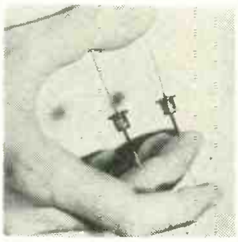
Silicon rectifiers

The 1N537 and 1N538 silicon rectifiers have been announced by G-E. Occupying a total volume of only .03 cubic inch and weighing .07 ounce, the diodes come with pigtail leads. Both are hermetically sealed.

The silicon rectifiers are rated at a maximum dc output current of 250 ma at 150°C. They may be designed into circuits for outputs of up to 750 ma where lower temperature conditions prevail. Maximum leakage current over their entire ambient operating temperature range of −65°C to 150°C is 0.5 ma.

High current loads can be carried

without the use of any heat sink. Thus, the new units are suitable for computer power supplies and for guided missiles, blocking, magnetic amplifiers, other low-leakage applications and a wide variety of high-temperature electronic equipment power supplies.



The 1N537 is rated at a maximum peak inverse voltage of 100; the 1N538 at 200. Maximum surge current for both is 10 amperes. Full-cycle average forward voltage drop is a maximum of ½ volt for both.

6CD6-GA

The 6CD6-GA, a high-perveance beam power tube of the glass-octal type for use as a horizontal-deflection amplifier tube in TV receivers, has been announced by RCA. It is smaller and more compact than the 6CD6-G, but features a modified mount design to maintain the same high perveance and to permit operation at higher ratings.

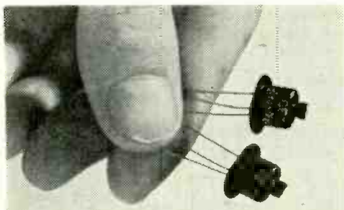
The 6CD6-GA has a maximum peak positive-pulse plate voltage rating of 7,000 and a maximum plate dissipation of 20 watts. These ratings in addition to low mu-factor, high plate-current rating at low plate voltage and a high operating ratio of plate current to grid-2 current enable a 6CD6-GA, in suitable circuits, to deflect fully picture tubes having a deflection angle of 90°.

Like the 6CD6-G, its structure provides for cool operation of both grids 1 and 2 to minimize grid emission and also for maximum distribution of heat to prevent plate hot spots.

The 6CD6-GA is unilaterally interchangeable with the 6CD6-G. Its heater requirements are 2.5 amperes at 6.3 volts.

2N170

A new high-frequency n-p-n transistor for radio hobbyists, the 2N170, was announced by G-E. Its introduction marks the first time the price of a high-frequency transistor has reached the level of equivalent electron tubes. It is being sold at "considerably less than $2."



In a typical common-emitter circuit the 2N170 has a power gain of 22 db

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at 455 kc, making it useful in if circuits. Alpha, or maximum frequency cutoff with useable gain, is 4 mc. Maximum ratings are: collector to base voltage (emitter open), 6; collector current, 20 ma; emitter current, −20 ma; collector dissipation (25°C), 25 mw.

6903

A head-on type of multiplier phototube, the 6903 is intended for detecting and measuring ultra-violet radiation and for other applications involving low-level radiation sources.

The 6903 is constructed with a fused-silica faceplate which transmits radiant energy in the ultra-violet region down to and below 2,000 angstroms. At 2,000 angstroms, the spectral sensitivity is more than 50% of the maximum response. The spectral response covers from about 2,000 to 6,500 angstroms, maximum at approximately 4,400 angstroms.

Other design features include a semi-transparent cathode having a minimum diameter of 1⅝ inches; 10 electrostatically focused multiplying (dynode) stages; a focusing electrode with external connection; the capability of multiplying feeble photoelectric current produced at the cathode by a median value of 400,000 times.

5725

A "premium" sharp-cutoff pentode of the 7-pin miniature type, the 5725 is intended particularly for use in gated amplifier circuits, delay circuits, gain-controlled amplifiers and mixer circuits. Constructed to give dependable performance under conditions of shock and vibration, this tube, which is similar to the 6AS6, is especially suited for use in critical industrial applications and in mobile and aircraft equipment.

The 5725, announced by RCA, includes separate base-pin terminals for grids 1 and 3. Each of these grids has a sharp-cutoff characteristic and can be used independently as a control electrode.

Featured in the design of the 5725 is a compact structure in which special attention has been given to features which improve its strength for both shock and vibration, and a pure tungsten heater having high mechanical strength to give long life under conditions requiring frequent "on-off" switching.

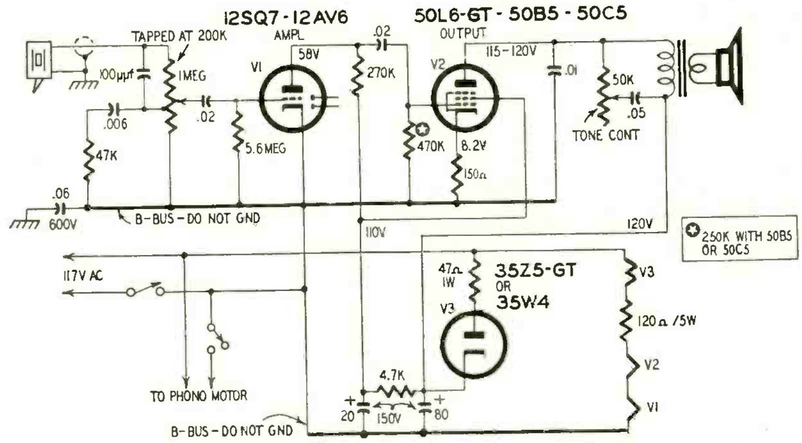
END

Question Box

SIMPLE PHONO AMPLIFIER

Please print the circuit of a simple transformerless type audio amplifier for use with a high-output crystal pickup.—N. J. S., Blowing Rock, N. C.

Use caution when constructing this and other transformerless apparatus and take care to minimize shock hazards by completely enclosing the ampli-



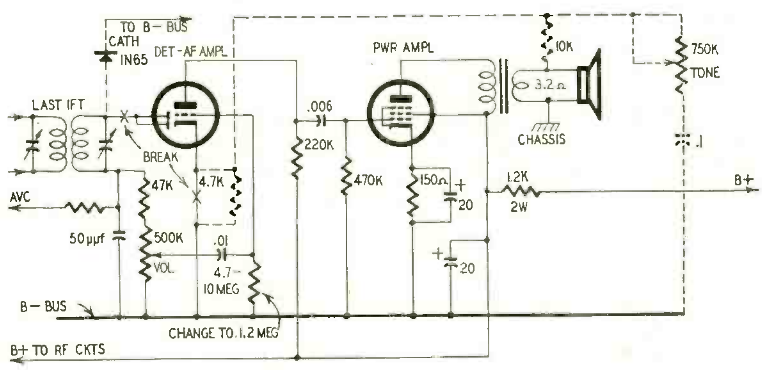
Here is the circuit of a simple amplifier that will deliver a maximum output of approximately 1.5 watts. You can use any of the tubes listed in any combination.

fier in a nonmetallic cabinet with any protruding mounting screws and bolts insulated or countersunk. Use a plastic tone arm and spring type slip-on knobs on the controls.

ADDING A TONE CONTROL

I have an ac–dc radio–phonograph to which I'd like to add inverse feedback and a tone control. What general rules that I can follow in making the

a 6SQ7, 12AT6 or similar type and the power amplifier is a 50C5, 50L6-GT or equivalent. Inverse feedback and tone control circuits are shown in dashed



modification?—H. O. M., Greensboro, N. C.

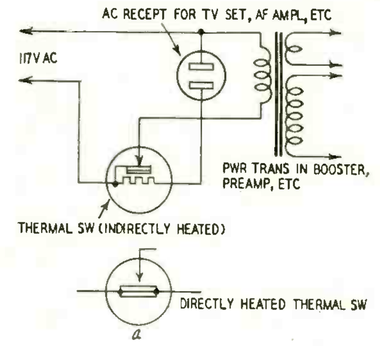
The diagram shows a typical audio circuit as used in an ac–dc type radio or phono amplifier. The input stage is

lines. The feedback network is designed as described in "Improving Your TV Audio" in the January, 1956, issue. The tone control is between feedback loop and ground.

THERMAL SWITCH

Several TV boosters, phono preamplifiers, control units and similar devices have a built-in switch or relay that turns them on when the audio amplifier, TV set or other equipment is turned on. Please explain how these units work and tell me where I can obtain one.—L. A. W., Florence, S. C.

Thermal switches or relays have a bimetallic strip that bends and closes a contact when heated. In some units the bimetal strip is heated directly by current flow through it. Others have an auxiliary heater that carries the current drawn by the main equipment.



In the average unit the contacts are rated at around 0.5 amp at 115 volts and the load drawn by the main equipment (amplifier, TV set and the like) ranges from 0.1 to 3 amps. The diagram shows the circuit connections, using an indirectly heated unit. The diagram of a directly heated unit is shown at *a*. The switch may be a Blonder-Tongue TR-3 or equivalent.

VOLTMETER QUERY

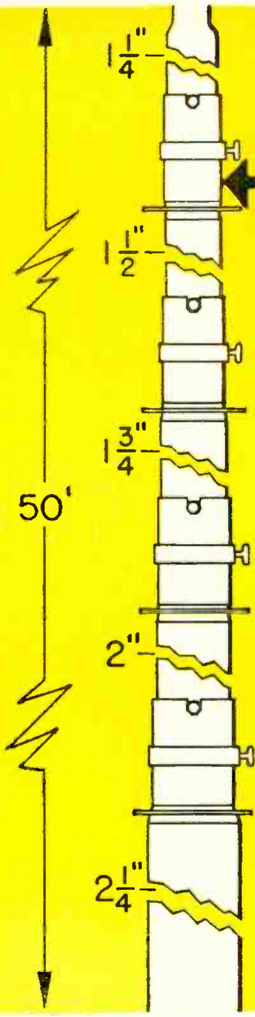
I'm having trouble with the transistorized voltmeter described in the December, 1954, issue. I used high-grade parts throughout. The calibration is good up to about half-scale on all ranges. The top half of each range is very crowded. For example, on the 50-volt range 25 volts input will deflect the meter to 0.5 ma (mid-scale) but 50 volts deflects the needle only up to 0.55 ma. The other ranges exhibit the same trouble. I tried replacing the CK722 and even substituted a CK722 for the CK721 without improving the performance. What causes this trouble and how can I eliminate it?—L. W. G., New Kensington, Pa.

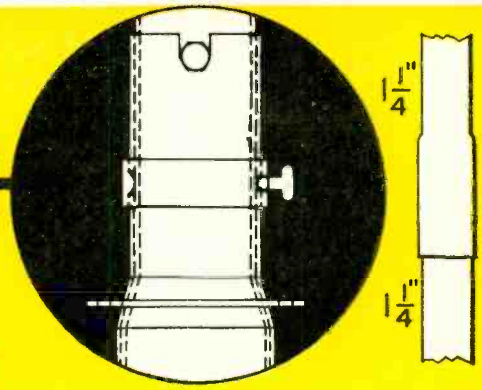
Mr. Turner reports that this trouble is caused by excessive static collector current (I_{co}) in the first transistor. This drives the second transistor to saturation and crowds the readings above mid-scale. This can be cured by selecting a transistor with low I_{co}. Ordinarily these transistors have such low static collector current that this trouble does not occur. Apparently you had the misfortune of purchasing two units with unsatisfactory characteristics for this application. END

CORRECTION

Mr. Cerveny states that there is a transposition of text material on page 35 in his article "Color Demodulator Alignment" in the July issue.

The text beginning with the sentence starting on line 11 of the third column and continuing through the 24th line should be inserted between lines 58 and 59 of the second column.





Same 1¼-inch piece of Perma-Tube can be used for telescoping masts or with another 1¼-inch piece to make smaller 2-piece masts.

Why buy assembled telescoping masts? Use J&L Perma-Tube in 10-foot lengths and easily make your own

Get flexibility in your stock SAVE MONEY—SAVE SPACE

Only J&L Perma-Tube offers:

- Joint design which provides instant field assembly.
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Buy only a carton each of five different sizes of Perma-Tube (1¼ to 2¼-inch) and make any telescoping TV mast up to 50 feet in height. Hardware—cotter keys or bolts, clamps and guy rings—may also be secured from your distributor.

You can now "tailor-make" your own TV masts up to 50 feet high by using standard 10-foot lengths of 16-gage Perma-Tube—and save money. Five diameters are available in easily-handled cartons from your local distributor. Largest base section OD is 2¼ inches and each telescoping section is ¼-inch smaller, the smallest section having an OD of 1¼ inches.

Corrosion-resistant Perma-Tube is treated with Vinsynite—then coated both inside and outside with a metallic vinyl resin base. It's made of a special, high-strength, J&L steel tubing. A 10-foot section of 1¼ inch diameter by 16 gage is capable of supporting a weight at its center point of 200 pounds with a minimum of deflection and permanent set.

J&L Perma-Tube—best for strength and rust protection

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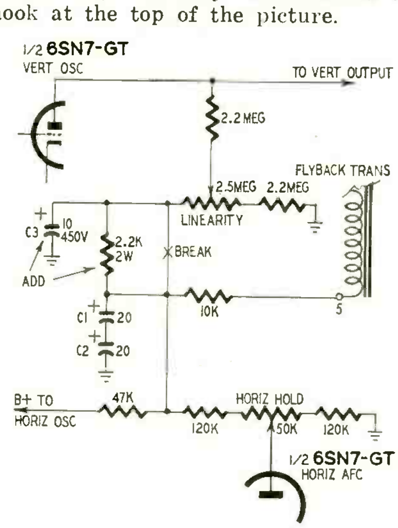
Technotes

PHILCO 48-1000

An extremely dark picture accompanied by unstable sync was found to be due to a leaky capacitor connected between the triode and diode plates of the agc amplifier tube. This capacitor leaks and disturbs normal agc action. It places a positive voltage on the agc bus which is then fed to the grids of the rf and if tubes. Replace the capacitor with a .01-μf 600-volt molded type. —*J. E. Ryan*

MAGNAVOX CHASSIS CT 358

A pronounced hook appeared in the top 20 lines or so of the picture. The cause was pulses from the vertical oscillator feeding back into the horizontal circuits despite electrolytics C1 and C2. The pulses upset the horizontal oscillator directly and, via the horizontal afc, indirectly. This caused the hook at the top of the picture.



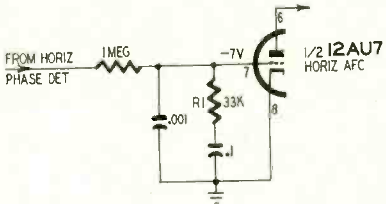
The remedy consists of adding a decoupling filter in the feed to the vertical linearity control. This line is the B-plus supply to the vertical oscillator, the source of the offending pulses. Break circuit as shown, insert a 2,200-ohm 2-watt resistor and the bypass capacitor C3, a 10-μf 450-volt electrolytic.—*E. A. Chung*

HORIZONTAL JITTER

Shaking of bushes in a strong side wind is a good description of the jitter displayed intermittently on a Sparton model 22312. After several false starts, the agc line was grounded by a jumper. The trouble did not recur after hours of monitoring. Further checking disclosed that a 2-μf, 50-volt, positive-ground capacitor hooked on the agc line to filter the spurts of agc voltage delivered by the agc keyer had an intermittent loss of capacitance. Disconnecting this capacitor, with the set performing normally, produced the jitter. The unfiltered pulses resulted in a spurious modulation of the horizontal sync by the spurts on the agc line feeding through the if.—*A. Philip Monroe*

G-E MODEL 21T7

A jagged effect on circles, like the teeth on a cog wheel, was the complaint of the owner of this set. The effect was more pronounced than simple interlace trouble resulting in the pairing of lines with somewhat similar distortion of circles.



Resistance checks localized the trouble to R1, 33,000 ohms, which had increased in value to about 150,000 ohms. This resistor (see diagram) is part of the grid filter network of the 12AU7 horizontal reactance tube. Replacing the resistor eliminated the cogwheels in the picture.—*Alfred Roberts*

FAINT PIX ON WARMUP

On an RCA KCS77 chassis the picture would come on very faint when the set was turned on. After about 10 minutes the picture would suddenly blossom to full strength. I checked the picture and horizontal output tubes. All were normal, except that one of the 6BQ6's had a loose plate cap. I put the output tubes back and, when the picture came on weak, I pressed down on the loose plate cap. This caused the picture to jump to full strength. I dented the

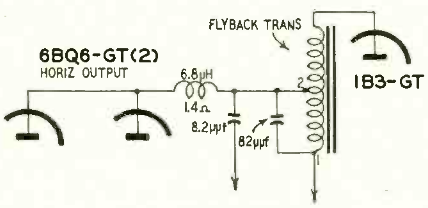


plate cap for better contact with the plate wire and resoldered this joint.

The trouble was that only one of the horizontal output tubes (see diagram) was functioning and the loss of high voltage produced a dim picture. As the heat from the tube with the bad cap expanded the plate wire, after about 10 minutes it contacted the cap, restoring normal operation.—*A. R. Clawson*

PURE OIL 518 RADIO

In case of birdies due to if oscillations, decouple the B-plus feed to the screen grid of the 12SA7 converter by inserting a 2,200-ohm 1-watt resistor between the screen grid and the electrolytic capacitor. In place of the pres-

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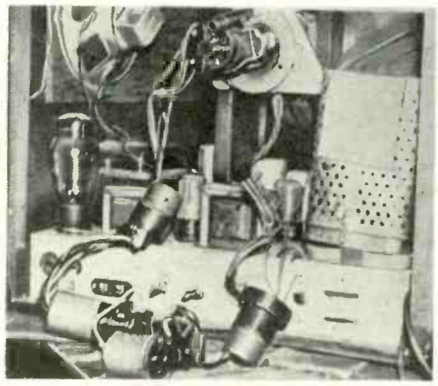
ent .01-μf bypass capacitor from the screen grid to chassis, insert a 0.1-μf capacitor.—*E. A. Chung*

MILKING A PIX TUBE

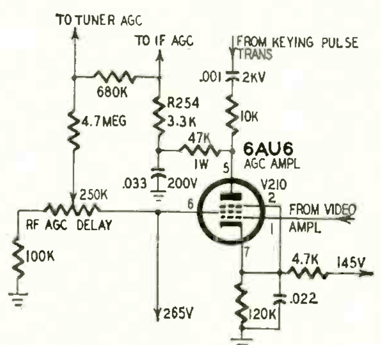
Like the farmer who tries to milk the last drop from his cow, this set owner (see photo) used not one brightener or rejuvenator but four! Despite this array of voltage boosters, the picture-



tube heater did not fail. I'm surprised he didn't try to buy rejuvenators for the rest of the tubes!—*Alfred Roberts*

DU MONT RA-340/341 342/343

To prevent horizontal line displacement due to erratic firing of the horizontal oscillator when no station is being received or when the fine tuning

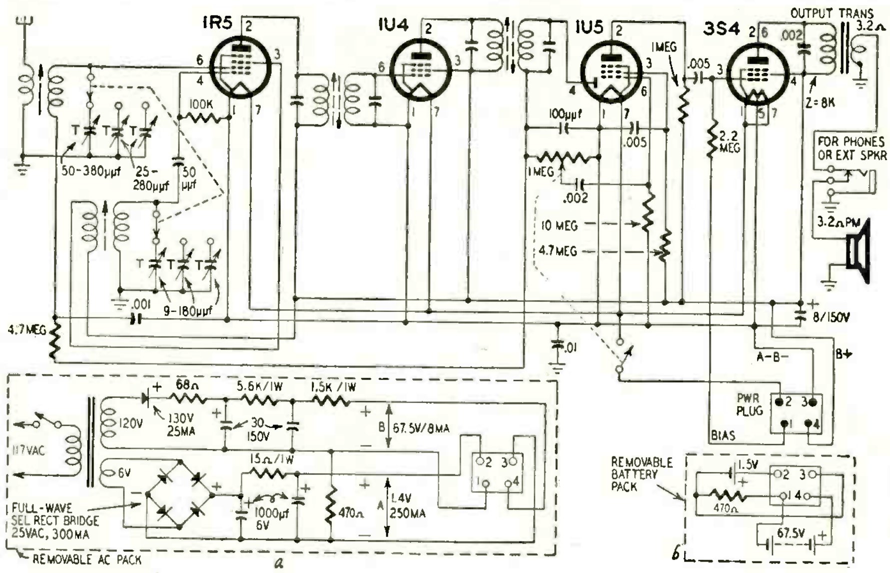


control is misadjusted, additional filtering (see diagram) is added to the agc circuit. The filter completely eliminates the horizontal sweep keying pulse from the agc line. Resistor R254, a 3,300-ohm unit, is added to the agc circuit. Chassis with this modification are coded RUN 3.—*Du Mont Service News* END

radio-electronic Circuits

DARB HOLIDAY RECEIVER

A number of readers have asked for additional information on the bicycle radio shown on the cover and page 43 of the February issue. It is the Holiday model made by Darb, a division of S. C. Ryan Co., 1316 Yale Place, Minneapolis, Minn. This four-tube portable operates from dry batteries, 117 volts ac or a 6-volt vibrator-type supply. The power packs are separate units that can be clamped to the bottom of the 4 x 5 x 6-inch cabinet or mounted at a remote point and connected to the receiver through a power supply cable.



a b

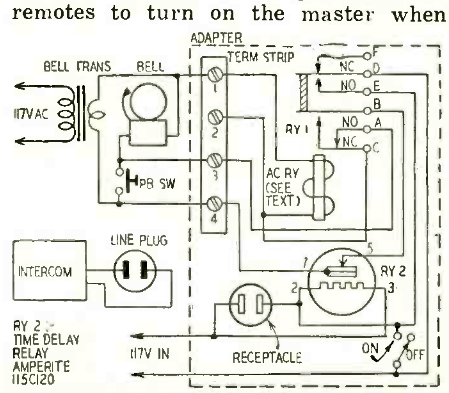
This set does not have continuous tuning over the broadcast band. Instead, it has a three-position lever switch for station selection. Position 1 is for any pretuned station between 540 and 1350 kc and positions 2 and 3 are for stations in the 600–1600-kc range. Stations are preset by adjusting the oscillator and antenna trimmers with a screwdriver through holes in the case. The ac and battery power packs are shown at *a* and *b*, respectively.

ADAPTER FOR INTERCOMS

An intercom in the home is a practical device with innumerable uses. For example, a remote station can be mounted outside the front door so a caller can be identified before the door is opened. Mother, without interrupting her chores, can keep an attentive ear on Junior in the playpen on the porch or she can save needless trips to the door just to say, "Please leave three quarts of milk" or "Johnny can't play with you now. He is eating his lunch."

Intercoms in the home have been restricted largely to baby-sitting applications. They have not been popular for other uses because of the inconvenience of waiting for them to warm up. If you have a remote at the front door, a caller must wait for you to reach the master station and then another half minute or so while the unit warms up. Leaving the system on constantly is not practical in the home where hours or even days may pass without the unit being used.

Here is a simple and inexpensive method of cutting down the lag between the ringing of the doorbell and time that the normally off intercom is ready to operate. It also permits other remotes to turn on the master when



making a call. Plug the master station's line cord into the adapter and run three leads from the doorbell circuit to the adapter as shown in the diagram.

When the bell rings, the transformer voltage energizes the coil of RY1 through the normally closed contacts A and C. The relay operates, opening contacts A and C and locks in through contacts B and C and the normally closed contacts of thermostatic time-delay relay RY2. Contacts A, B and C are adjusted for a make-before-break arrangement (C contacts B before breaking with A) to prevent chattering and insure proper operation. Energizing the relay also closes contacts D and E to apply power to the intercom through the receptacle. (The intercom's line switch must be on at all times when using the adapter.)

RY2 is an Amperite type 115C120 whose contacts open 120 seconds after voltage is applied to its heater. It opens the circuit and turns off the intercom after 2 minutes—a desirable feature, especially when no one is at home. The spst switch is thrown to ON when the conversation exceeds 2 minutes and is thrown to OFF when it ends.

RY1 is a Guardian series 200 or equivalent type with dpdt contacts and an ac coil to match in the voltage supplied by the bell transformer.

In systems with more than one remote, each additional remote turns on the master with a normally open pushbutton switch connected across terminals 2 and 4 on the adapter's terminal strip.

SCOPE TESTS FLYBACKS

Meter type flyback testers are almost nonexistent here in England. British TV technicians use a scope to check flyback transformers for shorted turns. The method used could hardly be simpler. All you need is access to the scope's sawtooth sweep voltage! If it is not available at the front panel, you can install an output jack.

Turn the set off and apply the sawtooth voltage to the transformer primary through a .001-μf capacitor and connect the scope's vertical input leads across the primary as in Fig. 1. In many cases it will be most convenient to attach the leads to the horizontal output plate and the damper cathode. The grounded vertical input lead may also be connected to points 1, 2 or 3 with equally good but slightly different results. On some sets this connection can be made to the chassis.

Briefly here's how it works: The flyback from the scope sets the transformer ringing just as a normal flyback in the set would. Without the damper to stop them the oscillations continue for perhaps 10 to 15 cycles or more, gradually dying away. Being triggered by the scope's sweep signal they are automatically synchronized and a steady trace as in Fig. 2-a will appear on the scope. This is the normal pattern for a good transformer. Any shorted turns in the transformer will damp these

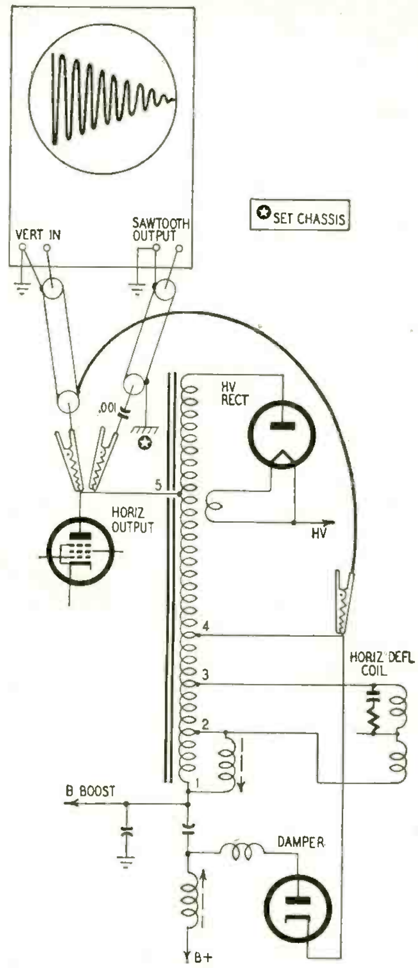


Fig. 1

oscillations heavily and the trace will appear as Fig. 2-b.

The choice of sweep frequency is not at all critical. On one make of scope I found 1,500 cycles best, while another gave good results on 3 kc.

Remember that this is a comparative test. The best way is to find which speed most suits your instrument and stick to that. In my case I set the fine frequency control to maximum and

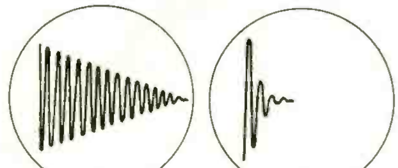


Fig. 2

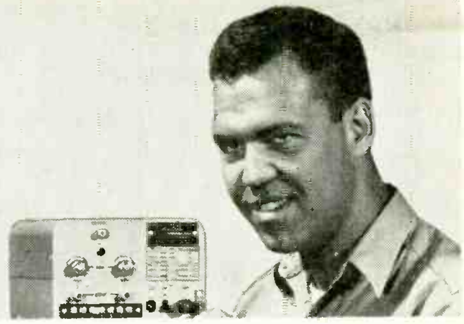
chose position 2 on the coarse frequency control. The same applies to the vertical gain; choose the setting which gives optimum results and always return to that same setting.

When a faulty trace is obtained, first disconnect the deflection coils. If the trace still indicates a short circuit, disconnect the remaining leads from the transformer one by one. If the trace suddenly goes normal, check for a short in the width control, yoke or other component just removed.

Experiment with various types of horizontal output transformers to learn the specific characteristics of each.—*Peter E. Clement, Essex, England* END

UNDERCOVER STORY PROVES JERROLD SUPERIORITY

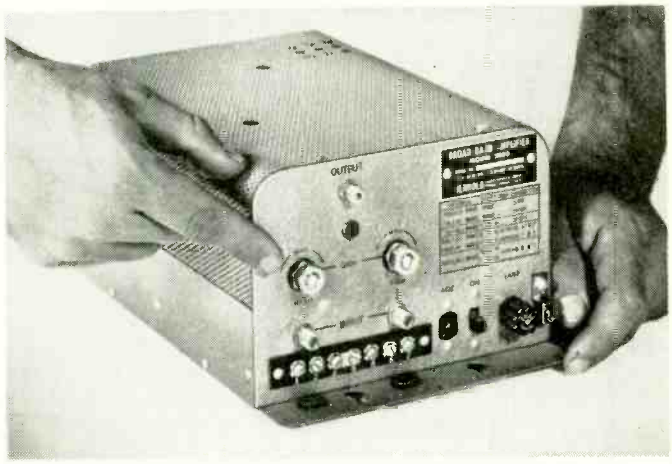
...MODEL 2300 RF AMPLIFIER FOR MASTER TV ANTENNA SYSTEMS



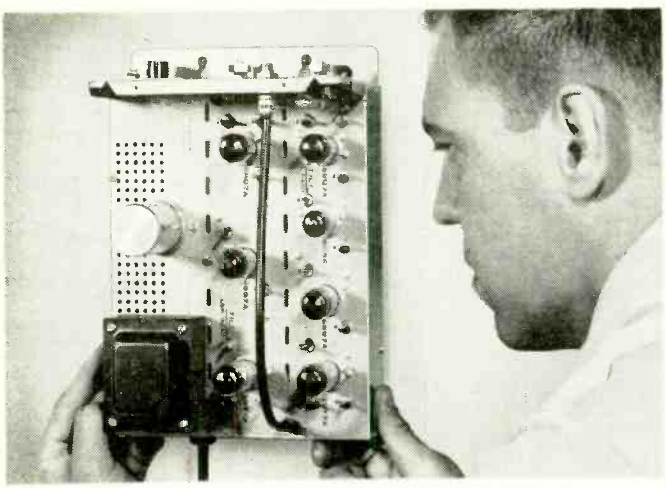
The new Jerrold Model 2300 is a high gain (38 db minimum), high output (.3 volt/channel) broad band amplifier specifically designed for use in large TV master antenna systems. It insures easy, low-cost installation and requires minimum maintenance. But the real reason for better performance and longer life is the undercover story.

SPECIFICATIONS:
FREQUENCY RESPONSE: ±1 db—Channels 2 thru 6 and 7 thru 13
GAIN: 38 db min.
GAIN CONTROLS: Hi and Lo, 16 db range
TILT CONTROLS: Separate Hi and Lo
RATED OUTPUT (MAX.): .3v/channel for 9 channel operation
TUBE COMPLEMENT: 4-6BQ7A, 2-12BY7A, 1-6CB6
POWER REQUIREMENTS: 117 volts AC 63 watts

LIST PRICE for MODEL 2300—$164.00
slightly higher west of the Rockies



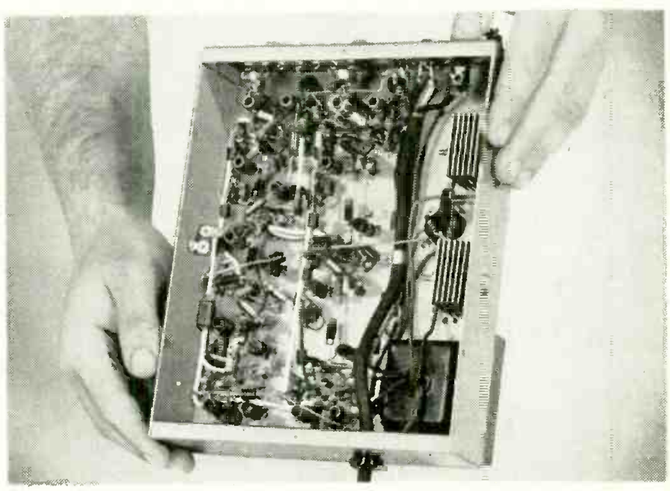
Universal input circuit permits use of a variety of 72 ohm or 300 ohm antennas—broad band or separate hi-lo arrays. An alignment tilt control (reached through hole in cover) can be adjusted so that the Jerrold Model 2300 will work with various lengths of coax cable without need for external line equalizers. Unit is housed in handsome silver-gray metal housing with perforated cover for ample ventilation.



Model 2300 may be shelf or wall mounted. It may be used singly or in cascade. It has wide application for TV master system use in motels, apartment houses, hotels, schools and for line extenders in community antenna systems.

Jerrold never compromises with quality—that's why Jerrold equipment always means a more consistent and better picture on the TV screen. Yet Jerrold equipment actually costs less to install, is easier to maintain and lasts longer.

For complete information on the Model 2300 broad band amplifier write today for Jerrold Technical Bulletin #544 or see your nearest Jerrold Distributor.



Positive Match input and output circuits provide extremely low VSWR over the entire VHF Band resulting in clear, no-smear pictures on all channels. Slug-tuned coils mean easy alignment . . . no tweezers or coil dope needed. Overrated components in all circuits insure longer trouble-free life.

JERROLD
ELECTRONICS CORPORATION
23RD AND CHESTNUT STREETS
PHILADELPHIA 3, PENNA.

Patents

CONTROL DEVICE

Patent No. 2,717,356

James H. Foster, Erie, Pa. (Assigned to Erie Resistor Corp.)

This control device consists of a capacitor whose capacitance varies with applied voltage. It is basically a dielectric body made of barium and strontium titanate. This mixture has a dielectric constant that varies considerably with applied potential. One side of the dielectric body has three metallic electrodes, A, B and C. A resistive coating connects B and C. A and B are terminals of a capacitor. B and C are resistor terminals.

Fig. 1

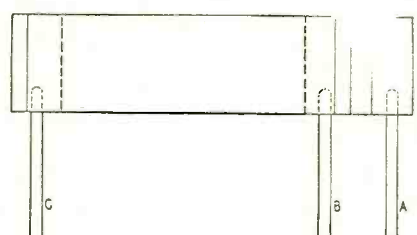


Fig. 2

Capacitance between A and B varies with the voltage between them. When current flows between B and C there is heating of the titanate and further increase in dielectric constant. For maximum effect, A and C are strapped together as a single terminal and B is used as the second terminal. An applied voltage now produces a greater change in capacitance than is possible when the resistor or capacitor is used alone.

The effect of the polarizing voltage is almost instantaneous. The heating effect requires about 20 seconds for full stabilization.

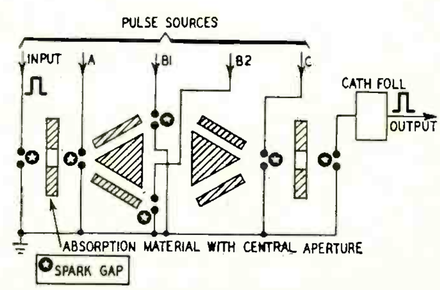
AND–OR NETWORK

Patent No. 2,729,753

Raymond W. Ketchledge, Whippany, N. J. (Assigned to Bell Telephone Labs, Inc.)

Relay and switching networks often require *and* or *or* circuits. In the *and* type each of several inputs must be energized before an output is obtained; in the *or* type any of several inputs will produce output. The diagram shows a combination *and–or* network. It contains several stages of spark gaps which may be fired in turn.

When any spark gap breaks down, its spark initiates a shock wave which carries ions. This



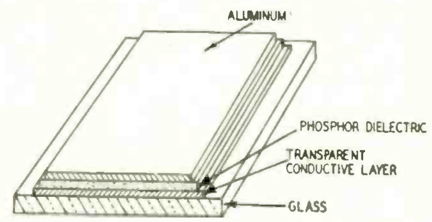
wave is transmitted to the next gap in line. The wave alone is not sufficient to fire a gap, but if the latter is pulsed at the same instant, breakdown will occur. Absorption material (shaded sections) is placed between the gaps to guide the shock wave from one gap to the next.

When the initial gap is fired by a signal pulse, the shock wave travels down to the next gap. This one will also fire if pulse A occurs at the same instant. The next stage is an *or* stage which may be fired by either pulse B1 or B2. All stages in the series constitute an *and* network because each stage must be excited by a pulse before output can occur. The last gap is coupled through a cathode follower.

The gaps may be spaced by 0.1 inch and the electrodes in any gap may be .05 inch apart. Breakdown voltage is about 5 kv.

ELECTROLUMINESCENT LAMP
Patent No. 2,728,870

Warren Calvin Gungle, Peabody, and Robert Emmett Cleary, Danvers, Mass. (Assigned to Sylvania Electric Products, Inc.)



Electroluminescence is the term applied to light generated when a phosphor is excited by an electric field. As shown in the diagram, the lamp may consist of a phosphor dielectric between two conductive layers. The phosphor is embedded in a plastic material and may contain zinc sulphide with small amounts of lead, copper and chlorine. When 600 volts ac is applied between conductors, the phosphor gives off light that is visible through the glass plate.

This inventor finds that efficiency is greatly increased if the phosphor dielectric is heated while voltage is applied, permitting the phosphor particles to align themselves in the direction of the electric field. After cooling, the particles retain their positions and can emit more light for a given power.

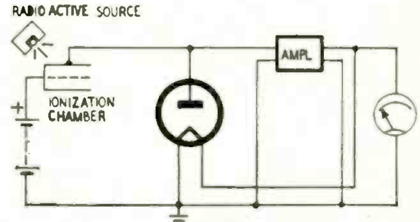
RADIATION DETECTOR
Patent No. 2,728,862

Pierre L. de Bourgknecht, Boston, Mass. (Assigned to Tracerlab, Inc., Boston)

Radiation detectors are most useful when they can measure over a very wide range, perhaps from a million to one. This can be done by this measuring circuit that functions logarithmically.

The diagram shows in ionization chamber under the influence of a radiation source. The current through the chamber and the diode is a linear function of the radiation count. As the count increases, a greater voltage appears across the diode. This is amplified and indicated on the meter. The amplifier output heats the diode filament. Thus more intense radiation increases diode emission and lowers its internal resistance.

The lower resistance reduces the voltage across



it and almost (but not quite) offsets the initial voltage rise. As a result even a considerable increase in radiation shows only a slight rise in the meter deflection.

END-OF-RECORD DETECTOR

Patent No. 2,739,238

John E. Bartelt, Poughkeepsie, N. Y. (Assigned to IBM, New York, N. Y.)

Data for computers are fed in as pulses recorded on magnetic tape. It is important to determine when the end of a recording has been reached, so the computer can go to the next step without delay. In this circuit designed for that purpose, V1 (Fig. 1) is one triode of a 12AV7; V2–V3 are triodes of a second 12AV7. The diodes are 1N54's or equivalent.

Inverter V1 receives the pulses from the tape and feeds them to V2–V3, a one-shot multivibrator. Normally, V2 is blocked and V3 conducts since the latter has the smaller plate resistor load. R1 and C1 control the timing of the

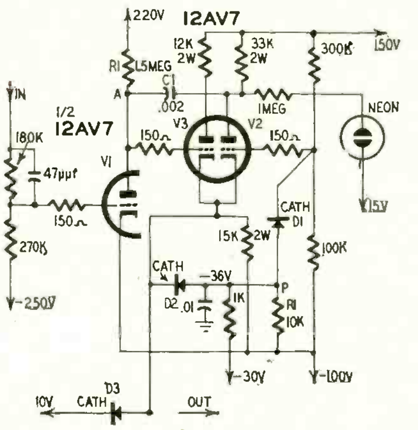


Fig. 1

multivibrator. With the constants shown in the diagram, the multivibrator remains "flipped" for about 400 μsec, after which it returns to its normal condition. Flipping occurs when a positive pulse is received at the *in* terminal.

The cathodes of V2–V3 are normally very positive because heavy current flows into V3. The positive cathodes block D2 while D3 conducts. The output terminal is 10 volts positive. At this time the plate of V2 (which is blocked) is at 150 volts, and there is sufficient potential difference to ignite the neon lamp which therefore indicates that no signal is being received.

Upon receiving pulses (through V1) the multivibrator flips. V2 now conducts and V3 is blocked. V2 has a larger plate resistor so less current flows through it than did through V3. The multivibrator's cathodes are less positive than previously and D2 now conducts while D3 is blocked. The output from this circuit is −36 volts.

The grid of V2 returns to a voltage divider which maintains it at −38 volts. Thus D1 is blocked. During conduction this grid may pass considerable current. This flows through D1, so the voltage-divider action is not disrupted. When V2 conducts, its plate voltage drops, whereupon the neon lamp is extinguished.

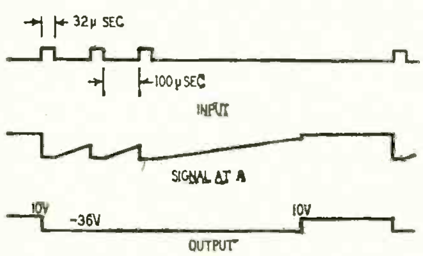


Fig. 2

Fig. 2 shows the operation of this circuit. It assumes tape pulses that are 32 μsec wide and spaced 100 μsec apart. Since the period of the multivibrator is 400 μsec, the spacing between pulses is too short to permit it to flop back to normal. This can occur only 400 μsec after the last pulse arrives.

The end of a recording is indicated when the output voltage rises from −36 to 10 and when the neon lamp lights. END

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KNIGHT MULTIMETER KITS

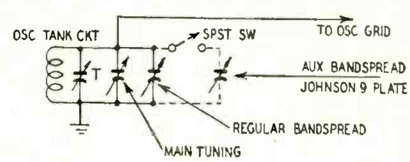
Some of the Knight 83F140 20,000-ohms-per-volt multimeter kits are supplied with the small penlight cells without paper jackets—just the bare zinc cans. If these cells are installed in the battery holder in this condition, adjacent cans will touch each other as well as the battery retaining strap, and three of the four cells will be shorted out. The instructions do not mention this. The remedy is to wrap each cell with a band of adhesive tape around its middle. This keeps them separated from each other and from the retaining strap and prevents shorts.—*John Sareda*

(Knight Electronics Corp. reports that some of the flashlight cells supplied with these kits did not have insulated paper jackets and will short when not insulated as mentioned above. The remainder of these cells have been removed from stock and replaced with insulated types. They will be happy to replace the uninsulated ones with insulated types upon receipt of a letter from the customer.—*Editor*)

DUPLEX SIGNAL TUNING

Duplex signal positioning is an attractive feature, easily installed on most communication receivers, that enables the ham or SWL to switch from one side of the phone QSO to the other and eliminates tuning back and forth across the dial.

The procedure to follow is this: Install at some convenient spot on the receiver front panel an E. F. Johnson or similar 1.8–8.7-$\mu\mu f$ miniature variable capacitor with dial plate and knob.



Near by on the panel install a toggle, lever or slide-type spst switch. Wire the switch in series with the grid side of this midget variable as shown. The stator plates go to ground or B minus. In most sets the midget capacitor is wired directly across the bandspread and main tuning capacitors.

With the duplex signal positioning switch open, tune in a QSO. Only phone bands below 50 mc are recommended. Get station A and then wait until the conversation is turned over to station B. When station B takes over, flip the duplex positioning switch closed and this is *it* ...the new remote control TV tuner by

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tune in station B. Now the bandspread capacitor is handling station A. And your miniature variable with duplex switch closed will take care of station B. Actually, this same switching can be done with relays operated by the carriers. When station A cuts its carrier, station B is automatically switched over.

Remember that frequency lowers as capacitors mesh. Therefore it is advisable when spotting your stations on the dial to allow sufficient down-frequency coverage so that the complete spectrum of the phone band being used may be covered on the miniature. It sometimes takes practice to become accustomed to this new method of lining up your stations. But soon you will be more than satisfied with the ease with which you will be able to switch quickly from one side of the QSO to the other.

As might be expected, additional wire and other capacitances effect a slight change in the receiver oscillator settings. This may be amply compensated for by readjusting the receiver oscillator trimmer.

So long as the part of the band to be covered when using duplex positioning is below 50 mc, there is only slight rf loss in the receiver when, for instance, station B is a bit down the band from station A. Phone bands are comparatively narrow and the rf circuits are fairly broad so tracking and sensitivity will not suffer too much. This method of tuning works best when both stations are S7 or better.—*George D. Philpott*

TRANSISTOR SHIPPING TUBE MAKES A HANDY INSULATOR

If the negative terminal of an electrolytic capacitor—its outer case—is connected to the chassis, there is no problem of insulation except for the positive lead. However, in many applications the positive terminal is grounded, leaving the capacitor case "hot." This occurs frequently in transistorized portables.

The photograph shows a use for the plastic case in which many transistors are shipped. Punch a hole in its bottom for the pigtail lead and put the capacitor in it. If your transistors have different type cases or subminiature capacitors are employed, a plastic pill tube may be obtained from the drugstore.

If the shipping tube does not hold the capacitor snugly, a piece of tape or cardboard will do the trick. The cardboard from a match cover can be used to wedge it tightly.—*Lawrence Show*

Business

Merchandising and Promotion

Perma Power Co., Chicago, Ill., de-

signed a new three-dimensional display, shown in the photo above, for its garage-door opener.

Telematic Industries, Brooklyn, N. Y., is promoting its new line of TV

color extensions and service aids through the use of a new counter display.

Rek-O-Kut Co., Long Island City, N. Y., has prepared a recording time table for standard and microgroove discs. It is available from Rek-O-Kut for 25c.

Futuramic Co., Chicago, has prepared a series of lab lessons for TV trade schools. The lessons show photographically how to use voltmeter probes for troubleshooting by means of signal-tracing techniques.

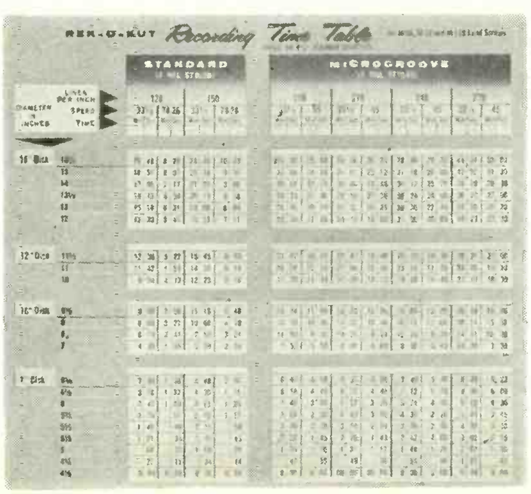
ORRadio Industries, Opelika, Ala., designed a new self-service package dis-

play for its three most popular *Irish* brand recording tapes.

Sylvania Electric Products, New York, will sponsor a TV film adventure series, "The Buccaneers" this fall, according to an announcement by Terry P. Cunningham, director of advertising and sales promotion. Sylvania has relinquished its sponsorship of "Beat The Clock" after 5½ years.

Production and Sales

RETMA reported production of 2,862,177 TV sets and 5,585,390 radios for the first 5 months of 1956 compared to 3,238,820 TV sets and 5,853,954 radios for the 1955 period. It also announced retail sale of 2,428,888 TV sets and 2,551,272 radios, exclusive of automobile sets, for the 1956 period. This compares with 2,722,648 TV sets and 2,-



007,631 radios sold in the first 5 months of 1955.

New Plants and Expansions

Sylvania Electric Products completed a 50,000-square-foot addition to its picture-tube plant in Fullerton, Calif.

P. R. Mallory & Co. moved its New York district sales office to Teaneck, N. J.

Hickock Electrical Instrument Co. opened a new San Francisco branch in Berkeley, Calif. George Ksander, Hickok sales engineer, was named West Coast manager. Bert Clintsman, manager of the new office, and Bill Cotie, manager of the Los Angeles branch, will work with him.

Raytheon Manufacturing Co. purchased a 15-acre site in Goleta, Calif., where it will erect a new engineering laboratory for airborne electronics and infra-red equipment.

Alliance Manufacturing Co., Alliance, Ohio, leased an additional building which will provide 80,000 square feet of floor space for expanded production facilities.

Hycon Electronics Inc., Pasadena, Calif., has realigned its organization to provide for an increase in production and sales. Its engineering facilities will be increased by drawing skilled personnel from the parent company, Hycon Manufacturing Co. Hycon Electronics will also market many products developed by other divisions. Hycon Eastern Inc., Cambridge, Mass., also a subsidiary of Hycon Manufacturing Co., acquired an additional 7,000 square feet.

Olympic Radio & Television, Long Island City, N. Y., purchased Presto Recording Corp., Paramus, N. J. George J. Saliba, president of Presto, will continue to direct operations as vice president and general manager. David Bogen Co., New York City, another Olympic subsidiary, will transfer part of its manufacturing activities to a plant adjoining the Presto factory. END

CORRECTIONS

Mr. Queen points out that the ferrite-rod antenna used in his shirt-pocket radio (July) is a type MS-264 rather than the MS-166 specified in the article and that the now-available MS-272 ferrite loop provides better tracking and is highly recommended. Do not remove turns from this unit. Just cut enough off the ends of the form so it fits snugly in the case like the original unit. He also advises that the type MS-126 if transformer has been discontinued and replaced by the MS-268. Headphones should have an impedance of 3,000 ohms or higher.

There are two errors in the signal-tracer diagram on page 81 of the June issue. The switch connected to the second 6BA6's grid is part of the bandswitch and should be ganged to the other three sections. The top lead of the secondary of the output 550–1650-kc transformer goes directly to the bandswitch fixed contact and should not be connected to tuning capacitor and diode plates.

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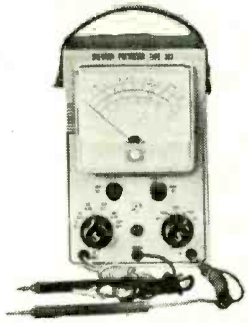

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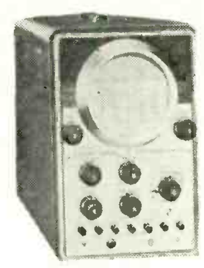

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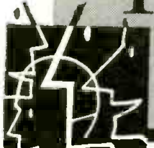

People

James O. Burke was elected president of Standard Coil Products Co., Melrose Park, Ill. He succeeds **Glen E. Swanson** who becomes chairman of the board of directors. Burke, who had been executive vice president, assumed the responsibilities of president early this spring when Swanson was granted a leave of absence for reasons of health.

William C. McFadden, named executive vice president of Hycon Manufacturing Co., Pasadena, Calif., had previously been vice president and general manager of the Camera and Instruments Division.

George C. Isham (left), new general merchandising manager of Sylvania Electronic Products Sales Dept., New York, was formerly Eastern regional manager of distributor sales for electronic products. **Donald J. Hughes** (right), advertising and sales promotion supervisor for electronic products, was promoted to advertising manager of electronic products sales.

William H. Dean (left), joined G-C Electronics Manufacturing Co., Rockford, Ill., as sales manager. He had been with a leading parts distributor and Bendix Home Products. **Robert C. Koemoud** (right) was promoted to sales promotion manager of the parent company, General Cement Manufacturing Co., and its sales divisions. He has been in its Advertising Dept. a number of years.

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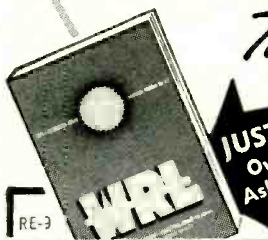

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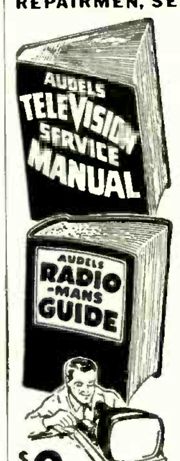

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John R. Ward, appointed controller of Pyramid Electric Co., North Bergen, N. J., comes to the company from CBS-Columbia, where he held a similar position.

Obituaries

Frank A. Poor, founder and vice chairman of Sylvania Electric Products, at Huggins Hospital, Wolfsboro, N. H., after a brief illness, at the age of 76.

Cecil C. Agate, director of advertising for Sonotone Corp., at his home in Orange, N. J., at the age of 68.

Brig. Gen. Stephen H. Sherrill, at Walter Reed Hospital, Washington, D. C., following a heart attack. Awarded the Legion of Merit for supervising the training of 64,000 radar specialists during World War II, he was later commandant of the Eastern Signal School Training Center, Fort Monmouth, N. J.

Col. George P. Dixon, USA (Ret.), at Georgetown University Hospital, Washington, D. C., at the age of 67, executive vice president of the Armed Forces Communications & Electronics Assoc. and former director of communications for the Army Air Forces in Europe. A vice president of IT&T before joining the Armed Forces Communications & Electronics Assoc., he was editor of the association's journal, *Signal*.

Personnel Notes

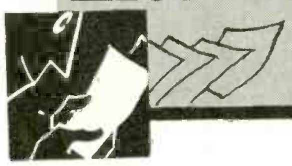
. . . **Dr. W. R. G. Baker**, General Electric vice president, was elected president of RETMA succeeding **H. Leslie Hoffman**, president of Hoffman Electronics. Other officers include: **James D. Secrest**, executive vice president and secretary, and **Leslie F. Muter**, Muter Co., treasurer and chairman of the Finance Committee. **Glen McDaniel**, New York attorney will continue to act as the general counsel for the association.

. . . **Paul V. Galvin**, president of Motorola, was awarded the 1956 Medal of Honor by RETMA at its annual convention in June.

. . . **Mal Parks, Jr.**, who recently joined Howard W. Sams & Co., Indianapolis, was named general manager of the Magazine Division and *PF Reporter*. **Joe Morin**, sales manager of *PF Reporter*, takes over additional duties as circulation manager, and **Glen Slutz**, technical editor, advances to editor.

. . . **Aldon M. Asherman**, according to an announcement by Terry P. Cunningham, Sylvania director of advertising and sales promotion, was appointed advertising manager for four product divisions of Sylvania Electric Products Inc.—Parts, Tungsten and Chemical, Atomic Energy and Electronic Systems. He comes to Sylvania from American Cyanamid. END

technical Literature



SERVICE DATA INDEX

1956 Index to Most-Often-Needed Television and Radio Servicing Information lists every radio and TV set in Supreme Publications' 27 volumes of diagrams and servicing information. All sets are listed alphabetically by manufacturer and numerically by model number.

Supreme Publications, 1760 Balsam Rd., Highland Park, Ill., 25c

DRAFTING

Standard and Simplified Drafting Practices (56 pages) devotes 20 pages to standard drafting-room practice. The final 24-page section on simplified drafting starts out with 11 rules as covered in detail by Mr. Bergen in his booklet *Simplified Drafting* and then goes into the specifics of simplified practice. *Available to interested parties on company letterhead from Public Relations Dept., American Machine & Foundry Co., 261 Madison Ave., New York 16, N. Y.*

SCHOOL BROCHURE

Capitol Radio Engineering Institute has put out a new edition of the brochure *Your Future in the World of Electronics*. It includes a 9-page detailed, factual report on opportunities in the radio electronic industry for technically educated men, by E. H. Rietzke, founder and president of CREI.

The 44-page brochure then discusses the importance of advanced technical training and goes on to describe CREI home study.

Registrar, Capitol Radio Engineering Institute, 3224 16th St. N. W., Washington 10, D. C.

HI-FI TUBES

Tubes that combine the advanced design of Philips of the Netherlands and Amperex engineering research are described in a new brochure.

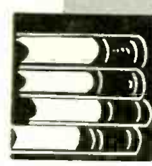
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, Long Island, N. Y.

AUTO AERIALS

An 8-page catalog describes auto aerials with specifications for front, rear and side mounts and lists accessories. One section illustrates up-to-date dealer displays.

Ward Products Corp., Div. of Gabriel Co., Dept. 56, 1148 Euclid Ave., Cleveland 15, Ohio END

Books



TECHNICAL MANUAL, Sylvania Tubes. Sylvania Electric Products Co., 1740 Broadway, New York 19, N. Y. 5½ x 9½ inches, loose-leaf binding, pages not numbered. $2.

Intermediate in price as well as content between the cheapest tube handbooks and the elaborate affairs selling for more than $10, this manual contains a surprising number of features found in the more expensive books. The purchaser obtains for 1 year supplements to insert in his book, thus keeping up-to-date with the newer tubes. (Incidentally, tube tester settings for users with Sylvania tube testers are included. No doubt these could be converted to other testers, solving the problem of new tubes without checking data.)

A tube-data section of abridged information on obsolete and discontinued types as well as on a number of more popular tubes is very useful. Other sections cover picture tubes, special tubes (including crystal diodes but not transistors), resistance-coupling data and an appendix of useful information.

Resistance-coupled amplifier data is given for two sets of input signal values—representing high and low input levels, and the percentage of distortion is given for each.

COLOR TELEVISION STANDARDS, by Donald G. Fink. McGraw-Hill Book Co., New York, N. Y. 6 x 9¼ inches, 520 pages. $8.50.

Compatible color TV has been accomplished only through the intensive efforts of many scientists. In 1950, the NTSC (National Television System Committee) was organized by the TV industry for the purpose of setting up standards for color. At that time, several systems were being proposed and confusion was beginning to mount. No existing system could provide a satisfactory and compatible color picture. The NTSC went to work to determine the problems and how to solve them. By the middle of 1953, a final report was forthcoming, and this forms the basis of our present-day color system. This book covers the activity of the NTSC, details of the final standard signals, latest types of color films and processes and definitions relating to color TV.

As examples of the contents, one committee report describes in very simple language the features of a compatible color signal. Another panel was given a questionnaire regarding

BOOKS *(Continued)*

the subjective factors of color TV. These questions (and the panel's answers) form a very interesting report on such topics as: depth of field, fidelity, surrounding room brightness and other characteristics of a color picture. Still another group was assigned the task of making field tests of the finally standardized color signal. Their results appear in the book.—*IQ*

TAPE RECORDERS, by Charles G. Westcott. Howard W. Sams & Co., Inc., Indianapolis, Ind. 5½ x 8½ inches, 177 pages. $2.75.

A tape recorder is mechanical as well as electronic and therefore needs description from both viewpoints. This introductory book makes a good job of it. Prospective buyers will find here which important factors differentiate one recorder from another. Hi-fi fans will be interested in the discussions on wow and flutter and also how noise and hum are reduced. Technicians will note especially the typical schematics and the hints on maintenance and lubrication.

The book begins with a history and brief theory of magnetic recording. The transport mechanism receives considerable attention and there is data on motors. Several exploded views show the insides of a few recorders. As for the electronic end, chapters appear on volume indicators, bias oscillators, equalizers and amplifiers. There is a chapter on tape characteristics and another (very, very brief) on test procedures.

WORLD RADIO HANDBOOK FOR LISTENERS. Edited and published by O. Lund Johansen, Copenhagen, Denmark. Distributed in U. S. by Gilfer Associates, New York. 168 pages. $2.

The 10th edition of an internationally known listing of broadcast and TV stations of the world. Prepared mainly for the shortwave listener but lists long- and medium-wave stations (151-1875 kc) as well. Shortwave stations are listed by country and by frequency. The listings by country also include mailing addresses, hours of operation, QSL'ing information and a few bars of the stations' identifying musical themes. END

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

SCHOOL DIRECTORY PAGE 157

BRANCH ADVERTISING OFFICES: Chicago: 1413 Howard St. Tel. ROgers Park 4-8000. **Los Angeles:** Ralph W. Harker and Associates, 600 South New Hampshire. Tel. DUnkirk 7-2328. **San Francisco:** Ralph W. Harker and Associates, 582 Market St., Tel., GArfield 1-2481.

FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., London E.C. 4. **Australia:** McGill's Agency. Melbourne. **France:** Brentano's, Paris 2e. **Belgium:** Agence et Messageries de la Presse, Brussels. **Holland:** Trilectron-Heemstede. **Greece:** International Book & News Agency, Athens. **So. Africa:** Central News Agency, Ltd., Johannesburg, Capetown, Durban, Natal; Universal Book Agency, Johannesburg. **Middle East:** Steimatz Middle East Agency, Jerusalem. **India:** Broadway News Centre, Dadar, Bombay #14. **Pakistan:** Paradise Book Stall, Karachi 3.

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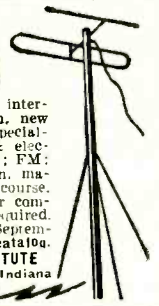

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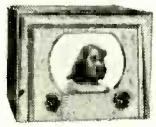

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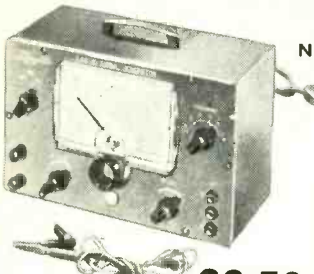

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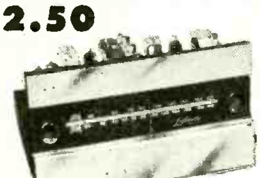

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PROFESSIONAL TRANSCRIPTION TURNTABLE AND VISCOUS-DAMPED TONE ARM

THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE

PK-100 TURNTABLE, PK-90 TONE ARM AND G.E. CARTRIDGE WITH GENUINE DIAMOND AND SAPPHIRE STYLI.

72.50

COMBINATION DEAL

PK-100A TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13 1/2" x 14" and requires 2 3/4" clearance above and 3 3/4" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-100-A .... Net **49.50**

PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.
This tone arm is a quality companion to the PK-100 with matching finish. Shpg. wt., 2 1/2 lbs.

PK-90 .... Net **19.50**

New!

HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

14.95

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4 1/4" long x 3" diameter, lens extends 2 1/2". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 .... Net **14.95**

METAL-CASED CONE TYPE HI-FI TWEETER

• FREQUENCY RESPONSE 2000-16,000 CPS • HANDLES 20 WATTS OF POWER

5.95 Net

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required; the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3 1/8" x 2 1/8" x 3" Diam. Shpg. wt., 3 lbs.

HK-3 .... Net **5.95**

CROSSOVER NETWORK

• CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS • BUILT-IN LEVEL BRILLIANCE CONTROL

8.75

The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2 1/2 ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2 5/8" H x 2 5/8" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 .... Net **8.75**

NEW!

IMPORTED 12" HI-FI COAX. SPEAKER

- FREQUENCY RANGE 30-15000 CPS
- HANDLES 20 WATTS OF POWER
- COMPLETE WITH LEVEL CONTROL
- POWERFUL TSK-5 MAGNETS
- SPECIAL SHEEPSKIN-EDGED CONE

A Lafayette exclusive import and exceptional value. Consists of a 12" woofer, coaxially mounted 2 1/2" tweeter and a built-in crossover network. The specially processed fibre cone has a sheepskin edge to suppress unwanted nodal vibrations and insure beautiful tone quality. Highly efficient TSK-5 magnets. Level control provides variation to 6 db cut. Maximum input 20 watts. Impedance 8 ohms. Rugged all-metal frame. If made in this country, would cost at least $49.50. Shpg. wt., 11 lbs.

Reg. Price ~~44.50~~ Net **29.50**

SK-58 .... Net **29.50**

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Gm. & Em. ULTRAFAST TUBE & TRANSISTOR TESTER

Completely NEW!

PRECISE MODEL 116K in kit form....... $69.95
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Incl. carrying case and cover

Servicemen know the Precise Model 111 (the winner in an independent survey) easily rates "the finest tube tester in the field" at any price, BUT FOR AN ON THE JOB QUICK-TEST . . . the fastest, most accurate is the PRECISE Model 116. What's more you test tubes the foolproof method inherent in the famous Precise Model 111.

Did you ever wish you could plug in 5 of the same type tubes at once and check each one individually by rotating a switch? YOU CAN WITH THE PRECISE MODEL 116—Plug in 5 IF tubes and let them heat up at once and then check each one separately by rotating the TUBE BANK switch. ACTUALLY CHECK 5 TUBES IN 20 SECONDS, 4 SECONDS PER TUBE.

The Precise Model 111 taught the lesson that IF amplifier tubes (like the 6BC5 or 6AU6) should be tested for Gm (mutual transconductance) while the power amplifiers (like the 6L6) should be tested for Em (emission)—that's ULTRAFAST Model 116 test! It checks each section of each tube separately . . . by rotating the FUNCTION SWITCH . . . each triode of a dual triode is checked individually . . . each diode and the triode of a duo-diode-triode is separately tested and not lumped as in other testers . . . and a pentode is tested as a pentode—not a diode. TRANSISTORS, SHORTS, GAS, LIFE, Em, Gm etcetera can be tested with the PRECISE Model 116.

You can inexpensively extend the Precise Model 116 to test filament current, etc. The Model 116 gives an accurate, ultra-fast (3 basic knobs for testing) check of television tubes!

No Surplus—An etched panel—beautiful Moleskin covered wood carrying case and cover and specially simplified instructions makes the PRECISE MODEL 116 THE FINEST FAST-CHECK TUBE TESTER AND DOLLAR EARNING TRAVELING COMPANION A TV SERVICEMAN EVER HAD.

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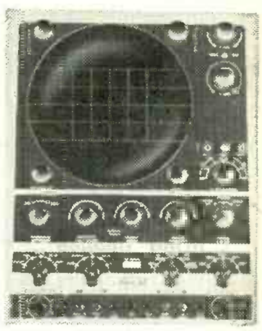

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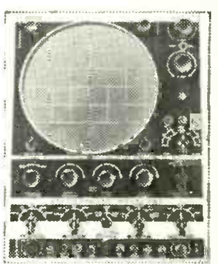

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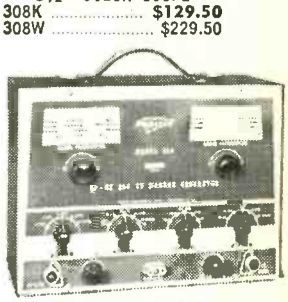

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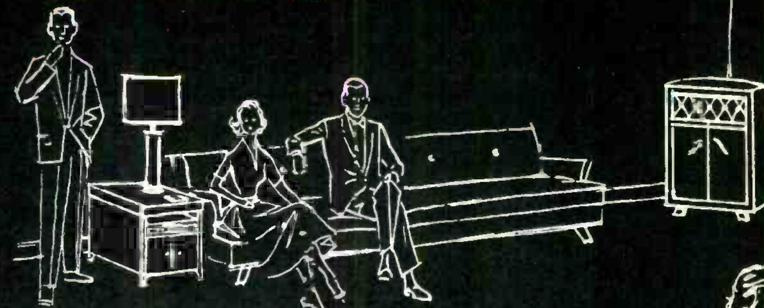
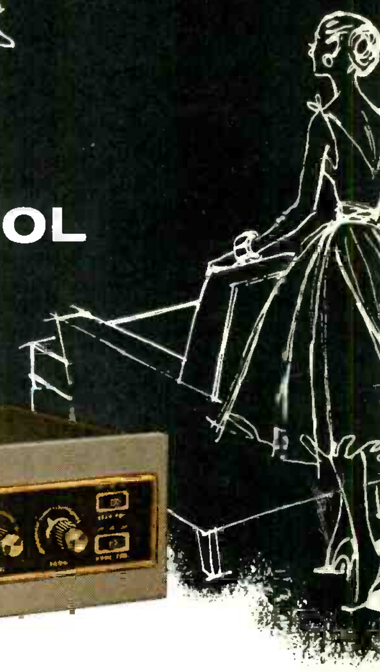
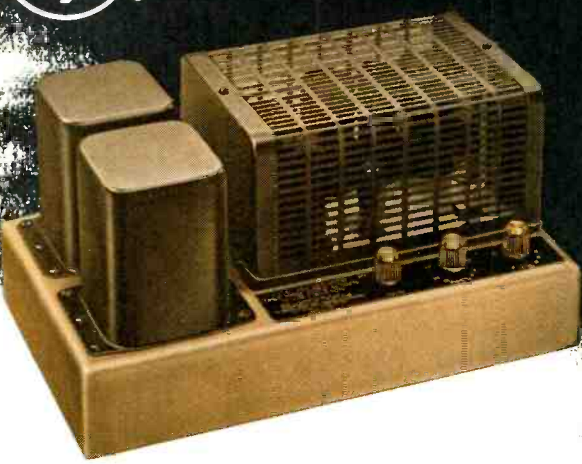




CIRCLOTRON AMPLIFIERS and MUSIC CONTROL CENTERS



Model A20CL Music Control Center and 20-watt Power Amplifier. Features unique, exclusive "Presence" control. Response 20-20,000 cps. ±1.0 db at rated 20 watts, 40 watts peak. Controls include Playing Selector, Loudness, Bass, Treble, Volume and Power, Phono-Selector. Power Amplifier utilizes Circlotron Circuit and Variable Damping Control. Low-boy style. **Net, $124.50**

Model A15CL Music Control Center and 15-watt Power Amplifier. Similar to Model A20CL above except Power Output 15 watts rated, 30 watts peak. Controls include Power, Bass, Treble, Volume, Playing Selector and Phono-Selector. **Net, $93.50**

Model PC1 Music Control Center. Serves as control for line amplifiers. Has self-contained, shielded, low-noise power supply. Features exclusive E-V "Presence" control. Other controls include Playing Selector, Loudness, Bass, Treble. Volume, Power and Phono-Selector. **Net, $99.50**

Model PC2 Music Control Center. Serves as control for line amplifiers. Controls include Playing Selector, Bass, Treble, Phono-Selector, Volume and Power. Self-contained, shielded, low-noise power supply. **Net, $67.00**

Model A15 Circlotron Amplifier. Power output: 15 watts rated, 30 watts on peak. Response: ± .5 db 20-50,000 cps. **Net, $69.50**

Model A20 Circlotron Amplifier. Power Output: 20 watts rated, 40 watts on peak. Response: ± .5 db 20-60,000 cps. **Net, $85.00**

Model A30 Circlotron Amplifier. Power Output: 30 watts rated, 60 watts on peak. Response: ± .5 db 20-75,000 cps. **Net, $108.00**

Model A50 Circlotron Amplifier. Power Output: 50 watts rated, 100 watts on peak. Response: ± .5 db 20-75,000 cps. **Net, $169.00**

Model A100 Circlotron Amplifier. Power Output: 100 watts rated, 200 watts on peak. Response: ± .5 db 20-50,000 cps. **Net, $261.00**

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