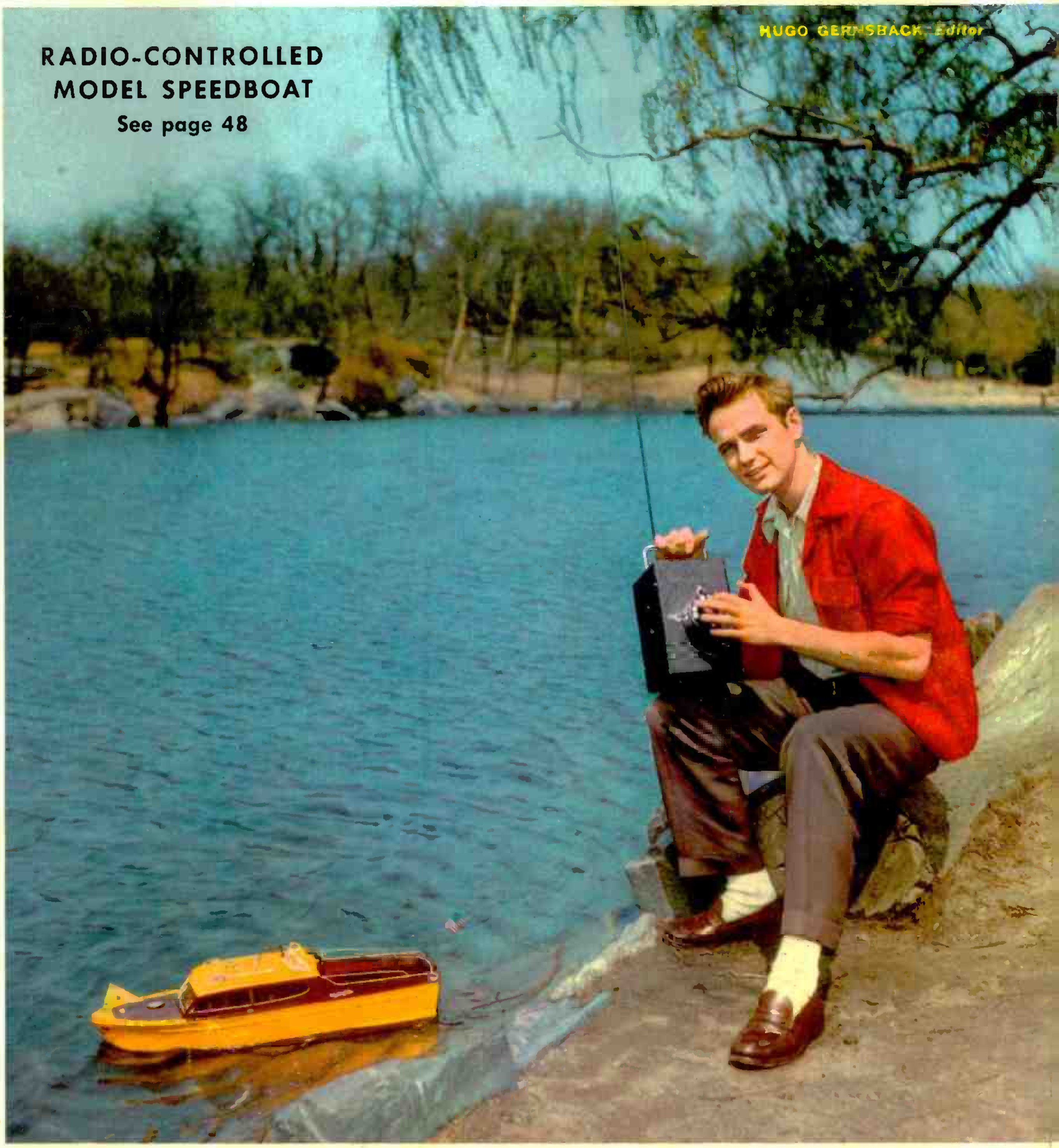
JULY 1953

RADIO-ELECTRONICS

LATEST IN TELEVISION • SERVICING • AUDIO



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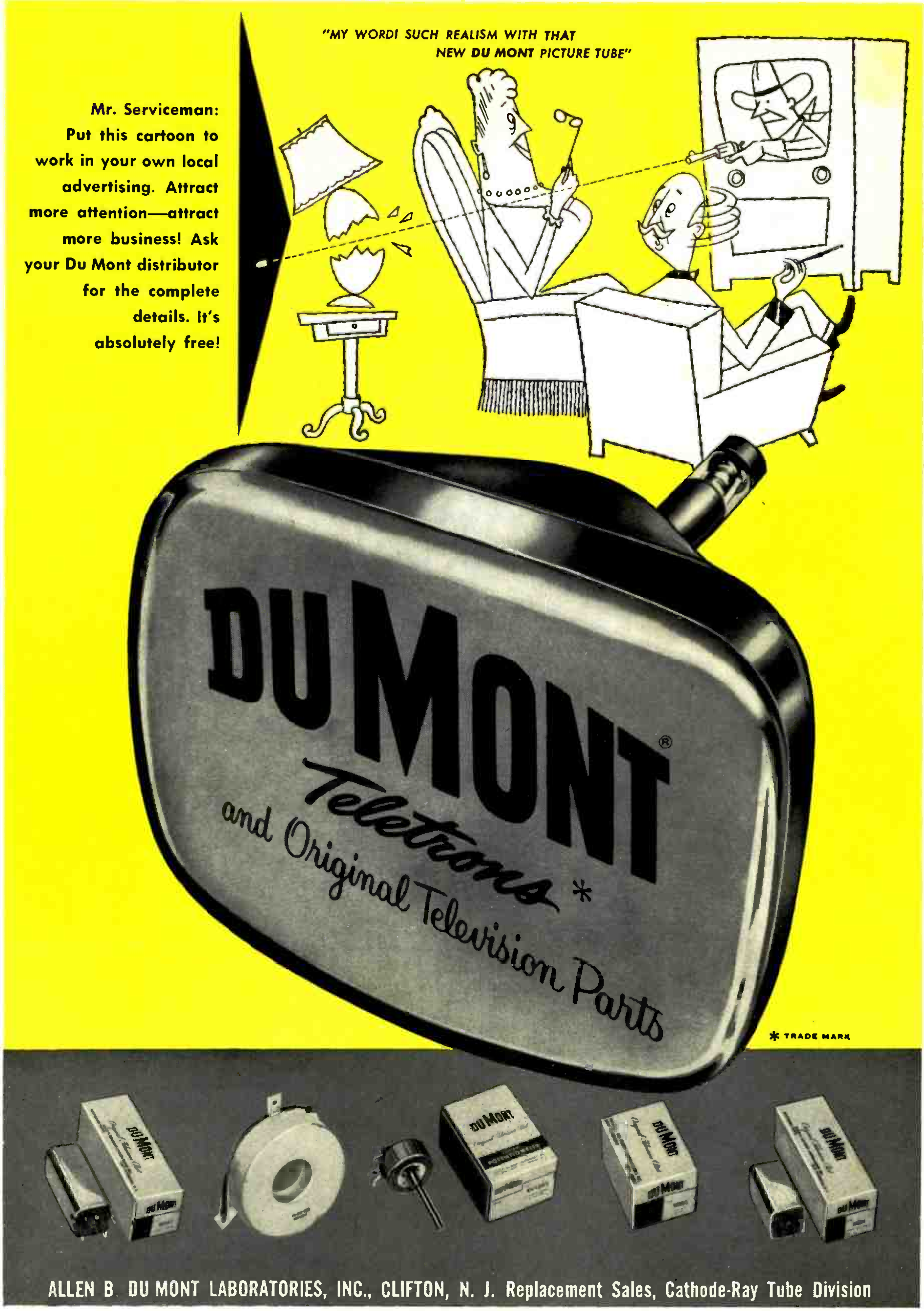
U. S. and CANADA

In this issue: **Community TV Systems • Novice 2-Tube Superhet • Advanced Scope Techniques**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Teletrons*
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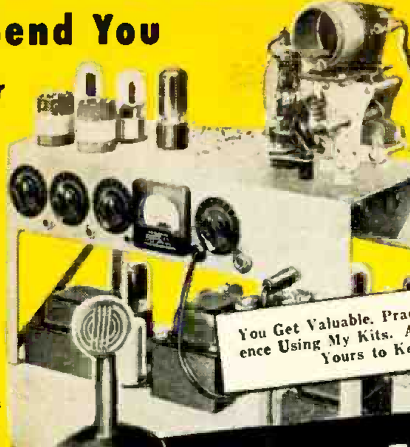
ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J. Replacement Sales, Cathode-Ray Tube Division

YOU PRACTICE COMMUNICATIONS with Kits I Send You

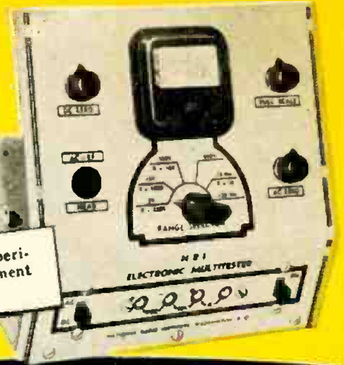
Build This Transmitter

As part of my Communications Course I send you parts to build the low power Broadcasting Transmitter shown at the right. Use it to get practical experience putting a station "on the air," perform procedures required of Broadcast Station operators. You build many other pieces of equipment with kits I send. I train you for your FCC Commercial Operator's License.



You Get Valuable, Practical Experience Using My Kits. All Equipment Yours to Keep.

YOU PRACTICE SERVICING with Kits I Send You



Build This Tester

You build this Multitester from parts I send, use it to earn extra money in your spare time fixing neighbors' Radios. I also send you speaker, tubes, chassis, transformer, loop antenna, everything you need to build a modern Radio and other equipment. You get practical experience working with circuits common to both Radio and Television. All equipment is yours to keep. See and read about it in my FREE 64-page book. Just cut out and mail coupon below!

J. E. Smith has trained more men for Radio-TV than any other man.

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TV now reaches from coast-to-coast. Over 15 million TV sets are now in use; 108 TV stations are operating and 1800 new TV stations have been authorized. This means more jobs, good pay jobs with bright futures. Now is the time to get ready for success in TV. Find out what Radio-Television offers you. Mail coupon now for my 2 Books FREE!

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Do you want a good pay job, a bright future, security? Then get into the fast growing RADIO-TELEVISION industry. Hundreds I've trained are successful RADIO-TELEVISION TECHNICIANS. Most had no previous experience, many no more than grammar school education. Keep your job while training at home. Learn RADIO-TELEVISION principles from easy-to-understand lessons. Get practical experience on actual equipment you build with parts I send you.

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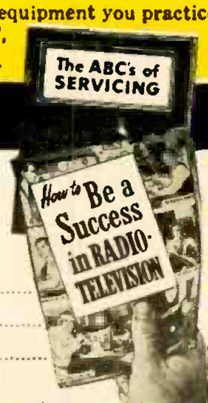
Tested Way to Better Pay

Good for Both - FREE

The ABC's of SERVICING



MR. J. E. SMITH, President, Dept. 3GF
National Radio Institute, Washington 9, D. C.

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RADIO-ELECTRONICS

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

ON THE COVER (See page 48)
Radio-controlled model speedboat starts out on a trial run on a lake in New York's Central Park.
Color original by Avery Slack

CONTENTS — JULY, 1953

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There is a place for *you* in the great Radio-Television-Electronics industry when you are trained as National Schools will train you at home!

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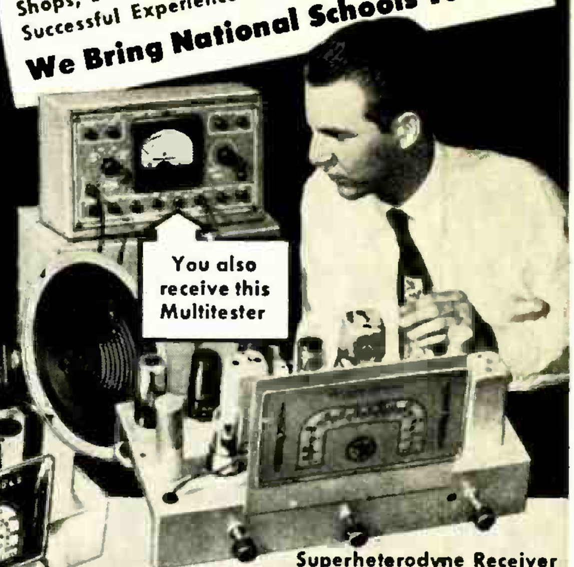
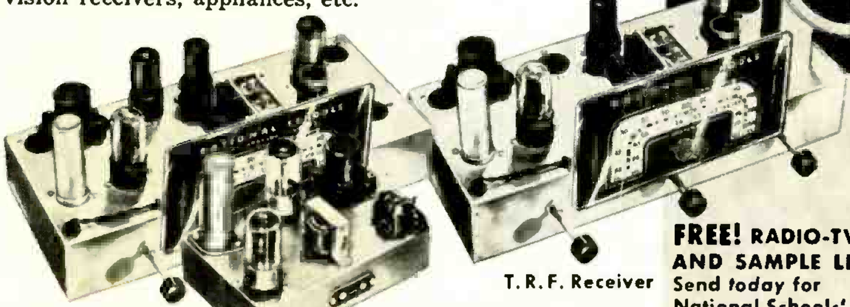


You also receive this Multitester

Superheterodyne Receiver



Signal Generator

Audio Oscillator

T. R. F. Receiver

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You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

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National Schools prepares you for your choice of many job opportunities. Thousands of home, portable, and auto radios are being sold daily—more than ever before. Television is sweeping the country, too. Co-axial cables are now bringing Television to more cities, towns, and farms every day! National Schools' *complete* training program qualifies you in all fields. Read this partial list of opportunities for trained technicians:

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- Radio Manufacturing, Sales, Service • Telecasting
- Television Manufacturing, Sales, Service
- Laboratories: Installation, Maintenance of Electronic Equipment
- Electrolysis, Call Systems
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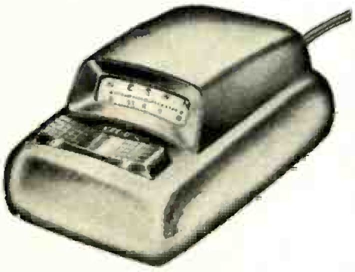
BY THOSE WHO KNOW AT THE CHICAGO SHOW

THE GREAT NEW VEE-D-X ROTATOR

They came — they saw — they bought. Their interest, their enthusiasm and their endorsement exceeded our fondest hopes. The VEE-D-X Rotator was truly the **BRIGHTEST STAR** at the Show.



THE MAGNIFICENT

Decorator Styled

CONTROL CONSOLE

Beautiful and efficient, the VEE-D-X console has unique fingertip action control which operates with a convenient downward pressure. It is streamlined, compact and engineered for instantaneous clockwise and counter-clockwise action. Choice of colors — Heather Green and Cordovan Mahogany.

DO YOUR CUSTOMERS A GOOD TURN BY INSTALLING THE

"IT STOLE THE SHOW"

And it will steal the spotlight wherever a rotator is needed. The VEE-D-X rotator and control console are packaged with the highest "EYE-Q" of any on the market.

VEE-D-X ANTENNA ROTATOR

A FEW NOTES A FEW QUOTES from the CHICAGO SHOW

NOTE: Finest in design, construction and performance.

QUOTE: "Congratulations! This is the rotator that we want."

NOTE: It's streamlined.

QUOTE: "Your in-line mounting finally gives us a good looking rotator."

NOTE: Finest gearing of any rotator.

QUOTE: "Your gear train is really something, and it's built with watch precision."

NOTE: Three world-famous manufacturers collaborated in producing the VEE-D-X Rotator.

QUOTE: "At last we've got a rotator that is absolutely complete and ready to install with no bag of loose bolts and nuts or other accessories to fumble around with."

NOTE: Beautiful Decorator Styled Control Console.

QUOTE: "Your control console is the smoothest, most compact unit I've seen yet - and it's really got eye appeal."

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Hugo Gernsback, with S. L. Baraf of U.T.C., president of the Parts Show Corporation and toastmaster of the banquet at which the globe was presented.

A SCULPTURED SILVER GLOBE was presented to Hugo Gernsback, publisher and editor of RADIO-ELECTRONICS, as a trophy representing "Fifty years of devoted effort and contributions to the radio-electronic art and to scientific prognostication—1903-1953." The presentation was made at the Radio Industry Banquet of the 1953 Electronic Parts Show in Chicago May 18. Mr. Gernsback is at the left side of the photograph above.

The globe, which shows the land masses of the world in relief, rests on a tapered cylindrical base on which are inscribed the names of the large number of individual and corporate sponsors who contributed to the award, and the names of prominent scientists living and dead whose pioneering labors have contributed to the progress of the radio-electronic art.

NEW FINDINGS IN V.H.F. DX transmission over mountainous areas are under intensive study by Government scientists. Tests on frequencies between 38 and 160 mc show the existence of signal "paths" relatively free from transmission loss or fading over distances as great as 200 miles. Calculations indicate the equivalent increase in transmitter power—as great as 70 db (10 million times)—may hold at even greater distances, and at frequencies up to 1,000 mc and more.

These discoveries—in addition to their military value—may eventually make it possible to get consistent television reception at great distances over mountain terrain, provided the right locations are found for the transmitting antennas. A receiver just behind a mountain, however, might get nothing at all, due to the natural deflecting effect of any large obstacle on very short electromagnetic waves.

THE LATE DR. FRANK CONRAD, pioneer engineer, who established the world's first regularly scheduled broadcast station (KDKA) in 1920, was unanimously chosen for the fourth annual Radio Hall of Fame Award of the Radio Pioneers. Five living leaders received citations from the Pioneers—Dr. V. K. Zworykin; Dr. E. F. W. Alexanderson; John V. L. Hogan; Dr. O. H. Caldwell; and Donald Manson, retired general manager of the Canadian Broadcasting Corporation.

Dr. Conrad spent his entire career with Westinghouse, rose from bench hand to assistant chief engineer which position he held at his death in 1941. He held over 200 patents.

MULTIPLE SKY-WAVE ECHOES that interfere with high-speed code and facsimile transmission over long-distance radio circuits can be eliminated by a new method developed by Dr. Millett G. Morgan. Reflections from the two principal layers of the ionosphere and from "waves" in their surfaces can transform a single transmitted dot into a whole series of dots at the receiving end.

Dr. Morgan, who is director of research at Dartmouth University's Thayer School of Engineering, found the solution is to transmit an elliptically polarized signal from two antennas, adjusting the axis ratio of the ellipse continually to counteract changes in the heights and surface irregularities of the ionosphere layers. It may be possible to make these adjustments automatically with the aid of a small pilot transmitter that continuously "sounds" the confirmation of the ionosphere.

MANY HAPPY RETURNS of the day to the transistor, whose birth was announced June 30, 1948.

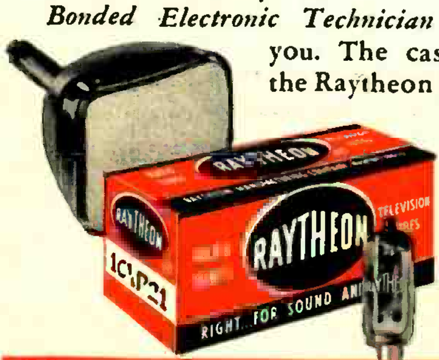
HERE'S A WINNING CARD...

The RAYTHEON Bonded Electronic Technician's Identification Card

is mighty important to customers. It instantly identifies the bearer as an expert technician representing a reputable company — lends re-assurance to the apprehensive set owner.

But this is only one of the ways the *Raytheon Bonded Electronic Technician Program* helps you. The cash-protection of the Raytheon Bond (backed by Continental Casualty Company), the Raytheon "Code of Ethics" and the sound, sensible business methods the code suggests all help to create customer confidence and good will. That means more business now, and more business in the future from a steadily increasing backlog of satisfied customers.

This potent weapon in the war against consumer mistrust is yours *without cost* if you can qualify for it. It is Raytheon's investment in *your* future. Call your Raytheon Tube Distributor today, and ask him if you can become a *Raytheon Bonded Electronic Technician.*



RIGHT...FOR SOUND AND SIGHT

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RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES

A.R.R.L.'S 1953 NATIONAL CONVENTION will be held at the Shamrock Hotel, Houston, Texas, July 9, 10, 11, and 12. More than 2,500 licensed amateurs and representatives of the electronics industry are expected to attend. The Houston Amateur Radio Club, Inc., is sponsoring the 4-day meeting, which is the seventh national convention in the A.R.R.L.'s history.

"PAY-AS-YOU-SEE" TELEVISION—at least on a nationwide basis—was viewed as a dead duck by Brig. Gen. David Sarnoff in an address at the convention of the NARTB in Los Angeles. Emphasizing that this was his personal opinion and not RCA policy, General Sarnoff cited the failure of "wired wireless" subscriber radio service in the early days of radio (1924-1925), and said that any attempt to transform our present TV system to a regulated public-utility type of service—except on a strictly local basis—would destroy our "freedom to look and freedom to listen," and would jeopardize "the preservation of our present competitive system of broadcasting."

AN ATOMIC DRY CELL with a *gas* electrolyte activated by nuclear radiation has been invented by Philip E. Ohmart, president and director of research of the Ohmart Corporation, Cincinnati, Ohio. The inventor found that a measurable unidirectional current flowed between two air-insulated electrodes of lead and gold when the air surrounding them was exposed to radiation from a microscopic quantity of radium. Reversing the connections reversed the direction of current flow, proving that ionization of the gas electrolyte by *beta* radiation was responsible for the current. As a double check, Mr. Ohmart built an airtight cell and connected it to a vacuum pump. As the air was exhausted the current dropped steadily, reached zero, and then *reversed itself* when the cell was almost completely evacuated.

Further research led to the adoption of colloidal graphite *(Aquadag)* instead of gold as the positive element. An experimental model develops enough power to run a tiny electric motor for demonstration purposes, but the principal uses for the Ohmart "atomic" battery at present are in radioactivity-detection instruments.

EYE FATIGUE AND HEADACHES from watching radar screens in almost total darkness pose new problems for military medics. Their recommendations—as reported in the *U. S. Armed Forces Medical Journal*—are almost identical to those made for TV-viewing: Increase the ambient lighting; reduce uninterrupted watching time (in this case to shifts of one-half hour or less); and arrange more comfortable seating for radar operators. They also suggest operators put on dark-red goggles before leaving the radar room to lessen the discomfort of sudden exposure to bright sunlight and to speed accommodation to comparative darkness on return.

A 3-D TV DEMONSTRATION was presented recently by the American Broadcasting Company over KECA-TV in Hollywood. The test system uses a synchronized mirror rotating 30 times per second in front of the TV camera to produce two images with an apparent lateral displacement equivalent to the average pair of human eyes. These are reproduced on separate picture tubes at the receiver, and projected onto a special screen. Viewers must wear polarized glasses.

A little initial confusion was created by the fact that the pictures came in upside down and either the receivers or the viewers had to be turned bottom-up. An invited audience found the results strikingly effective.

CANADA'S TV POLICY will be to establish at least one TV station in each province before permitting additional stations in areas already served, according to a recent statement by National Revenue Minister J. J. McCann. When an adequate national TV system has been developed, private stations may be permitted in areas covered by government-owned CBC stations, and the CBC may establish stations in areas receiving service from private TV stations. Licenses granted for private stations in areas not covered by CBC will contain a provision permitting the government-controlled network to take over if the area cannot support more than one TV outlet.

Meanwhile applications have been filed for private TV stations in Calgary (channel 2); Edmonton (3); Kitchener (6); Rimouski (3); Saskatoon (8); and Regina (2).

A TEST OF BINAURAL broadcasting on AM was made recently by Rensselaer Polytechnic Institute, Troy, N. Y., in co-operation with WGY, WTRY, WHAZ, WPTR, and WXKW. Two microphones spaced about 10 feet apart were linked by wire lines to separate transmitters. A third mike, midway between the first two, fed both lines simultaneously. Listeners were advised to use two receivers tuned to equal volume, with the same 10-foot spacing between them.

Most binaural broadcasting done in recent months has been by simultaneous transmission over AM and FM stations. The Rensselaer experiment is the first one reported in several years using AM transmission only.

Reports from the public agreed with a special panel of six experts that this form of binaural transmission was highly effective on small vocal groups and solo instruments but not so good for band music because of confusing reverberations.

AN ULTRAVIOLET PHOTOMETER for detecting extremely minute concentrations of dangerous gases in air has been developed by scientists of the Du Pont Company. The new instrument is 100 times as sensitive as the human eye, and can detect changes as small as 1 part in 10,000 in the light absorbed by gaseous mixtures. END

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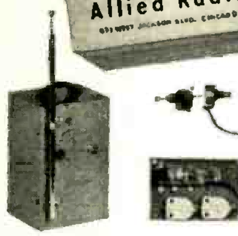
Build this powerful 3-way superhet portable for AC, DC or battery operation. Tunes 535-1650 kc broadcast band; has built-in antenna, PM speaker, printed audio circuit, handsome carrying case. Easy to assemble from illustrated manual. High-quality kit includes all parts, tubes and case (less batteries). Shpg. wt., 6 lbs.
83-730. *Only*............. **$18.75**
Battery Kit............... **$3.64**



PHILMORE RADIO CONTROL KIT

Build your own remote-control transmitter and receiver. Operates model airplanes, boats, autos, etc. Crystal-controlled transmitter for 27.255 mc (requires easily obtained FCC operating permit). High-gain super-regenerative receiver. Easy to build. Complete with all parts, telescoping antenna, crystal and cabinet (less batteries). 4½ lbs.
83-034. *Only*............. **$41.47**
Complete Set of Batteries.... **$7.15**

KNIGHT SELF-CHARGING PORTABLE

Deluxe superhet portable for AC, DC or battery operation. With battery "Rejuvenator" circuit which extends normal "B" battery life 2 to 4 times! Covers full broadcast band; has tuned RF amp, loop antenna, AVC, 5" PM speaker. Attractive carrying case, 10 x 12⅝ x 4¾". Complete with tubes, less batteries. 9 lbs.
6K-718. *Only*............. **$35.75**
80-652. *Battery Kit*........ **$4.36**

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Squeeze the trigger—you're ready to solder in 5 seconds. Latest heavy-duty, instant-heat gun; with 2 spotlights that light up working area. Air-cooled transformer. 3 lbs.
46-642. Single-heat, *only*... **$9.75**
46-641. Dual-heat, *only*... **$11.71**

PET ¼" DRILL VALUE

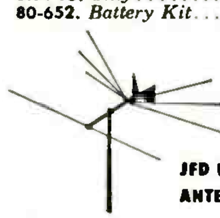
Precision gear-type chuck drill with pistol grip. Instant-release lock-type trigger switch built into grip. Forced ventilation; runs cool. Speed: no-load, 1600 rpm; full-load, 900 rpm. Capacity: ¼" in steel, ½" in hardwood. 6-ft. cord. For 110-120 v. AC or DC. 4 lbs.
46-280. *Only*............. **$17.21**

TV BOOSTER BARGAIN

Famous Standard Coil printed circuit TV booster at less than half original price. Provides uniform gain on all 12 VHF channels. Easy to tune; use with indoor antenna in primary areas, with outdoor antenna in near-fringe areas. Improves reception markedly. For 110-120 v., 60 cy. AC. Shpg. wt., 4 lbs.
97-233. While they last,
Only..................... **$9.95**

ELECTRO-VOICE UHF CONVERTER

New! Micrometer tuning for smooth, continuous reception of all UHF channels. Just connect to antenna input of any VHF TV set and plug in. Operates with all-channel antenna or separate VHF and UHF types. Single-knob, easy control. Uses VHF channels 5 or 6 as IF. 300 ohms input and output imp. Complete with tubes. For 110-120 v., 60 cy. AC. 5 lbs.
98-097. *Only*............. **$33.96**



JFD UHF-VHF ANTENNA

Wonderfully efficient; uses conical element and reflector for VHF and "bow-tie" for UHF. Equipped with printed circuit antenna coupler for excellent signal transfer into single transmission line. Easy to install. (Less mast and 300-ohm twin line.) Shpg. wt., 6 lbs.
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New! Drawer cabinet for small parts. Contains 4 drawers, with dividers for 48 compartments (dividers adjustable on 1½" centers). Each drawer 1½" h, 11" w, 11"d. Cabinet overall, 3½ x 11 x 11". Olive green baked enamel finish. Shpg. wt., 20 lbs.
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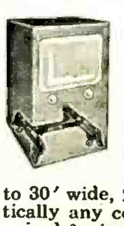
TRAV-ELECTRIC SENIOR CONVERTER

Ultra-compact 60 cycle converter for changing 6 volts DC to 110 volts AC. Capacity: 30 watts continuous, 40-45 watts intermittent. Simply plugs into auto cigarette lighter. Permits mobile use of broadcast and SW radios, recorders, dictating machines, fluorescent lamps, etc. Fully filtered. Only 2½x2½x3½". 3¼ lbs.
80-272. *Only*............. **$10.63**



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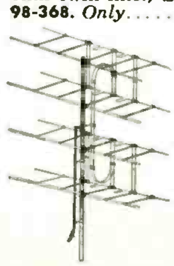
Easy to install under any TV console—permits quick and easy rolling to any desired location. Rolls smoothly in any direction. Steel frame is adjustable to 30' wide, 27" deep to fit practically any console. No tools required for installation. Shpg. wt., 11½ lbs.
98-989. *Only*............. **$5.95**



FINNEY 400A UHF-VHF ANTENNA

New! Double co-lateral UHF-VHF antenna featuring 32 driven elements for high gain and directivity, with superior signal-to-noise ratio. Superb for fringe-area reception—good for VHF up to 150 miles or more. Rugged; corrosion-proof; pre-assembled, lightweight. Requires 10-ft. mast and 300-ohm twinline. 14 lbs.
97-104. *Only*............. **$32.34**

TAP-A-LINE

New type electrical line outlet, powering as many as 8 separate appliances from any wall outlet. Plastic cased; 12" long, 1" square. With 6-ft. cord and plug. Rated 1000 watts. 1½ lbs.
52-636. *Only*............. **$1.47**

KNIGHT VT VOLT-OHM-MILLIAMMETER KIT

Terrific Value! Response to 2.5 mc. Bridge-type circuit; 1% resistors. Input res.: DC, 20 megs; AC, 1.5 megs. 4½" meter. Ranges: AC p-to-p volts, 0-8-28-84-280-840-2800; AC rms & DC volts, 0-3-10-30-100-300-1000; DC ma. 0-3-10-30-100-300-1000; res. 0-1000-10K-100K ohms & 0-1-10-1000 megs; cap., .005-.5, .05-5, .5-50, 5-500, 50-5000 mfd. With tubes, leads, case, instructions. For 110-120 v. DC or 60 cy. AC.
83-120. *Only*............................ **$24.95**
83-121. Hi-V Probe; extends DC range to 30 KV **$6.95**
83-122. Hi-Frequency Probe for AC range to 200mc **$5.95**

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BAROMETER of the PARTS INDUSTRY

During May, 70 of the leading 400 manufacturers of Radio-Television-Electronic parts and equipment made changes in their lines. There was an increase in "change activity" as compared to April.

In price revisions by the number of manufacturers and products affected, the following summary illustrates the comparative trend for the months of April and May.

	No. of Manufacturers	
	April	May
Increased prices	22	24
Decreased prices	8	16

	No. of Products	
	April	May
Increased prices	967	368
Decreased prices	466	125

For a summary of the most active product categories, see the following tables:

Product Group	Increased Prices		Decreased Prices		New Products		Discontinued Products	
	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products
Antennas & Access.	5	14**	6	83*	15	461*	9	107**
Capacitors	1	9**	0	0**	3	28**	1	127*
Controls & Resistors	0	0	0	0	0	0**	1	93*
Sound & Audio Prod.	8	119*	2	4*	16	150*	12	92*
Test Equipment	3	13**	0	0	2	26*	2	2**
Transformers	2	54*	0	0	3	53*	3	27*
Tubes	4	156*	7	37*	7	27**	4	17**
Wire & Cable	1	3**	1	1**	2	28*	2	7

* Increase over April
** Decrease from April

Comment: The product picture has been altered slightly since the last reported period with more manufacturers reporting changes in their line. The sudden activity among wire and capacitor manufacturers has decreased considerably, while sound and antenna manufacturers again dominate this "change activity" scene.

This data is prepared by the staff of United Catalog Publishers, Inc., 110 Lafayette Street, New York, publishers of Radio's Master, the Official Buying Guide of the Parts Industry.

Merchandising and Promotion

Ward Products Corp., division of The Gabriel Co., Cleveland, launched a new promotion aimed at building auto antenna sales. The program, "How You Can Sell More Auto Antennas," is described in an 8-page booklet which points out new sales prospects and describes the completely prepared promotional material, including mats, radio announcements, post cards, point-of-purchase displays, etc.

Raytheon Manufacturing Co., Waltham, Mass., presented the latest in its lectures on "How to Interpret What You See in UHF," in Los Angeles recently. William Ashby of Raytheon gave the main speech, which was illustrated with slides. Over 1,750 TV service technicians from Southern California attended the lecture which was co-sponsored by local Raytheon distributors.

The General Electric Tube Department, Schenectady, N. Y., is sponsoring a contest for service technicians in which $7,125 will be distributed to the 140 contestants who best explain in 50 words or less how they would use $2,500 to better their businesses. The "Write Your Own Ticket" contest runs from June 15 to August 31.

Jensen Industries, Chicago, introduced a new phonograph needle display and storage case which serves as a combination sales and inventory unit. It is available to dealers with the purchase of a special "turnover balanced" assortment of 27 conventional Jensen needles.

Minnesota Mining & Manufacturing Co., St. Paul, has compiled a kit of national consumer magazine articles on tape recording in business, the church, and the home. It is being offered in limited quantities to tape distributors.

Technical Appliance Corp., Sherburne, N. Y., is offering a new package dispenser for the Taco *Selectronic* antenna selecting switch. The dispenser holds 10 individually boxed units.

RADIO BUSINESS

Ram Electronics Sales Corp., Irvington-on-Hudson, N. Y., conducted a technical review and discussion for the Television Technicians Association of Perth Amboy, N. J., sponsored by Monmouth Radio Supply Co., local distributor. Al Friedman and Victor Markosian, Ram's national field sales engineer and chief engineer, respectively, presided. Ram will conduct similar forums in other localities at a later date.

McIntosh Laboratory, Binghamton, N. Y., and **Weathers Industries,** Barrington, N. J., recently conducted an audio demonstration in Chicago. The demonstration was unique in that it featured the kind of good music that most likely would be played in the home, rather than "show" pieces. The program was presented in a living-room setting.

Burgess Battery Co., Freeport, Ill., is distributing two point-of-purchase sales aids—a counter card showing the

latest makes and models of portable radios and the Burgess batteries they use, and a three-dimensional, electric flasher sign for window or counter.

Lloyd Austin, assistant chief engineer of **Simpson Electric Co.,** Chicago, addressed a special clinic for radio service technicians now handling TV, sponsored by the Engineering Department of the University of Missouri. He also spoke on u.h.f. test equipment at the Annual Spring Convention of NATESA in Kansas City, Mo.

Production and Sales

RTMA reported the production of 2,259,943 TV receivers during the first quarter of 1953. This is an annual rate in excess of 9,000,000—almost double the 1,300,000 sets produced in the 1952 period. During the same period, 3,834,784 radios were produced.

RTMA reported that a total of 122,058,756 receiving tubes valued at $82,955,367 were produced during the first three monthes of 1953. During the same period, 2,798,921 TV picture tubes valued at $67,696,464 were manufactured. Of this total, more than 65% were in the 19- to 21-inch category.

Show Notes

The Fourth Annual Convention-Conference of NEDA, to be held in St. Louis, September 14 to 16, promises to be a sellout, judging by the present rate of applications for booths, according to L. B. Calamaras, executive vice-president of NEDA.

The Western Electronic Show and

Convention will open with a record 316 booths, according to Heckert Parker, business manager of the show. Last year's booth total was 224. The 1953 show will be held in the San Francisco Civic Auditorium, August 19 to 21.

New Plants and Expansions

Raytheon Manufacturing Co., Waltham, Mass., is constructing a new TV picture tube plant in Quincy, Mass. Governor Christian A. Herter of Massachusetts spoke at the cornerstone-laying ceremonies.

Erie Resistor Corp., Erie, Pa., manufacturer of electronic components, will build a new plant in Holly Springs, Miss.

Oxford Electric Co., Chicago speaker manufacturer, acquired Radionic Controls, Inc., and the Wilder Manufacturing Co., both near Carbondale, Ill. Hugo Sundberg, vice-president of Oxford was elected executive vice-president of the two new subsidiaries. All products will be manufactured under the supervision of Oxford personnel and sold under the Oxford name.

Rohn Manufacturing Co., Peoria, Ill., manufacturer of towers and accessories, has located its executive offices next to its factory in enlarged and renovated quarters. The new mailing address is 116 Limestone, Bellevue, Peoria, Ill.

National Electric Products Corp., Pittsburgh, wire and antenna manufacturer, moved its executive offices to new and larger quarters at 140 Stanwix Street.

Davis Electronics, TV antenna manufacturer, moved its offices and assembly manufacturing to its new plant in Burbank, Calif. The new quarters provide approximately five times as much floor space as the company had at its previous location.

Electric Regulator Corp., manufacturer of *Regohm* voltage regulators for the electrical and electronics industries, is building a new 2,100-square-foot addition to its plant in Norwalk, Conn.

Heppner Manufacturing Co., Round Lake, Ill., opened a second plant in Mendota, Ill., for the exclusive manufacture of ferrite rod antennas and flyback transformers.

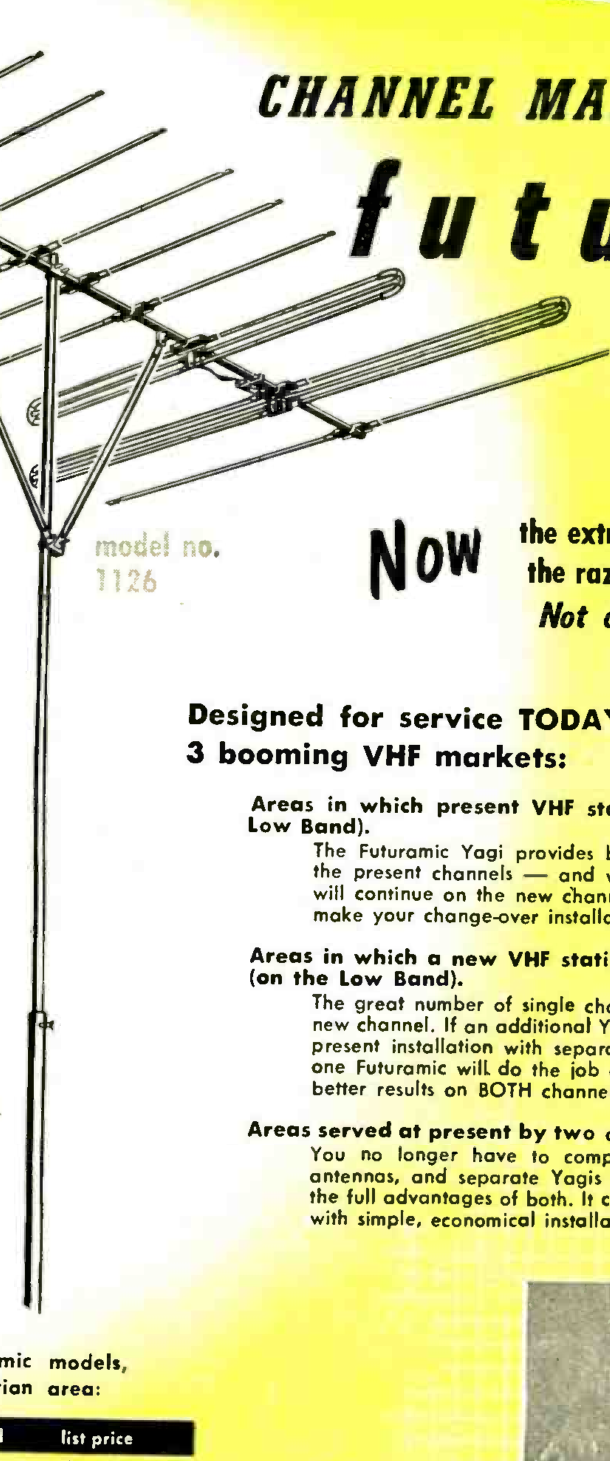
Continental Electronics Corp., Philadelphia, is expanding its present factory facilities in order to double its output of *Piktron*, an exchange line of television picture tubes.

Allen B. Du Mont Laboratories officially opened its new Instrument Division plant in Clifton, N. J.

Aerovox Corp., New Bedford, Mass., acquired Cinema Engineering Company, Burbank, Calif., designer and manufacturer of electronic components and equipment. A. C. Davis, who founded the company in 1936, will remain as its director, and James Fouch will be retained as general manager. Cinema is currently building an additional new plant in Burbank. Cinema will become an Aerovox division. The acquisition of Cinema is the second addition to Aerovox's West Coast facilities. The company is constructing a new plant in Monrovia, Calif. END

At Last! a YAGI for the ENTIRE LOW BAND!

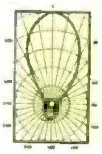
CHANNEL MASTER'S Newest *futuramic*



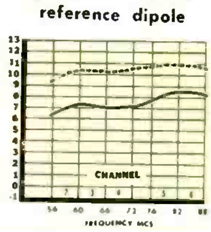
Completely covers every low band channel– 2 through 6

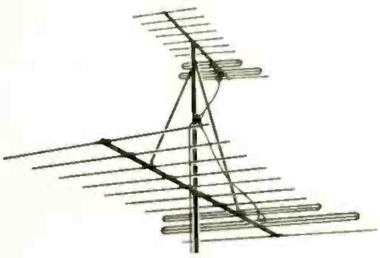
Now the extraordinary high gain of a Yagi . . .
the razor-sharp directivity of a Yagi . . .
Not on just one channel — but clear across the entire Low Band!

horizontal polar pattern (relative voltage)



gain above tuned reference dipole





A high-low Futuramic combination is the most sensitive array ever designed for all-channel VHF reception. Just combine models 1173 and 1126.

Designed for service TODAY and TOMORROW in these 3 booming VHF markets:

Areas in which present VHF stations are changing channels (on the Low Band).
The Futuramic Yagi provides better reception than conventional Yagis on the present channels — and when the shift occurs this superior reception will continue on the new channel WITHOUT INTERRUPTION. And you can make your change-over installations NOW.

Areas in which a new VHF station is being added to the present one (on the Low Band).
The great number of single channel Yagis now in use will not bring in the new channel. If an additional Yagi is installed it will have to be tied into the present installation with separate leads and a switching system. However, one Futuramic will do the job of BOTH antennas — at lower cost — with better results on BOTH channels.

Areas served at present by two or more VHF stations on the Low Band.
You no longer have to compromise between conventional broad band antennas, and separate Yagis for each channel. The Futuramic gives you the full advantages of both. It combines highest gain and sharpest directivity with simple, economical installation.

Now — 6 great Futuramic models, designed for every reception area:

model no.	channels covered	list price
1173	7 — 13	$20.83
1124	2, 3, and 4	
1125	2, 3, 4, and 5	
1136	3, 4, 5, and 6	$40.97
1146	4, 5, and 6	
1126	2, 3, 4, 5, and 6	

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KIT $19.95 WIRED $29.95
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KIT $19.95 WIRED $28.95
950K R-C BRIDGE &
R-C-L COMP. KIT $19.95
WIRED $29.95
360K SWEEP GEN.
KIT $34.95 WIRED $49.95
New 214K VTVM KIT
$34.95 WIRED $54.95
OVER 1/4 MILLION
EICO INSTRUMENTS
in use the world over!
New 536K MULTIMETER
KIT $12.90 WIRED $14.90
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New 377K SINE & SQUARE
WAVE AUDIO GEN. KIT $31.95
WIRED $49.95
EICO new modern facilities for research, development and production—your greater assurance of . . .
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NEW 7" Push-Pull OSCILLOSCOPE
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KIT $34.95 WIRED $49.95
CRA PIX TUBE ADAPTOR
for Tube Tester $4.50
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CALIBRATOR
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GUIDED MISSILES

. . . Electronically-steered missiles are becoming more complex . . .

By HUGO GERNSBACK

THE PROBLEM of electronically-guided missiles, which at one time seemed not too difficult to solve, is becoming extremely complex as time goes on. The Germans particularly were far ahead of anyone about ten years ago, and although the U. S. has spent over three billion dollars in eight years of research, we still have not advanced much beyond the Germans' accomplishments of a decade ago, according to those best informed on the subject.

One reason, possibly the main one, for our present lack of progress, is that as the art of guided missiles advances, more and more complications are encountered. When the Germans did most of their epoch-making research, which they immediately translated into actual weapons, the problems were far more simple. Airplanes at that time had not reached supersonic speeds, while today planes actually have flown over 1238 miles an hour. (The Federal Skyrocket.) These speeds are increasing continually and the time is not far off when weapons will fly at the rate of 10 miles a second, which is 36,000 miles per hour. It is one thing to build missiles of the V-1 and V-2 types, which move at rates of 600 and 3,000 miles per hour respectively, but quite another problem to shoot them down. While it is true that electronically-guided guns did shoot down a goodly percentage of V-1's over England during World War II, it is also true that far too many got through, destroying a vast portion of London.

A great deal of progress has been made in the meanwhile. Our modern radar interceptor guns will bring down a fair percentage of enemy long-distance bombing planes. Still no one in authority will admit that the problem is anywhere near being solved, because even huge slow-moving bombing planes, if launched in sufficient quantity by an enemy, cannot all be shot down. Many will get through even today.

This situation will become worse if instead of piston propelled bombers an enemy used rocket planes. A much larger percentage of such faster flying planes will get through any modern radar gun barrage. It is probably fair to say that the problem of ground-to-air defense cannot be solved completely, that is, no radar-electronically-operated and guided gun can ever bring down *all* the attacking planes or missiles over a given point.

The chief reason for this is the very complexity of the problem. We shall give here only a few of the reasons. All of the following interfere with surface-to-air missiles—even if the missile is one that seeks its target electronically or otherwise:

Changing air currents, humidity, clouds, barometric pressures, whether the missile approaches the target from the North or East (the rotation of the Earth must be taken into consideration!), heat, cold—all of these have their effect on the accuracy of the missile.

When missiles begin moving between 5 and 10 miles a second, in the not too distant future, the probability of hits by guided missiles becomes far more difficult. Even the matter of detonating the missile becomes a problem of some magnitude. If the contact is made a tenth of a second too fast or too slow, the missile will not reach its target. As the present speed of planes and rockets increases, this condition steadily worsens, as a little reflection will make clear.

For these reasons, military scientists and electronic researchers and physicists in general are mostly agreed today that surface-to-air guided missiles are inefficient now, and perhaps will be used only for specific purposes, i.e., to guard vital installations, warships, flat-tops, etc., to shoot down the *occasional* missile that gets through in spite of all other defenses.

The best defense would seem to be not surface-to-air means, but air-to-air defense. One of the great difficulties with a surface or ground-to-air defense is that the target is usually sighted too late. There simply isn't time enough for preparation, even if there is no gun crew and the shooting is all controlled electronically. On the other hand, when we have a *mobile* air defense which by radar and other means is constantly on the lookout for enemy missiles while they still are far distant from our vital centers, then there is a much better chance to cope with the problem. Hundreds of miles away from our shores or borders, the defending, highly mobile force will be in a much better position to cope with enemy missiles, whether they are bombing planes, rockets, or other fast flying weapons.

The time element here is much more advantageous for the defender, even if the oncoming missiles should move at 10 miles a second. Here we can have a mobile aerial defense *in depth*, meaning that there can be successive lines of aerial defenses which are able to deal much more effectively with the enemy. The outermost "front" line will probably be guided television-controlled flying weapons which are now a reality.* A line of unmanned observation planes will follow the television-radar planes, while behind these will be another force of special electronically-equipped fighter planes. While the latter are manned, the men are really only "battle-technicians" because in the future no man will be able to shoot down a fast-flying missile. All the shooting will be done by radar and electronic means. The crews will only steer their planes in the general direction of the enemy; the planes do the rest.

Now comes the most complex part of the entire problem: that is, *the enemy also has the same radar-electronic means that we have.* His attacking flotilla will have electronic gear by which he will try, by counter measures, to upset and jam the defender's radio waves so that the latter's attacking missiles will misfunction and become harmless.

To be sure, the defender has the same means. Specially-built and engineered guided missiles which must be jam-proof, have even now been evolved.

As anyone familiar with warfare knows, there has never been invented a weapon to which a counter was not found. This law remains as true today as it was in the day of the bow and arrow. War simply has become more complex. Thus the battles of the future will be fought not so much by human brains, which are now far too slow, but by electronic brains—electronic super-computers and similar means.

In the end, the side with the best electronic gear and the fastest electronic computers will probably win the future aerial battles.

END

*The writer was the first to technically describe the manless "Radio-Controlled Television Plane." See November 1924 issue of THE EXPERIMENTER.

Audio Reactance Charts

Simplified nomograms for quick solutions to some very common audio design problems

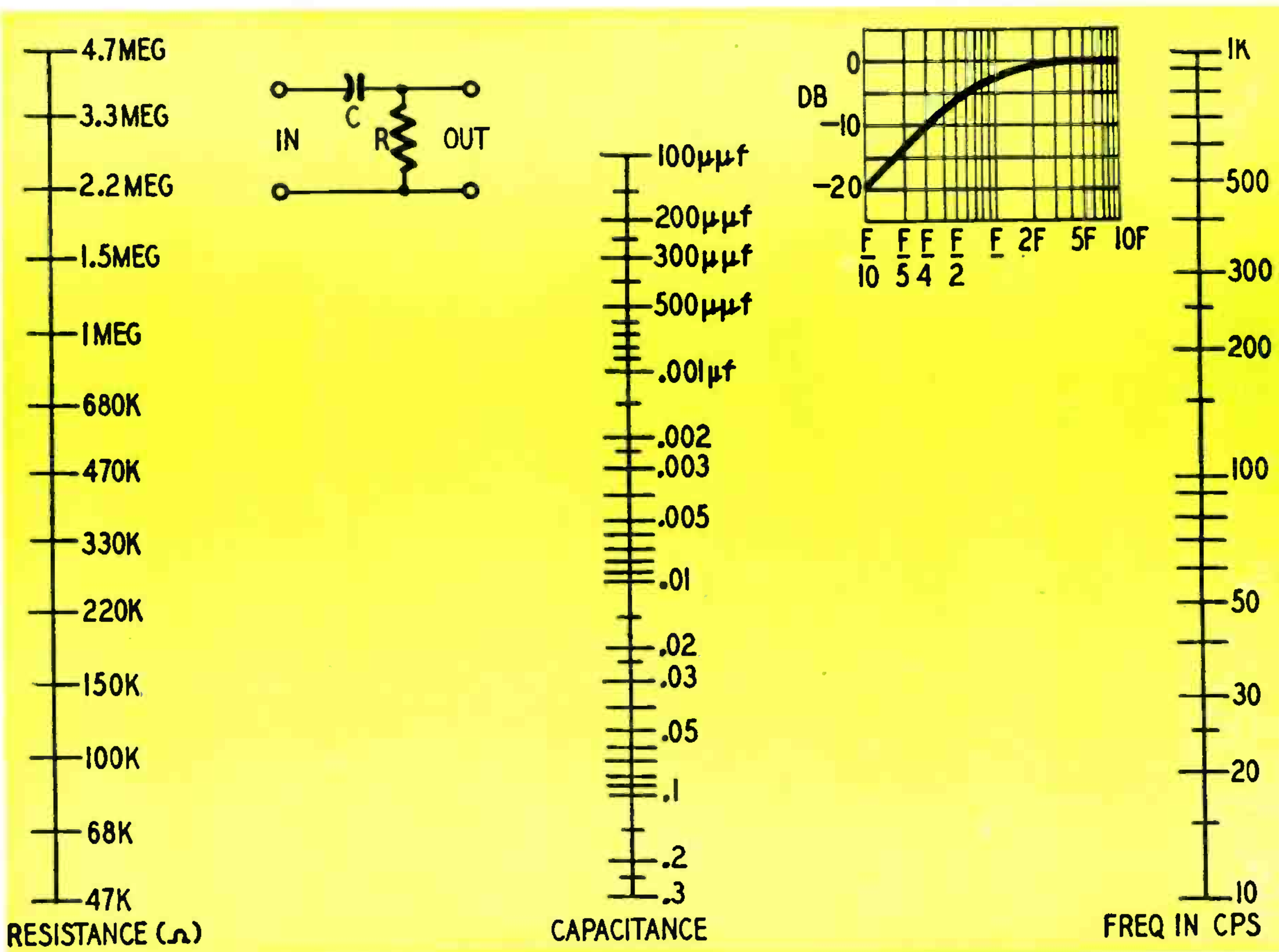
By HECTOR E. FRENCH

ALMOST every radio amateur or audio enthusiast tries at one time or another to calculate the frequency response of an audio amplifier while the design is still on paper. Or, even worse, he tries to design a particular frequency-response characteristic into an amplifier. But the harder he tries, the more mixed up he is apt to become when he tries to use the ordinary garden-variety reactance chart.

What's the reason for all this? Aren't reactance charts supposed to simplify these problems?

Well, they are supposed to, but for any one of a number of reasons they don't always work out. To begin with, the usual reactance chart gives too much information for too many values of too many variables over too wide a frequency range. And to add a finishing blow, it does not always give the decimal point, which means that the point usually lands in the wrong spot and spoils the whole calculation.

In an attempt to make reactance charts easier to use in audio circuit design, I studied all the reactance charts I could find, and then developed the two charts shown here specifically for audio applications.



Simplified reactance nomogram for solving low-frequency-cutoff problems in audio design work. Note that the resistance scale shows only standard 20%-tolerance values, and that the response is down 3 db at the cutoff frequency F.

The first feature of these charts is that they separate the audio spectrum into two parts. The low-frequency chart, covering 10 cycles to 1 kc, is intended for design problems where the frequency response must drop off *below* a certain frequency. And the high-frequency chart, which covers 1 kc to 100 kc, is intended for design problems where the frequency response drops off *above* a certain frequency. With two charts there is no unnecessary information to confuse things and in addition, the frequency scale is stretched out for easier reading.

To make these charts even simpler to use, the only reactance considered is *capacitive* reactance, since the usual audio circuit contains so many more capacitors than inductors. The output transformer is generally the only inductance which carries audio frequencies, and there is very little to be lost and much to be gained in simplicity of operation by omitting inductive reactance entirely.

Probably the most novel feature is the use of commercial resistor values instead of the customary logarithmic scales of ten. Each value of resistance is given in one of the standard ± 20% RTMA values, which works out much better than the usual chart, where the user has to fit the commercial resistor values into the decimal type of division. Also note that each scale is identified specifically as ohms, microfarads, or cycles per second. This eliminates all possibility of error in selecting a position for the decimal point.

As a final aid to easier operation, each chart includes a basic circuit diagram and a frequency-response curve for a specific single-section resistance-capacitance filter. For example, the low-frequency chart shows a series capacitor and a shunt resistance (the same as the coupling circuit between a plate and the following grid in a resistance-coupled amplifier). The frequency-response curve on this reactance chart makes it possible to draw the response curve for any combination of resistance and capacitance given on the chart. A similar basic circuit and response curve are given on the high-frequency chart.

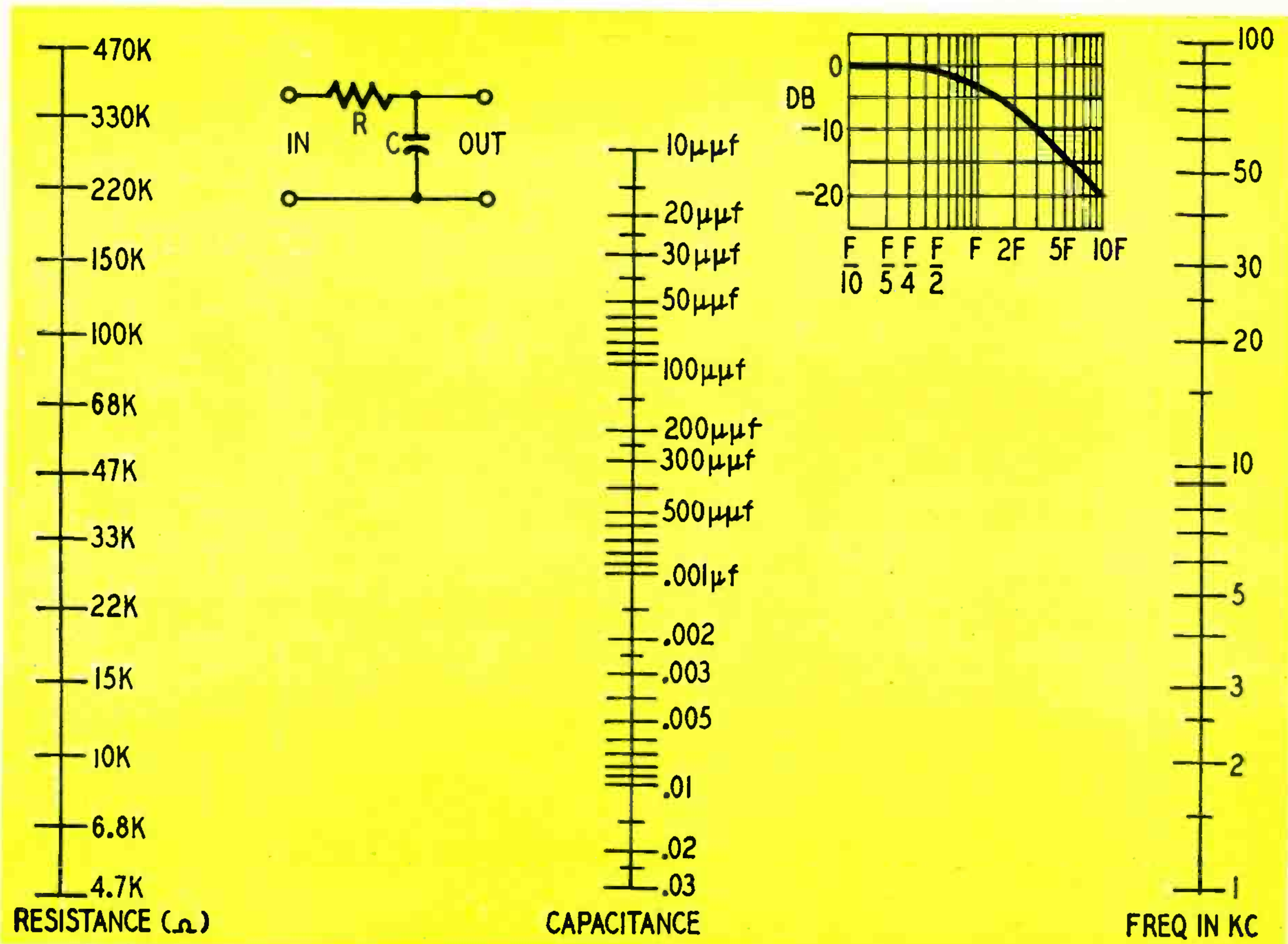
Applications

In using these charts to design an amplifier, sound system, or modulator, the first question to be settled is usually something like this: "What frequencies do we want to pass, and what frequencies do we want to discard?"

Take a low-frequency problem as an illustration. In amateur phone transmission, some operators like to cut their speech response below 300 cycles to improve their intelligibility and help punch through QRM. Voice frequencies below 300 cycles require considerable power to transmit, but actually contribute very little to maintaining communication under difficulties. Therefore these frequencies can be discarded in order to use the remaining speech frequencies more effectively.

The first thing to do, then, in this sample use of the low-frequency reactance chart, is to decide that the frequencies below 300 cycles are to be reduced, and the next thing is to refer to the chart itself. The basic circuit diagram in the upper left corner of the chart is identical to the coupling circuit between the plate of one stage and the grid of the next, so it will be necessary only to pick the correct values for a coupling capacitor and grid resistor in the modulator to get the desired response in this part of the circuit.

To find these values, just lay a straightedge across the low-frequency reactance chart, with one end of the



The high-frequency section of the simplified reactance nomogram. To use either chart, merely lay a straightedge across the values desired on any two scales. The straightedge will intersect the third scale at the corresponding value of R, C, or F for the circuit shown. Examples and further instructions for using these reactance nomograms are given in the text.

straightedge at 300 cycles and the other end at one of the commercial values of resistance. For example, if a 1-megohm grid resistor is to be used, reference to the capacitance graduations shows that a 500-μμf coupling capacitor is required. If no 500-μμf capacitor is available, a .001-μf capacitor and a 470,000-ohm grid resistor will do exactly the same job.

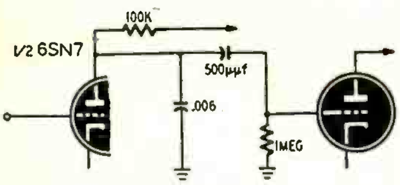


Fig 1—Part of a communications-type modulator with values derived from the reactance charts for reducing non-essential speech frequency components below 300 cycles and above 3 kilocycles.

To see how this affects the frequency response, refer to the response curve in the upper right corner of the chart. A little mental calculation shows that if the value indicated as F is 300 cycles, the response is down 6 db at F/2, or 150 cycles, and is down 12 db at F/4, or 75 cycles. A complete low-frequency response curve for this part of the modulator can be drawn up by simply substituting the specific frequencies in this curve, as will be shown in a few moments.

The high-frequency problems of an amateur phone transmitter are somewhat similar to the low-frequency problems. In amateur communication, cutting off the frequencies above 3,000 cycles can eliminate a great deal of sideband interference. The signal will sound the same when tuned in on a communications receiver, but the operator who is trying to pull in a weak signal a few kilocycles away will have less trouble from interference. By discarding frequencies above 3,000 cycles, the weaker station has a chance to be heard without interference from modulation sidebands spreading 4 or 5 kilocycles on either side of the stronger carrier. So for this illustration, let's decide to reduce the response at frequencies above 3,000 cycles, and to do this, refer to the high-frequency reactance chart.

The circuit digram on the high-frequency reactance chart may not look as familiar as the one shown for the low frequencies. However, if the resistance R is the plate resistance of one stage, and a shunting capacitance C is added to the circuit (if it is not already present as stray wiring capacitance and as the input capacitance of the next stage), the combination of plate resistance and shunting capacitance becomes exactly like the combination shown in the circuit.

Let's assume that the first stage is a low-mu triode, such as one section of a 6SN7, with a load resistance of 100,000 ohms. The tube manuals show that the plate resistance of one section of a 6SN7 is 7,700 ohms, which is so much lower than the load resistance that the 7,700-ohm plate resistance becomes the controlling value. Therefore, if we lay a straightedge across the high-frequency reactance chart between 3,000 cycles and 7,700 ohms, the resulting value of capacitance is .006 μf. A .006-μf capacitor between plate and ground will reduce the response at frequencies above 3,000 cycles. The frequency-response curve on the chart shows that if the frequency F is 3,000 cycles, the response will be down 6 db at 2F, or 6,000 cycles.

These samples of low-frequency and high-frequency calculations are summed up in the schematic diagram of Fig. 1, which shows the essential elements of the circuit that results. The frequency response of this part of the modulator is shown in Fig. 2, and includes both the high-frequency and the low-frequency characteristics.

This is the simplest possible circuit for this particular job, because it requires only one additional component—the .006-μf capacitor. The rest of the circuit requires only specific values for

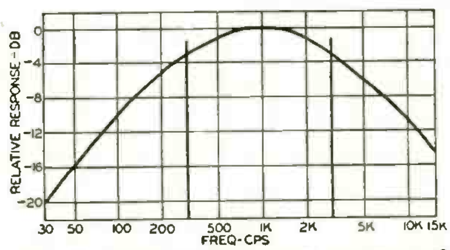


Fig. 2—Over-all frequency response of the a.f. circuit section shown in Fig. 1.

components that are in all resistance-coupled amplifier circuits no matter what the desired response may be.

Music systems

It's in the reproduction of music that the right frequency response can pay big dividends. And, surprisingly enough, the best amplifier for a given installation is not always the one with the widest frequency response. Instead, it is usually the amplifier designed to match the characteristics of the input signal, and the characteristics of the speaker and its enclosure. Here's where reactance charts can simplify the design problems.

For example, consider the low-frequency problems. Any loudspeaker, in almost any enclosure, has a tendency to generate large amounts of distortion and cross modulation near its low-frequency limit of response. If the speaker is ineffective below 90 cycles in its enclosure, cutting the response of the amplifier below 90 cycles often gives much cleaner bass response.

This strange result is actually very logical. Below 90 cycles the speaker cone just swooshes back and forth without radiating anything that can be heard. But if the speaker cone is called on by the program to do some fancy swooshing near 50 or 60 cycles, the resulting high-amplitude movements generate enough cross modulation and distortion to make crisp, clean, bass reproduction impossible—and all because of frequencies that wouldn't be heard anyway. It's obviously much better to reduce the response below 90 cycles. It doesn't cost anything, and the results are often well worth the effort.

Even if the music to be reproduced has no components below the low-frequency limit of the speaker, there are always low-frequency noises like turntable rumble, power-supply hum, and even voltage surges on the power line. These noises may not be audible by themselves but they can still be a very potent cause of fuzzy, indistinct, bass response by contributing harmonics and cross-modulation products in the audible range.

To reduce the low-frequency response in this case, use the low-frequency reactance chart in exactly the same manner as in the modulator design. A few moments with the straight-edge show that a .0025-μf coupling capacitor, and a grid resistor of 680,000 ohms will drop the response below 90 cycles as planned.

Reducing the high-frequency response may also improve the quality in certain cases. For example, in AM broadcasting, there is often nothing but noise and distortion above 5,000 cycles. The same thing is true with 78-r.p.m. records above (roughly) 7,000 cycles. And an inexpensive crystal pickup often has a sharp resonance peak anywhere from 4,000 cycles up, which artificially boosts the needle scratch near that frequency and gives the music a harsh quality.

The response of the speaker itself at high frequencies is also important. If you study a speaker response curve closely, you will find that the response becomes more and more irregular as the frequency increases. The curve becomes especially jagged near the upper limit of the speaker response, and then drops off irregularly. These jagged peaks often add unnatural harshness to reproduced music. The harshness may not be apparent at first, but if the music is fatiguing after a half hour or so of listening, these irregular peaks may be partly at fault. Here's another case where proper high-frequency response can improve the reproduction.

There's another very important point in this connection, and that has to do with harmonic distortion. It is these upper audio frequencies which contain the harmonic-distortion components, and a well-chosen high-frequency response can actually improve the distortion figure of the amplifier.

As an example, let's assume that the

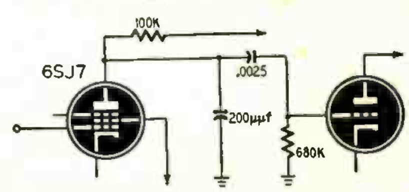


Fig. 3—Music-system amplifier designed to reduce speaker and record distortion by attenuating audio frequencies below 90 cycles and above 7,000 cycles.

music to be reproduced has nothing of interest beyond about 7,000 cycles. This would apply to the type of PA system usually rented for dances with 78-r.p.m. records, for example. To have definite figures, we'll further assume that the input tube is a pentode, such as a 6SJ7, operating with a load resistance of 100,000 ohms. The tube manuals show the plate resistance of a 6SJ7 to be over 1 megohm, which is so much higher than the 100,000-ohm load resistance that the *load resistance* becomes the controlling value. By laying a straightedge between 7,000 cycles and 100,000 ohms on the high-frequency reactance chart, the capacitance can be read directly as 200 μμf. This capacitance would be used as shown in the circuit of Fig. 3, with the over-all frequency response (including the low-frequency characteristics) shown in Fig. 4.

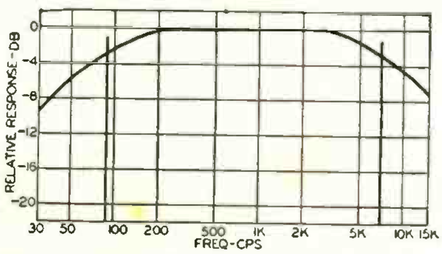


Fig. 4—Over-all frequency response of the amplifier stage shown in Fig. 3.

This, too, is the simplest possible circuit for the job, because it requires only one additional component, the 200 μμf capacitor.

There's one situation that still hasn't been considered, and which might be troublesome. If the input tube in this last example is a high-mu triode, such as one section of a 6SL7, with the same load resistance of 100,000 ohms, an added problem is introduced. In this case, the tube manuals show the plate resistance to be 44,000 ohms, which means that the plate resistance and the load resistance are so close together in value that neither one can be ignored. Therefore, it is necessary to calculate the resistance of the two in parallel, which turns out to be close to 30,000 ohms. Now if the straightedge is laid across the chart to intersect the values of 7,000 cycles and 30,000 ohms, the appropriate capacitance is 700 μμf, instead of the 200 μμf used with the pentode.

These reactance charts are not limited to these two applications, but can apply to any situation where the effects of resistance combined with capacitance are to be found in terms of frequency. This includes such problems as designing equalizers for phonograph pickups, designing correction networks for the frequency characteristics of a room, building up simple low-pass or high-pass filters, and the like. The only practical restriction is in the design of feedback amplifiers. The information built into these charts is not sufficient to predict the response with feedback when the resistance and capacitance elements involved are in the feedback loop. END

BOOKSHELF ENCLOSURE FOR GOOD BASS

Some hi-fi fans are not getting the best from their audio equipment because they lack space for the large enclosure which they believe necessary for good bass. In many instances, the need for a really good enclosure can be met by the R-J-type 8-inch bookshelf speaker cabinet in Fig. 1 and 2. The frame is made from ½-inch 5-ply wood. Pieces G, H, and J are cut to length from ¾-inch square stock. Fiberglas acoustic material about ½ inch thick is placed on the bottom, back, and the end of the enclosure away from the speaker. The acoustic lining should be cut so that it covers one-half to three-quarters of the total surface of the piece on which it is mounted.

The speaker mounts over a 6¾-inch circular cutout in the center of K. The speaker opening in the front panel (F) is centered over the cutout in K and is laid out by transferring the outline shown in Fig. 2 to a sheet of ¼-inch cross-section paper fastened to one end of the front panel.

Materials for enclosure

NUMBER OF PIECES	DIMENSIONS IN INCHES	USE
2	10 x 23½ x ½	A and B
2	10 x 10 x ½	C and D
2	10 x 22½ x ½	E and F
4	9 x ¾ x ¾	G
4	21 x ¾ x ¾	H
2	8½ x ¾ x ¾	J
1	10 x 10 x ½	K

Note: A, B, C, D, E, F, and K are 5-ply, ½-inch plywood. G, H, and J are cut from ¾-inch stock.

The dimensions and drawings for the top, bottom, and sides are for standard box-type joints which should be held firmly together with glue and screws or dowels. If you have woodworking equipment to handle the job, you can make the top and bottom joints as shown in the circled drawings. The front panel should be cut for a tight fit into the recess formed by the sides, top, and bottom and then glued and screwed in place. The back (E) is fastened on with screws which may be removed for mounting the speaker. Note that the ¾-inch square pieces are used in all corners except the two between the front and sides C and D. END

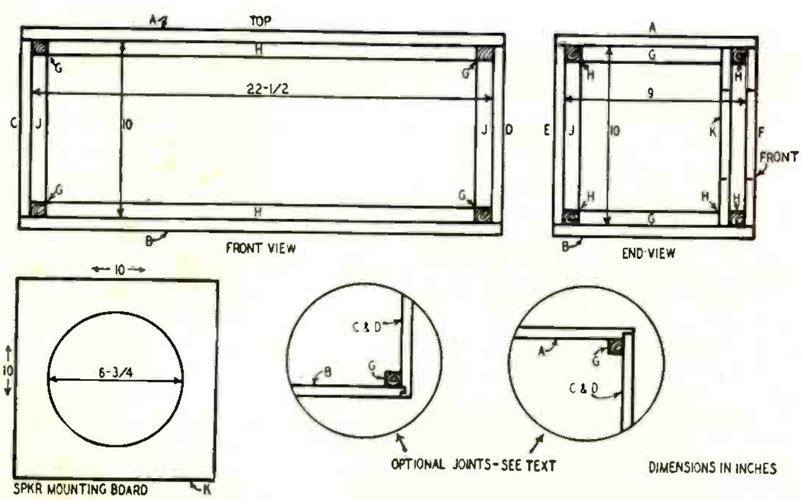


Fig. 1—The construction of a bookshelf-type cabinet for an 8-inch speaker. The ¾-inch blocks are used in all corners except where sides C and D meet front F.

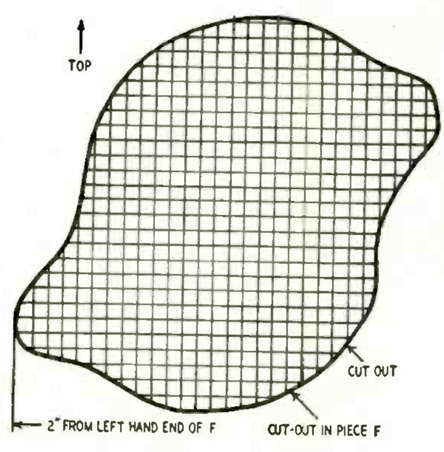


Fig. 2—Opening in front panel. Transfer each point on drawing to a grid of ¼-inch squares on F. Connect all points by smooth lines. Cut out and sand edges.

The importance of BALANCE in push-pull amplifiers

Suggestions for getting maximum output quality from high-fidelity units

By JOSEPH MARSHALL

INVERSE feedback is unquestionably the most valuable high-fidelity tool developed in our generation. The improvements it has made possible are almost magical when viewed in the perspective of the days before feedback. Unfortunately, the tendency has been to consider it a cure-all for any and all high-fidelity problems. If it is not included in a design to begin with, it is thrown in quickly as soon as something goes wrong.

I do not mean to disparage feedback in the slightest, but its versatility and effectiveness have tended to obscure a number of other basic principles in amplifier design. Observing these principles will greatly reduce the probability of a high-fidelity design going wrong in the first place, and makes the application of feedback much simpler and considerably more effective. One of these basic principles is the need for balance in push-pull amplifiers.

The great virtue of the push-pull amplifier in audio design is its ability to cancel even-order harmonic distortion. This feature allows us to drive the tubes harder and get more than twice the output of a single tube if we wish. It also improves the low-frequency response by reducing unbalanced d.c. in the output transformer primary which might saturate the core and reduce the inductance of the windings. In addition, push-pull operation almost entirely eliminates hum and noise from the power supply, but still the principal reason for using it is the distortion-canceling feature. It sounds simple: merely hook up two tubes in push-pull and you cancel second-harmonic and all other even-order distortion, thus disposing of the largest portion of distortion at one crack.

Unfortunately, this does not always follow as inescapably as day follows night. In fact, it is a very rare push-pull amplifier which fully exploits these distortion-canceling characteristics. Very few of them realize even 75% of the possible benefits; and many push-pull amplifiers produce even more distortion than a properly designed single-ended amplifier.

The fact that a push-pull amplifier utilizes only 75% of the distortion-canceling abilities of the circuit may not be serious in speech-range public-address equipment. But in high-fidelity amplifiers enjoyment of the wide frequency response is entirely dependent on reducing distortion to an absolute minimum. The amplitude of most music and voice sounds around and above 10,000 cycles is normally 30 or 40 db below the average sound level. Even 1% distortion of mid-range sounds would be louder than the normal h.f. components, and would not only mask them but also make them annoying to hear. To insure acceptable reproduction of the high frequencies, distortion must be reduced to the smallest possible fraction of 1%. This improvement is easily attainable by making the most efficient use of push-pull design.

The distortion-canceling property of a push-pull amplifier depends entirely on balance. Complete cancellation is achieved only when equal signals are fed to both sides, when both sides amplify equally, and when both produce the same amount of distortion. On the other hand, if the output and distortion of one side are 10% greater than the other, at best only 90% of the distortion is canceled.

The situation actually becomes even worse at some points in the dynamic range, especially at the points of maximum drive. For instance, suppose we deliver equal signals to both sides, but that one side is overbiased, either because the tube draws more current, or because its cathode resistor is higher than that of the other tube. Thus the overbiased tube reaches the bend of its curve before the other, and may generate 5% or more second-harmonic distortion while the correctly biased tube generates only 1%. After cancellation we have one side passing on a signal with 4% distortion, while the other side has none. From a distortion point of view, the amplifier would be much better if the overbiased section were not functioning at all—in other words, if it were an unbalanced single-ended stage.

Theoretically, it's simple to achieve complete cancellation; in practice, however, it may call for rather heroic measures.

Static balance

It is easier to get balance with transformer coupling than with resistance coupling. In high-quality transformers the turns ratios and d.c. resistances of the two sides are balanced to 1% or better; even the cheaper ones are not more than 3 or 4% out of balance. However, an input or output transformer does not automatically insure balance. In the first place, it is difficult to obtain identical tubes, and if one tube draws more current than the other, the two sections will be unbalanced. It is easy to get *static* balance by adjusting the bias voltages of the individual tubes so that both draw equal no-signal currents. This, of course, is fairly standard procedure. Almost all good power amplifiers have some means of adjusting the bias to the output tubes. But for minimum distortion, the driver stage should also be balanced.

Two ways of doing this easily and inexpensively are shown in Fig. 1. At *a* we use a small potentiometer ahead of a common bias resistor. By adjusting in one direction or the other from center, both tubes can be made to draw equal currents under static conditions. In *b* the two tubes have separate bias resistors, but one of these is adjustable.

Note that the circuit at *a* includes a bypass capacitor across the common bias resistor. No doubt you have read that such a bypass capacitor is not really necessary in push-pull stages. As a matter of fact, *if* the stage operates at a low level—one which never approaches the bend of the tube curves and therefore generates little or no distortion—a common *unbypassed* cathode resistor serves as a balancing device. However, if the stage is operated at signal levels high enough to produce distortion, the bypass capacitor is absolutely essential.

Harmonics cancel only where they appear out of phase. This is true in the output circuit, But the cathode resistor

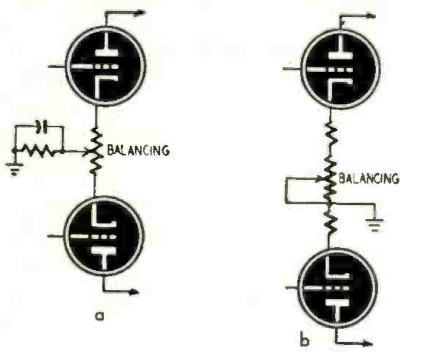


Fig. 1—Static balancing arrangements for push-pull amplifiers. (a) Mutual bias potentiometer with bypass for common cathode resistor. (b) Balance adjustment in one cathode without bypassing. See text for complete analysis.

is common to both the input and output circuits. In the cathode circuit the even-order output harmonics from one side of the stage appear *in phase* with the input signal of the other side. This is a form of positive feedback. The in-phase harmonics add themselves to the input signal and are amplified by the stage, producing a very serious form of distortion. This may not be important in cheap amplifiers, but it is most objectionable in high-fidelity designs.

We have seen a number of 6B4 amplifiers with large amounts of inverse feedback, which sounded terrible for this reason. These tubes need nearly 150 volts drive grid-to-grid. To produce this much, even with an interstage transformer, the drivers themselves have to be driven well into the nonlinear portions of their curves, generating a great deal of distortion. Fed back through the common cathode resistor, this distortion was not affected by the feedback network and was amplified to such an extent that there was much more distortion than the 6B4's would normally produce by themselves. For this reason, it should be routine to include a large bypass capacitor across common bias resistors in all high-level stages of high-fidelity amplifiers.

On the other hand, in amplifiers where the driver has to deliver only moderate voltage to the following stage, the circuit of *b* with separate unbypassed cathode resistors is preferable. Since the positive feedback referred to previously is present only with a common cathode resistor, an unbypassed resistor for a single section will not produce it. In addition, omitting the capacitors gives a small amount of negative feedback which helps preserve the balance and improves the frequency response as well.

Dynamic balance

Unfortunately, *static* balance is not necessarily *dynamic* balance. A stage which is balanced perfectly at zero input or at some fixed value of signal input will probably be out of balance somewhere in its dynamic or frequency range. Even a change in line voltage may throw the sides out of balance; and a stage balanced at zero input will almost invariably be out of balance at maximum input. An amplifier with plate-current meters in all plate circuits and means for controlling bias and plate voltages is very instructive in this respect.

The simplest way to check balance is to connect a high-resistance voltmeter from plate to plate of the stage to be balanced. Balance is indicated by zero voltage: adjust the balancing potentiometer until the meter indicates no voltage difference between the two sections. (This assumes that the d.c. resistances of the two halves of the push-pull plate load are equal.) This is most dramatically visible with power stages but is also true of voltage amplifiers.

Aside from negative feedback, there is another expedient which may be used to get approximate dynamic balance. This is shown in Fig. 2 and is an unbypassed choke of about 25 henries in series with the center-tap of the output transformer or the junction of the plate-load resistors. (A resistor may also be used this way, though it is not as effective as the choke.) Its operation is quite simple. The choke (or resistor) is an impedance common to both sides of the push-pull stage. As long as the currents flowing through both tubes are identical, there will be identical voltage drops for both tubes in the common choke. The moment one tube begins to draw more or less current, the voltage drop across the choke will increase or decrease as the case may be. This in turn will change the current of the other tube in the *opposite* direction, thus bringing the total voltage drop closer to the original. The same thing will apply of course to the a.c. currents generated in the plate circuit, so that both the d.c. parameters and the a.c. signal are kept much more closely in balance than if the common impedance were not there.

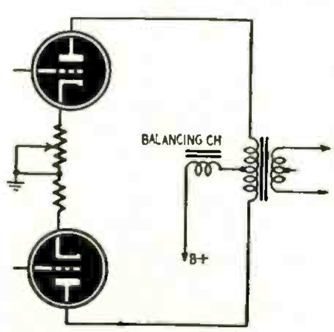


Fig. 2—Inserting a high impedance in the common B plus return improves balance by equalizing plate-current variations in the two sides of the circuit.

This method will not guarantee absolutely perfect balance, but even an arbitrary inductance value of 15 to 25 henries will improve the dynamic balance by a very large factor. This method works well in class A output stages. Whether it should be used in AB operation is another matter. It would improve the dynamic balance over the class A portion of the range; but the reduced regulation in the high-output class AB region might be deleterious. We have found it satisfactory and even valuable in several amplifiers. Many of the tubes used in power stages, especially the transmitting types, may have a variation as great as 5 ma between the two sides. Although they can be brought to static balance by adjusting

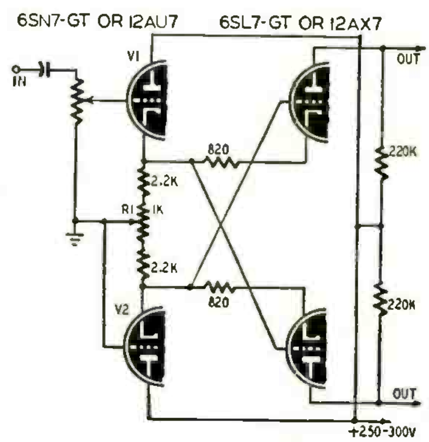


Fig. 3—Cross-coupled phase inverter with cathode balancing potentiometer.

the bias, they are very likely to produce severe unbalance and distortion at maximum output. The common choke reduces this materially without too much sacrifice of output power.

Balancing R-C Stages

The problem of balancing resistance-coupled push-pull stages is a little more troublesome. All the methods described above can and should be applied to R-C amplifiers as well as to transformer-coupled types, provided the much more serious unbalance due to unequal component parameters is also taken care of. One way to solve this is to use precision (1% or better) resistors in the grid and plate circuits, and to balance the cathode circuits by the methods shown in

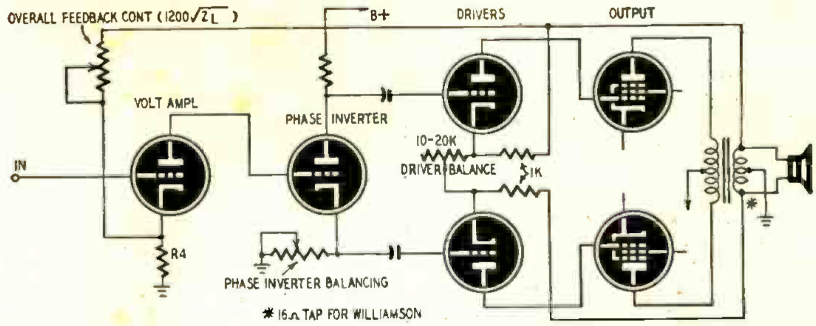


Fig. 5—A combination of balancing arrangements for a Williamson-type amplifier. The adjustable cathode resistor in the phase inverter equalizes the outputs to the driver grids. Feedback from the output-transformer secondary to the driver cathodes helps equalize the push-pull stages. See discussion in the text. Only components essential to the discussion are shown in this schematic.

Fig. 1. It goes without saying that the use of anything but matched pairs is out of the question in a high-fidelity amplifier—but it is not necessary to go to the expense of precision resistors. Ordinary 10% or even 20% resistors can be checked carefully on a bridge or an ohmmeter, to find pairs which match within 1 or 2%. Balance is much more important than actual value. Whether a plate-load resistor is 250,000 ohms or only 200,000 ohms is generally immaterial, as long as the two on opposite sides of the same push-pull stage are as nearly identical as possible. The improvement obtainable in an amplifier by replacing random-value resistors with matched pairs is quite astonishing, especially at maximum output. To a lesser degree, the same thing is true of coupling capacitors, although here the improvement is in frequency balance.

Phase inverters

We come now to a matter of quite serious importance: balance in the phase inverter. It is obvious that no matter how well balanced the succeeding stages are, if the stage which originates the push-pull signal is not balanced, and therefore delivers unequal signals to the two sides, all the balancing work is undone, as far as canceling distortion is concerned. This problem has been discussed many times in this and other periodicals.

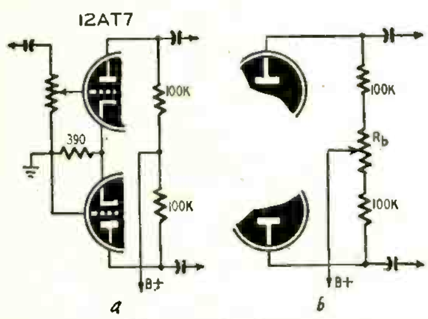


Fig. 4—(a) Basic cathode-coupled phase inverter. (b) Balancing potentiomer inserted in phase-inverter output circuit.

The most foolproof phase inverter is a good center-tapped transformer. True, a transformer with wide-range frequency response is expensive and bulky; but it will supply signals balanced to 1% or better. Only one vacuum-tube phase inverter we know of can approach a transformer in this respect. This is the cross-coupled inverter diagrammed in Fig. 3. By adjusting R1, the output can be balanced to 1% or even better, and the balance holds over its entire dynamic range. A simple way to balance it is to unground the grid of V2 and connect it to the grid of V1. Now feed in any signal and adjust R1 until the signal is inaudible or has minimum value at the output.

The second-best tube-type phase inverter is the cathode-coupled circuit given in Fig. 4-a. Theoretically, the output will be balanced if the plate resistors on both sides are identical. In practice a balance within 5% is achievable. A simple way to balance this inverter is to insert a potentiometer (R_b) between the two load resistors as shown at *b*, and adjust for equal outputs.

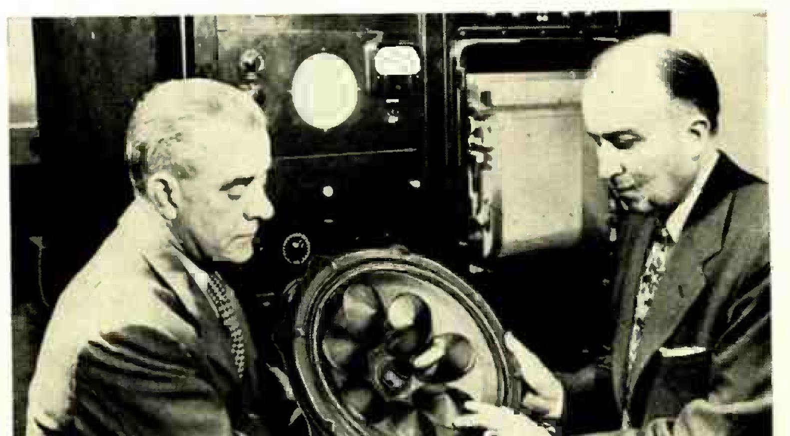
The split-load inverter used in the Williamson and other amplifiers can be balanced by making the cathode resistor variable and adjusting it for equal outputs from cathode and plate. This inverter is not balanced perfectly at high frequencies but this is said not to be serious. In any case, whichever circuit is used, the resistors in the two sides should match as closely as possible.

Feedback balancing

There is one more tool for balancing which remains for discussion and that is inverse feedback. It is the most important single corrective and, moreover, it produces dynamic rather than static balance. (More important, perhaps, it produces frequency balance as well.) To be effective in balancing, inverse feedback itself must be balanced. The single-ended type of feedback used in the Williamson circuit is not effective for balancing, although it is effective in reducing distortion by other means.

The ideal amplifier should have two feedback networks: one for balancing push-pull stages, and another to the input of the amplifier, for over-all frequency correction and distortion cancellation. For example, in the Williamson circuit balanced feedback could be applied to the driver cathodes by using an output transformer with a center-tapped secondary or split output windings. See Fig. 5. This is in addition to the feedback to the cathode of the input stage. About 10 db of feedback could be applied to the drivers and another 10 db to the input stage. In this way, and in conjunction with the other balancing measures described, we could combine the distortion-canceling properties of push-pull operation with those of inverse feedback, and presumably produce an amplifier with the absolute minimum of distortion.

In any case, the first and most important goal in high-fidelity design is to reduce distortion to the point where it cannot mar the enjoyment of a wide frequency range, which in itself is relatively simple to achieve. In approaching this goal, the use to the fullest extent of the distortion-canceling feature of push-pull amplifiers is an important and relatively inexpensive step that should be taken by all designers who want highest possible fidelity. END



New RCA LC-1A high-fidelity speaker shown here by Dr. H. F. Olson (right) and John Preston, co-developer, has irregularly spaced deflector domes mounted on its 15-inch main diaphragm to break up symmetrical standing-wave interference patterns and flatten the frequency response.

TELEVISION? ...it's a cinch!

From the original "La Télévision? . . . Mais c'est très simple!" Translated from the French by Fred Shunaman.

By E. AISBERG

Fifth Conversation:

Sawing into the heart of a deflection system—electromechanical or all-electronic sweep? Some problems of time and supersonic speeds

KEN—Just what's going on now? Why the important, secretive air?

WILL—Nothing in particular! I'm just getting ready to take out a patent, that's all . . .

KEN—A patent! I'd like to see the invention you'd turn out! May I ask just what scientific field you've selected to turn your genius loose in?

WILL—Television, of course. Ever since the last time we talked, it's been getting me more and more excited! You've been moving pretty slow with your explanations of how it works, so I've been digging into it myself. That's how I happened to invent my "rotating deflector."

KEN—Rotating deflector? That sure sounds like something new. I don't think I ever heard of anything like it.

WILL—I can trust you, Ken, so I'll tell you my idea. Strictly confidential, of course. Ever since we talked about electrostatic and magnetic deflection, I've been thinking hard about the way the spot is swept to make the lines of a frame . . .

KEN—Yes, we did cover that question in our third conversation, when we were studying the electrostatic deflection tube.

WILL—I remember it very well. You have to apply a voltage that starts negative and gets steadily more positive, to move the spot from left to right at a uniform speed. Then we have to get the spot back almost instantly, so we have to drop quickly back to the original negative value, and start all over again.

KEN—Do you think you can draw a figure showing that kind of voltage?

WILL—Sure! The passage from the negative voltage, –V, to the positive voltage, +V, is made at a constant rate, so the spot will move steadily across the screen, without changing its speed. So, on this graph, we make a straight line rising progressively from –V to +V, in time *t*, which is the duration of one line on the screen. The straight vertical line represents the almost instant change back to the starting value that brings the spot back again. And then the whole thing repeats.

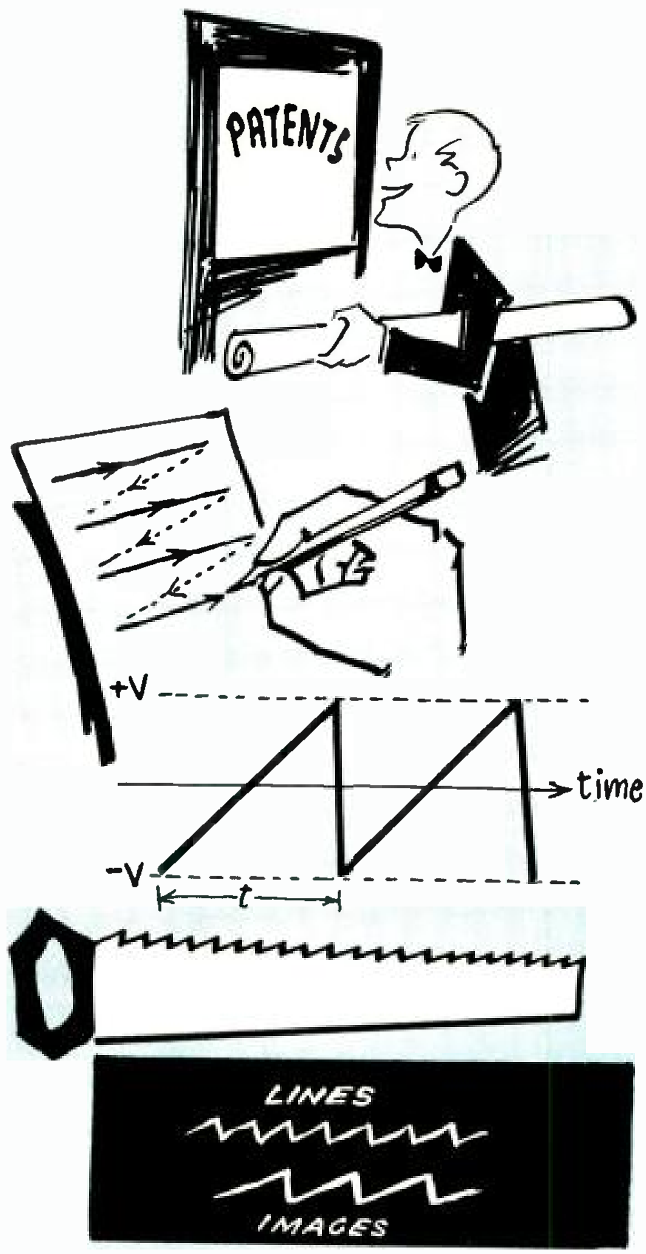
The electronic saw

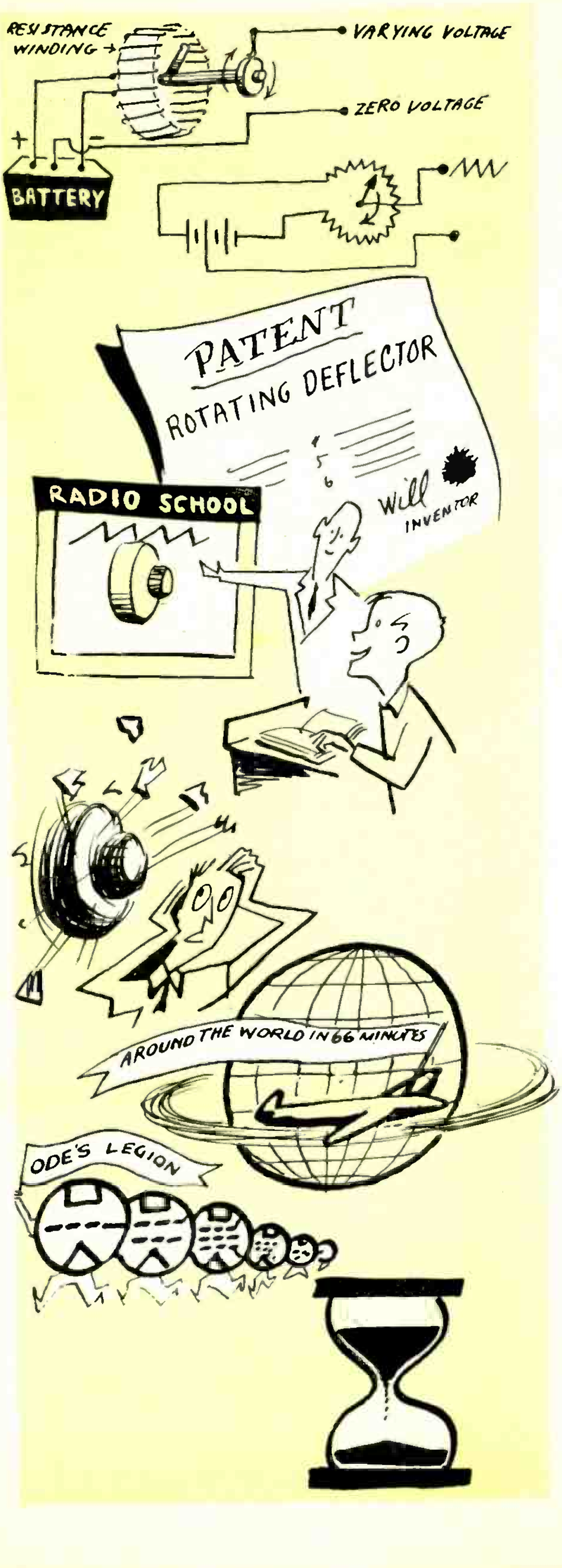
KEN—Does the shape of that line you've just drawn remind you of anything?

WILL—Yes, it's called a "sawtooth voltage," though I suppose on magnetic deflection tubes you'd have to use a sawtooth current?

KEN—Quite right.

WILL—And the same type of voltage (or current) deflects the spot in the vertical direction. However, the frequency is much lower, for it determines the number of pictures (or in the interlaced system, the number of half-pictures) a second.





KEN—I can see you really *have* been thinking about this problem. But none of this explains your "rotating deflector."

WILL—We're getting to it. The device which I have the honor of presenting to you is a sawtooth generator for both horizontal and vertical spot deflection. It's composed essentially of a cylinder of insulating material on which is wound a toroid of resistance wire. A shaft is placed along the axis of the cylinder. As this shaft rotates, a contact attached to it makes contact with the resistance wire on the interior face (or one edge) of the cylinder.

KEN—Once you've stripped the Patent Office language off this device of yours, I can't see that we have anything more than an ordinary potentiometer, of the type used for volume controls in some old radios.

WILL—Exactly! The only difference between my potentiometer and any other is that it has no stops, so the contact can keep turning continuously in the same direction.

KEN—But just what is this remarkable invention going to do?

WILL—Haven't you already gathered, Ken, that I intend to put a battery or other voltage source across the ends of my potentiometer? Then, as the contact moves, it passes progressively from a high negative to a high positive voltage; and, as it passes the last wire, it snaps back instantly to the negative voltage, as required in a TV deflection system.

Weakness of a mechanical system

KEN—Congratulations, Will. The idea (in itself) is good, and I've actually seen a demonstration apparatus in a radio school that worked exactly that way.

WILL—That's not all there is to the idea. I'm going to turn this potentiometer with a motor which will make exactly 60 turns per second, to give the correct vertical deflection voltage. Then, with a system of gears, another potentiometer will be turned to give the horizontal deflection.

KEN—Just what would your gear ratio have to be, and how fast would that make your second potentiometer turn?

WILL—That's not hard to figure out. With two fields a frame, the ratio would have to be 2 to 525, or 262½ to 1. And the speed of the second pot would be 525 times 60, or 31,500 turns. . .

KEN—. . . per second! Or a little less than two million r.p.m.! Just what kind of a gear are you going to get that will hold together at that speed? And wouldn't your resistance wire wear out a trifle fast?

WILL—Now, why didn't I think of that? Well, just another good idea gone wrong. So I guess we'll just have to toss mechanical methods on the junk pile and use some 100% electronic method . . .

KEN—When you bet on electronics, you win! Only an electron can move fast enough to do what's needed at TV sweep frequencies. Suppose you have a 16-inch tube—the line is just a little more than a foot long. The spot goes across the screen—and back—525 times a frame, or 1,050 times. And there are 30 frames a second. Figure it out, and you'll find that the spot is moving a little faster than 6 miles a second. At that rate, it would travel around the earth at the equator in very little more than an hour!

The electronic hourglass

WILL—Boy, when this army of 'odes—the pentodes, triodes, diodes, and all the rest—get under way, supersonic planes just don't move compared to them!

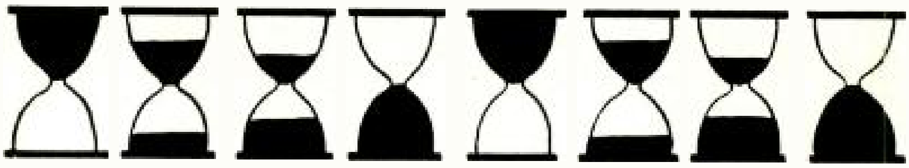
KEN—Actually, tubes play only a subordinate part in these time-bases, sweep circuits, or sawtooth generators, as they are called.

WILL—What a flock of queer names! But why time-bases? Is that because the voltages increase proportionately with time?

KEN—Probably. But whatever you call them, we need voltages that increase linearly with time, like those you've just drawn.

WILL—This time-base, then is a sort of hourglass where the grains of sand are replaced by electrons?

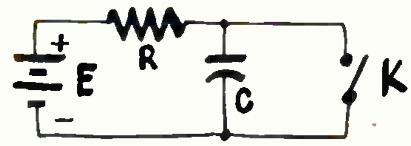
KEN—It's a good picture! Just as the amount of sand in



the bottom half of the glass increases steadily till—just as all the sand has run out—you turn the glass over and the bottom half is suddenly empty again, so in the time-base generator, the current charges a capacitor steadily till the moment of discharge. Then it also becomes suddenly "empty" and the cycle starts again.

WILL—So, a time-base is mostly a capacitor, if I get you right. But why does it discharge faster than it charges?

KEN—Because you charge it through a resistor. Just picture a source of direct voltage E connected through a resistor R to a capacitor C. Here, I'll draw it. When you close the circuit, a current flows that starts to charge the capacitor to the same voltage as that of the source. But you don't get the full charge instantly, because the resistor limits the amount of current that can flow.

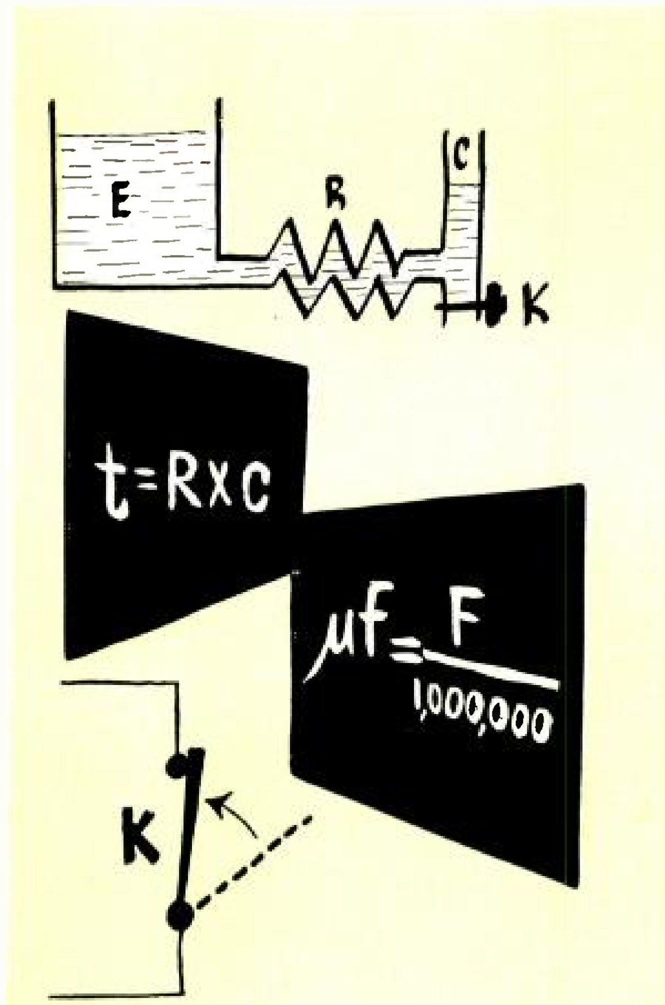


WILL—I guess you could compare that to a tank of water E connected through a thin pipe R to a smaller tank C at a lower level. When the valve is turned, C doesn't fill up immediately to the level of E because the pipe R prevents the water from rushing into it instantaneously.

KEN—Your comparisons are getting good today! And the bigger the tank E is in comparison with C, the better the comparison. In electrical terms, the job of charging the capacitor C shouldn't have any noticeable effect on the source voltage E.

WILL—It seems to me that the charging time depends on the capacitance at C as well as the size of the resistor R. The bigger C is, the more electrons you have to put in to charge it. Just the same as if you make the water tank C bigger, it will take more time for the water to reach the same level as E.

KEN—That's exactly why the product of resistance and capacitance (RC) is called the *time-constant* of the circuit. If you express R in ohms and C in farads (or R in megohms and C in microfarads, as we usually do in electronic calculations), this time-constant will give you, in seconds, the time it will take for the capacitor C to reach roughly ⅔ the voltage of the source.



WILL—So, with a resistance of 10,000 ohms and a capacitor of 2 microfarads, we'd have a time-constant of 20,000 seconds?

KEN—Not bad for a first approximation; you're only about a million times off! Didn't we say *ohms* and *farads*, or *megohms* and *microfarads*? Ten thousand ohms is .01 megohm, so your time-constant is 2x.01 or two-hundredths of a second!

WILL—Excuse the slight mistake! I see now that if we want our capacitor to discharge instantly, we have to have a very small resistance in circuit with it.

KEN—In actual practice, you close the key K, and put a dead short across the capacitor. (TO BE CONTINUED)

NO GOOD COLOR TV TUBE YET, SAYS SIRAGUSA

Production of color TV receivers before a satisfactory 3-color picture tube is available in mass quantities would be "a serious mistake," according to Ross D. Siragusa, president of Admiral Corporation. Speaking at a recent dinner in New York City, the Chicago executive said that his company's laboratories already have color-receiver circuits which produce excellent results—but the color tube is the chief problem. "Scientific progress cannot be produced or hastened by either congressional mandate or wishful thinking," said Mr. Siragusa. "The industry has to have the right color picture tube and the right tube simply doesn't exist at present. . . . In our laboratories we have color receivers with circuits which produce excellent results, but the color tube is the chief problem."

"Both of the two types available are handmade, bulky, and very costly. One does not give a color picture we consider satisfactory. The other is extremely complex, and has 12 critical interdependent adjustments for bringing the three colors into registration. That makes thousands of combinations of adjustments possible, only one of which is correct."

Mr. Siragusa added that one of Admiral's engineers had spent a year merely learning the technique of making the registration adjustments, and said that "when the color-tube problem is solved we will be able to manufacture sets at a price well within the reach of the great mass of American families."

UNUSUAL TV SERVICE CASES

A pretty pair of tricky ones—

Could you have cracked them?

THE PERSISTENT INTERMITTENT

The trouble was that lines or groups of lines were missing in the picture. Sometimes it appeared as though part of a frame were superimposed on the whole frame. Seldom did the picture lose either horizontal or vertical sync. Sometimes the video would be missing in one or several irregularly spaced bands, an inch or so wide. Occasionally the set would work perfectly for a week. Trouble was usually in the afternoon, seldom at night.

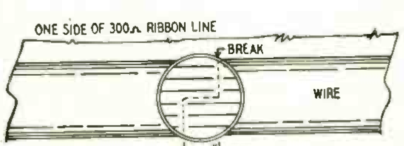
I worked (intermittently) on the problem for over a year. The set was bench tested several times. It was baked till the plastic installation was ready to drip. Capacitors were replaced. All to no effect. The set had a perfect bench record, but never failed to act up in the home. The afternoon cycle of interference was especially mystifying.

The trouble must be outside the set, I thought. I discovered that I could duplicate the video display by flicking the antenna terminals with a screwdriver. I decided the interference, whatever it was, must be coming in via the antenna. An ohmmeter was placed across the terminals of the 300-ohm lead. Violent gyration of the antenna and lead revealed nothing. Inch-by-inch inspection also produced no results.

An inside antenna was substituted for the outside one. Signals were weaker, but the trouble was still there. (The above tests were carried out at various times because of the intermittent nature of the trouble.)

After prolonged self-consultation I asked: "Could the trouble actually be in the old antenna and be radiating to the indoor one?" I shorted and grounded the outside lead. The set operated without a peep of interference.

Then we took down the line and placed each side across a storage battery. After a few seconds one side opened up! Only then was it revealed that the strands at one point were alternately broken so that they lapped each other by about a quarter of an inch. (See the drawing.) The lead went



up along the west wall of the house, and evidently in the afternoons the temperatures were high enough to expand the plastic and allow the wires to make and break contact in the wind. At night the plastic tightened and the wires made good contact.

The moral of this story is to short and ground out any suspected antenna when another is substituted!—*Edward P. Eardley*

THE UNEXPLAINABLE JITTER

My most unusual service job was on a Transvision model A chassis with a 12-inch tube. The complaint was a horizontal jitter in the picture. Close observation showed that the video information on random lines was displaced horizontally ¼ to ½ inch. The vertical edges of the raster were straight and did not tear but the picture information within the line moved back and forth. The jitter did not follow modulation on the sound channel.

After substituting tubes and checking resistors and capacitors, I hooked up the scope. With it, I detected a slight fuzziness on the peaks of the waveform anywhere in the horizontal sweep circuit from the sync amplifiers to the deflection yoke. The fuzziness on the waveform represented a voltage which was only about 2 to 5% of the total. I replaced the horizontal oscillator and flyback transformers and the yoke, one by one, without eliminating the trouble.

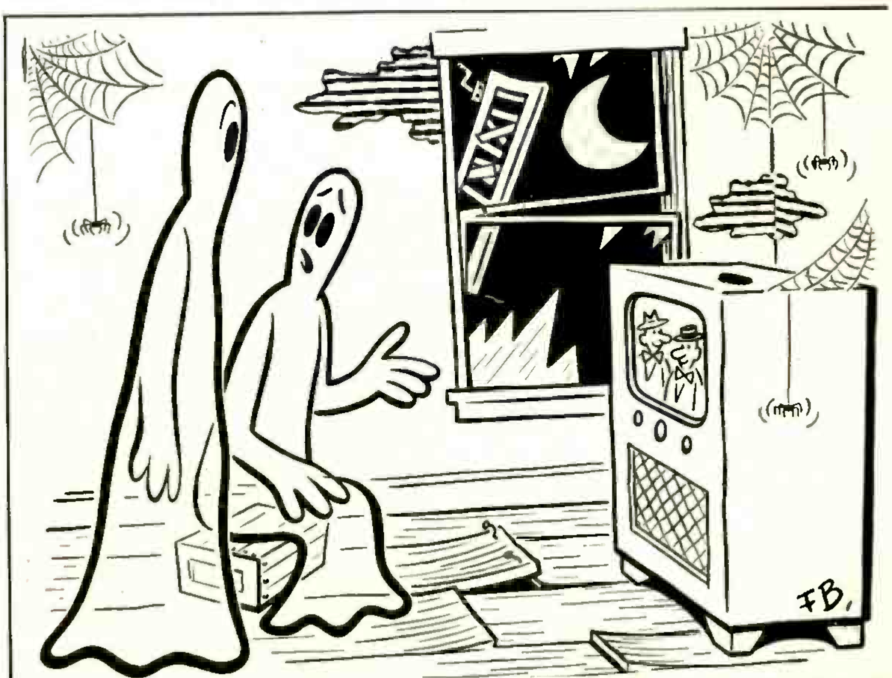
I left the TV set running on the bench while I stopped to do a quick job on a 5-tube a.c.-d.c. midget. As soon as the little set started working it picked up the usual warbling note from the horizontal sweep circuit of the TV set. Suddenly, I noticed a hissing and spitting noise in the background of the horizontal sweep radiation. *This unusual background noise was exactly in step with the interference in the picture.*

Now the path was clear! I made a probe consisting of a piece of shielded mike cable with the insulated center lead extending about 1 inch beyond the shield. The other end of the center conductor was connected to the antenna post of the AM set through a .001-μf capacitor and the shield was grounded to the radio chassis.

By placing the end of the probe close to the various components in the horizontal sweep circuit, I was able to detect the nature of the voltage in each. When the probe was placed close to the 47,000-ohm, 1-watt feedback resistor (between the damper-tube plate and the horizontal oscillator) the hissing was much louder. I changed this resistor and the trouble cleared up. I had previously checked this resistor and found that its resistance was right on the button.

After completing the repair job, I continued to experiment with the probe and found that this method of signal tracing can be extremely useful. I can probe anywhere in a TV set and get the characteristic sounds of each circuit. For example, there is the low-frequency buzz from the vertical circuits and the swishing from the video amplifiers.

I have found that the ear can detect foreign sounds that are 20 to 40 db below the level of the principal signal coming through. Such extraneous signals are often difficult to detect on a scope because it is a linear device and signals 20 db or so down are likely to be lost on the trace.—*William H. Greenbaum*



Suggested by Richard Frato, Detroit, Mich.

"Dear, you'd better call the servicemen—we're getting an awful lot of people on the screen lately."

Circuit Shorts

Improved a.g.c. systems for better TV reception in weak-signal locations

By ROBERT F. SCOTT

NOW that more and more people are buying TV sets in extreme fringe areas 100 miles or more from the nearest station, most set manufacturers have switched to cascode tuners for their higher gain and exceptionally high signal-to-noise ratio. Cascode r.f. amplifiers provide the highest signal-to-noise ratio when they are operated at maximum gain. Therefore, a.g.c. voltage should not be applied to the tuner until the r.f. signal level is high enough to overload the first i.f. amplifier. In the average set using a cascode tuner, the *tuner a.g.c.* bias should be delayed until the input signal rises to 300 to 500 microvolts. Applying tuner-a.g.c. voltage too soon reduces the r.f.-signal voltage to the point where converter noise predominates and decreases the signal-to-noise ratio.

If the a.g.c. voltage is delayed too long, the first i.f. amplifier will overload and there may be cross-modulation in the tuner. So, to provide optimum receiver performance under all operating conditions, various TV set manufacturers have developed various methods of delaying the application of a.g.c. voltage to the tuner.

The grid-voltage plate-current characteristics of the triode r.f. amplifiers and the i.f. amplifier pentodes are vastly different. This makes it desirable to use different values of a.g.c. voltage on the tuner and i.f. strip in addition to the delayed a.g.c. on the tuner.

The basic system of delaying and grading the a.g.c. voltages for the r.f. and i.f. circuits consists of developing the a.g.c. voltage across a voltage divider which is common to a portion of the B plus circuit. The a.g.c. and B plus voltages are polarized so that their currents flow in opposite directions through the voltage divider. If the currents through any section of the divider are equal, the net result will be zero current and the voltage across this section is also zero. The voltage at any point on the divider can be varied by varying the magnitude of one of the currents. Since the B voltage is fixed and the available a.g.c. voltage depends on the strength of the incoming signal, the voltage at any point can be made to vary between any two desirable levels by careful selection of the divider resistances and the B plus voltage. Clamping diodes or a fixed negative bias source are used to prevent the r.f. amplifier grid voltage from dropping below the minimum level required for proper operation for the optimum signal-to-noise ratio.

The Du Mont system

The a.g.c. circuit in the Du Mont RA-166, RA-167, and similar chassis is essentially a standard 6AU6 keyed-a.g.c. system with provision for delaying the application of the tuner a.g.c. voltage. The circuit is shown in Fig. 1.

The 6AU6 a.g.c.-keyer tube develops a negative voltage across the a.g.c. load resistor which consists of R5, R3, and R4 in series. With a strong signal applied to the antenna terminals of the set, a plate current of approximately 225 μa flows to ground through the a.g.c. load resistors. By itself, this current would make point A about 55 volts *negative* with respect to ground, but note that point A is also connected to the 270-volt B plus line through R1 and R2. Resistors R1, R2, R3, and R4 now form a B plus voltage divider. A current of 100 μa flows from ground to the 270-volt line. This 100-μa current opposes the normal 225-μa current produced by the 6AU6, so the net current through R3 and R4 is reduced to only 125 μa. This current, flowing from the 6AU6 plate to ground, makes point A 31 volts negative and the junction of R3 and R4 approximately 5.9 volts negative. The i.f. amplifiers receive their a.g.c. voltage from this point.

Since R1 and R2 are in series between points 31 volts negative and 270 volts positive, there is a total voltage drop of 301 volts across them. This voltage divides with a drop of about 274 volts across R1 and 27 volts across R2. This makes point B 27 volts *positive* with respect to point A, or 4 volts *negative* with respect to ground. The a.g.c. voltage for the tuner is tapped off at point B.

A reduction in the strength of the incoming signal decreases the negative voltage developed at A. As A becomes more positive there is a corresponding change in the voltage at B. For example, if A rises 4 volts from minus 31 to minus 27, B rises from minus 4 volts to zero.

If the signal is too weak to develop minus 27 volts at A, point B would go positive if it were not for the action of diode D2. The instant point B starts to go positive, D2 conducts and presents a low-impedance path to ground, so B remains at ground potential.

Diode D1 is connected in parallel with D2 through the 220,000-ohm a.g.c.-filter resistor. When the plate of D2 is at zero volts, contact potential develops about minus 0.5 volt at the plate of D1. This contact potential supplies the minimum bias of 0.5 volt that must be

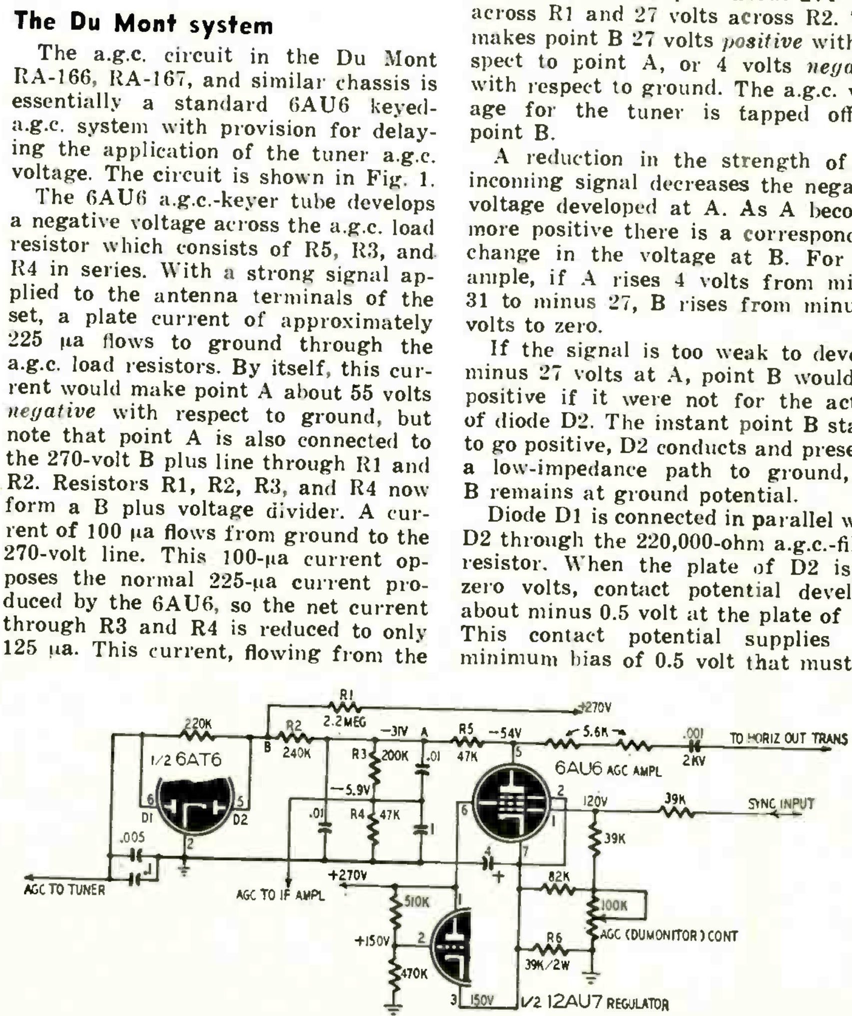
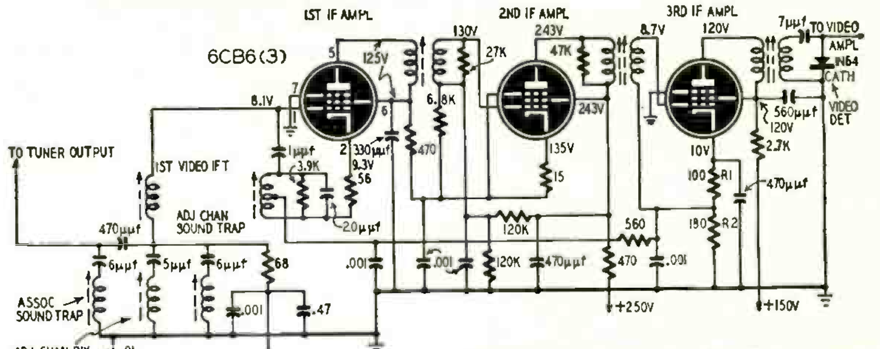


Fig. 1—Delayed keyed-a.g.c. circuits of the late-model Du Mont RA-166, 167, 170, and 171 *Telesets*. The 12AU7 voltage-regulator tube stabilizes the gain of the 6AU6 a.g.c. amplifier against variations in B plus and power-line voltages.

used to prevent the cascode r.f. amplifier from drawing excessive plate current.

The 12AU7 voltage-regulator tube stabilizes the 6AU6 cathode voltage and prevents the a.g.c. voltage from being affected by fluctuations in B plus load or power-line voltages. The 12AU7 grid is supplied with 150 volts fixed bias from a B plus voltage divider. The 6AU6 screen and 12AU7 plate are tied together and connected to the 270-volt line. The cathodes of the tubes are returned to ground through the same resistive network.

The circuit is balanced so that a change in the 6AU6 cathode current produces a change in the common cathode bias. This causes an equal and opposite change in the cathode current of the 12AU7. In this way, the 6AU6 cathode voltage and the voltage drop across R6 are held at a comparatively constant level.



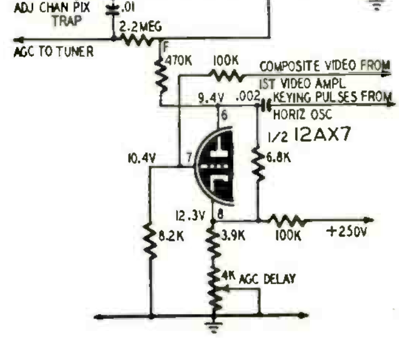


Fig. 2 (above)—Circuit of the delayed a.g.c. system and i.f. amplifier in Zenith 19K20, 19K22, 19K23, 21K20.

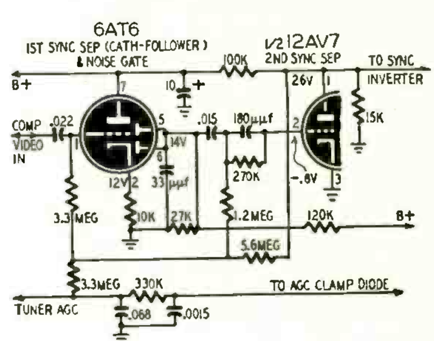


Fig. 3 (right)—A partial schematic of the Philco delayed a.g.c. circuit. See the text for description of its operation.

Zenith delayed a.g.c.

The a.g.c. system of the Zenith 19K20, 19K22, 19K23, and 21K20 chassis is shown in Fig. 2. Note that the cathode of the first i.f. amplifier is returned to the junction of the 100- and 180-ohm resistors (R1 and R2) in the cathode return of the third i.f. stage. The combined cathode currents of the first and third i.f. stages produce a voltage drop across R2 which makes the cathode of the first i.f. amplifier about 9.3 volts positive with respect to ground. The grid of the third i.f. amplifier is returned to the junction of R1 and R2, so it is biased solely by the drop across R1. The voltage at the junction of R1 and R2 varies from about 8 volts with no signal to 4 volts with a strong signal.

On weak signals the a.g.c. keyer does not conduct heavily and test-point F is approximately 8 volts positive. This positive voltage is dissipated in the 2.2-megohm a.g.c. resistor, so it does not reach the grid of the r.f. amplifier. (Any tendency of the r.f. amplifier grid to go positive causes grid current to flow. The grid current causes the full positive voltage to appear as a voltage drop across the 2.2-megohm resistor.) Actually, the grid of the r.f. amplifier is biased about 0.5 volt negative by the contact bias caused by the high resistance (2.2 megohms) in series with the grid.

The 8-volt positive a.g.c. voltage is applied to the grid of the first i.f. amplifier. But the cathode of this stage is 9.3 volts positive, so its grid is actually 1.3 volts negative with respect to the cathode. In this way, proper operating bias is applied to the i.f. amplifier under weak-signal conditions. The first and second i.f. amplifiers are connected in series for d.c., so any change in the first-i.f. plate current due to a.g.c. action produces a similar change in the plate current of the second stage.

On strong signals, the a.g.c. keyer conducts heavily and point F becomes 4 to 5 volts *negative*. This voltage is applied to the first i.f. amplifier through the 68-ohm resistor, and to the tuner through the 2.2-megohm resistor. Thus, when the signal strength changes from weak to strong, the r.f.-amplifier bias changes from minus 0.5 to minus 5 volts, while the i.f. amplifier bias changes from minus 1.3 to minus 4.3 volts. This differential in the r.f. and i.f. a.g.c. voltages is necessary because of the difference in the cutoff characteristics of triodes and pentodes.

A.g.c. in Philco sets

In the first production runs of the Philco type-35 r.f. chassis, the tuner-r.f. amplifier and the i.f. amplifiers were connected to the same a.g.c. bus so there was no grading or delay of the voltage applied to either circuit.

In later production runs, the tuner-a.g.c. circuit was modified to permit the tuner to operate with full gain until the r.f. signal reaches about 300 microvolts. The tuner-a.g.c. lead was disconnected from the a.g.c. rectifier and connected to the sync separator as shown in Fig. 3. This gives good sensitivity and a high signal-to-noise ratio for weak-signal reception while still maintaining adequate a.g.c. control to prevent overloading the i.f. amplifier on strong signals.

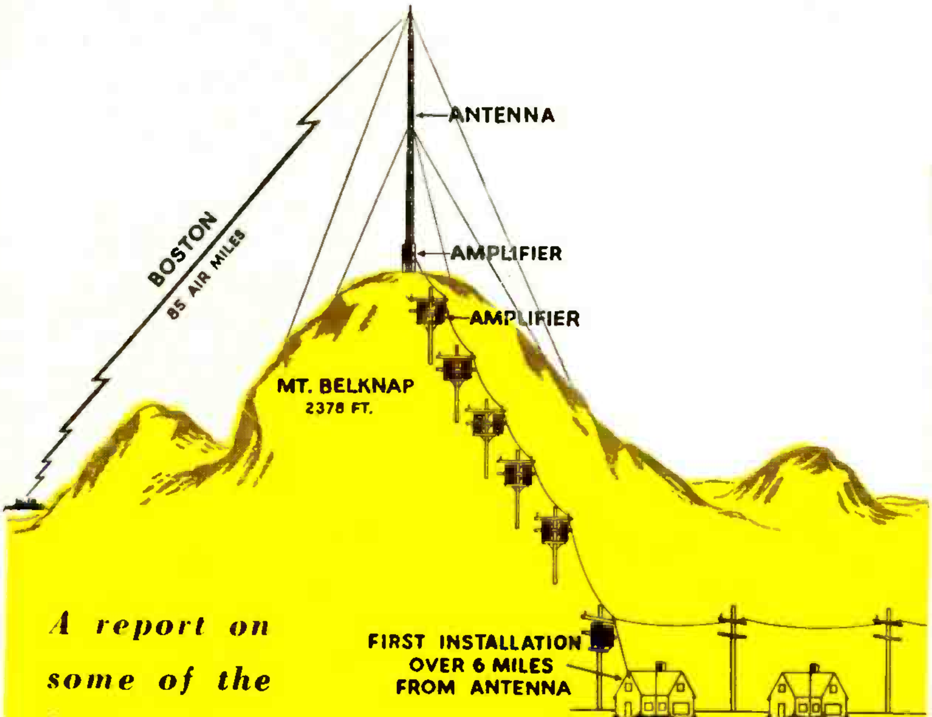
The positive sync pulses cause grid current to flow and develop a negative bias on the grid of the second sync-separator stage. The time-constant of the sync-separator grid circuit maintains the bias constant for the duration of several horizontal lines while allowing it to vary with slow changes in the level of the sync tips. The level of the sync tips is held constant at the transmitter, so the voltage which the sync pulses develop at the sync-separator grid will be directly proportional to the strength of the received signal. Since this voltage is proportional to signal strength, it can be used as a source of a.g.c. bias.

A tuner-a.g.c. bias bearing the proper relationship to the i.f.-a.g.c. voltage is tapped off the 3.3-megohm–330,000-ohm voltage-divider network in the grid return of the second sync separator. A positive delay bias for the tuner-a.g.c. line is obtained through the 5.6-megohm resistor from the B plus line. In the absence of a sync signal (no signal input to the receiver) the positive delay bias would tend to make the r.f.-amplifier grid positive. This is prevented by connecting the plate of a clamping diode to the a.g.c. line. If the line goes positive, the diode conducts so that the a.g.c. line is held close to ground potential.

The operation of the cathode-follower type first sync separator and noise gate were described in the September, 1952, installment of this series.

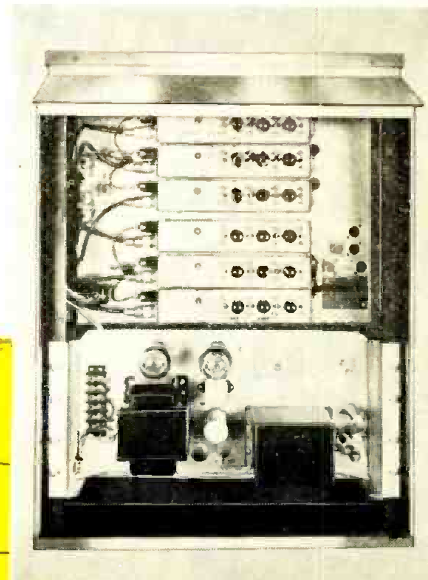
In this circuit the 6AT6 is equivalent to a triode and a *separate* diode rectifier, in spite of the common cathode. In some models the triode section of the 6AT6 is replaced by one unit of a 12AV7, and the diode is one section of a 12AU7—with plate and grid connected together. The other half of the 12AU7 is second sync separator. END

COMMUNITY TV SYSTEMS



A report on some of the larger systems

By E. D. LUCAS, JR.



Amplifier unit of the RCA SX-8C tower amplifier distribution system

THE community-television system for bringing good TV reception to entire towns or cities has become big business in the short span of three years. More than 160 companies are now operating community systems in 26 states. Some of these systems serve as many as 2,000 homes, and the plant investment in the larger installations amounts to a quarter of a million dollars or more.

While a community-TV system is basically an expanded version of the master-antenna devices installed in apartment houses, hotels, or dealers' stores (see "TV Distribution Systems" by Eric Leslie, in the January, 1953 RADIO-ELECTRONICS) it must actually be treated like a public utility. In plant investment, in construction, in operating and maintenance techniques, the larger community installations resemble local independent telephone companies in rendering a communications service to several hundred, or even thousands, of subscribers.

The elements of a community-TV system include: one or more receiving antennas mounted on a tower or towers; r.f. amplifiers, often with associated channel converters and automatic-gain-control equipment; and distribution circuits for feeding the amplified TV signals to individual subscribers. Associated with the principal elements are the miscellany of other essential items, including coaxial cables of various kinds, steel supporting or "messenger" cable, lashing wire, poles and crossarms, power transformers, and test equipment.

Preliminary tests

Every installation of a community-TV system should start with a *field survey* to determine the best site for the master antennas, since picture quality is the only product the system has for sale. There are several technical and economic factors to be considered. On the technical side, signal levels should be measured accurately under varying weather conditions and at various times of the day and night to determine maxima and minima. (Most manufacturers of community-TV equipment recommend a minimum of 100 microvolts at the antenna on each channel, although some systems are operating with daytime signals as low as 70 microvolts.) Electrical noise from power lines, automotive ignition, and FM or AM radio and television interference at the antenna site should be studied. Other important factors include airline distances to the TV transmitters; reports from neighboring set owners, if any, as to consistency of signals; distance of the proposed site from the nearest power source, and to the nearest homes; and accessibility of the site—especially in bad weather.

Antennas

Most community installations use an individual Yagi antenna for each channel to be received. Where signals are extremely weak, vertically and horizontally stacked Yagi arrays may be necessary, especially on high-band v.h.f. channels or on u.h.f. (These complex arrays are very bulky for low-band v.h.f. channels.) Corner reflectors and arrays with large numbers of driven elements backed up by "bedspring" reflectors have also proved useful for pulling in distant high-band-v.h.f. and u.h.f. stations.

Where there is room enough at the antenna site, some community-TV operators have installed rhombic antennas, but the general experience with rhombics has been disappointing. They are so highly directional that orientation is a very tricky job, and most community-antenna sites are on exposed hilltops where gales are apt to change the orientation of a rhombic without notice.

Where the signal level is reasonably good—200 microvolts or more on each channel—well-designed all-channel antennas are suitable. But individual Yagi antennas of good electrical design and sturdy mechanical construction, properly cut for each channel to be received, are probably the best and certainly the most popular types for community systems. For one thing, most preamplifiers are designed to boost individual channels; and this makes it easier to line up each antenna for maximum signal, and it eliminates low-level mixing networks, and simplifies the problem of equalizing the output on all channels. Separate antennas also make it possible to trap out noise or interference on an individual-channel basis.

A sensible safeguard, especially where the antenna site is on a relatively inaccessible mountaintop, is to provide duplicate antennas, lead-ins, and preamplifiers, with changeover-switching facilities at the bottom of the mountain or some easily reached spot.

When installing the antennas, it is important to check reception at various heights because of the "layer" effect. Layering occurs because ground waves and reflected waves will be either additive or subtractive depending on their phase relations at various heights above the ground. For example, good signals may be received at a height of 60 feet, while 10 feet higher or lower the level may be down 10 db.

Where necessary, traps can be inserted in the lead-in cable from the antenna to eliminate interference from FM stations, amateur transmitters, or adjacent-channel TV stations. These high-Q traps, usually of the bridged-T type, pass the desired channel with minimum attenuation (1 db or less) and attenuate unwanted frequencies by 40 db or more. The lead-in-cable is generally RG-59/U coaxial; but RG-11/U cable is more suitable for runs of more than 75 feet with weak signals, especially on higher frequencies. This cable should be anchored firmly to the antenna and tower, of course, to prevent whipping in the wind. An *antenna-matching network* is installed when feeding a single broad-band preamplifier from several individual channel antennas, and matching transformers are used, of course, for hooking up 300-ohm antennas to 72-ohm lead-in cable.

Head-end equipment

Electronic equipment for amplifying the signals picked up at the community-antenna site includes one or more of the following three major units: preamplifier; channel converter; and output amplifier (with or without a.g.c.).

Four principal techniques have been employed with these head-end units:

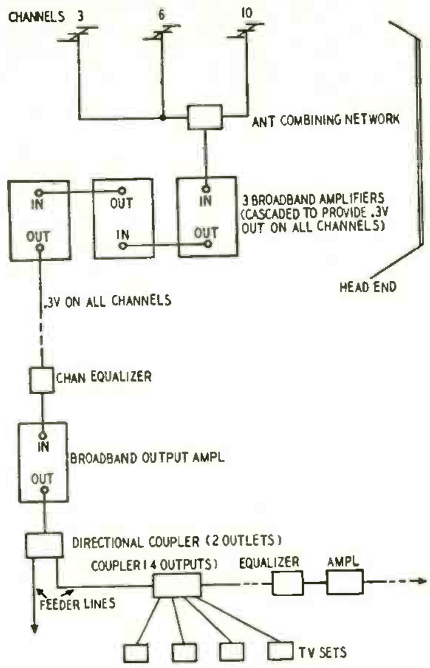
1. Broad-band preamplifiers and output amplifiers. One example is the Spencer-Kennedy Laboratories' "distributed" amplifier, used without either channel converters or a.g.c. The number of broad-band preamplifiers connected in cascade at the antenna site depends, naturally, on the incoming-signal level, amplifier gain, and the output level required to overcome cable losses and deliver adequate signal to the next amplifier. As many as three SKL broad-band amplifiers have been cascaded at the antenna site. See Fig. 1.

2. Broad-band preamplifiers; "re-amplifier" with separate strips for each channel and a.g.c. See Fig. 2. This combination is used in many SKL and Jerrold installations.

3. Individual-channel preamplifiers; similar strip-type re-amplifiers with output-mixing network and a.g.c. See Fig. 3. This system is used in Philco and some International Telemeter installations.

4. Individual-channel preamplifiers; high-to-low and low-to-low channel converters (either or both); similar strip-type re-amplifiers with output-mixing networks and a.g.c. See Fig. 4. RCA, Jerrold, and International Telemeter use this system.

Fig. 1—Block diagram of SKL (Spencer-Kennedy Laboratories) community-TV antenna system. Individual-channel antennas feed up to three cascaded broadband amplifiers through a matching network.



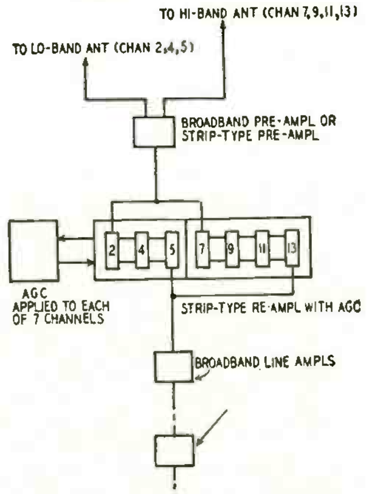


Fig. 2—A composite dual-antenna community TV system. Preamplifier feeds "re-amplifiers" with individual a.g.c. The input lines are shown at top of channel units; outputs at the bottom feed broadband amplifiers which supply signals to the distribution system.

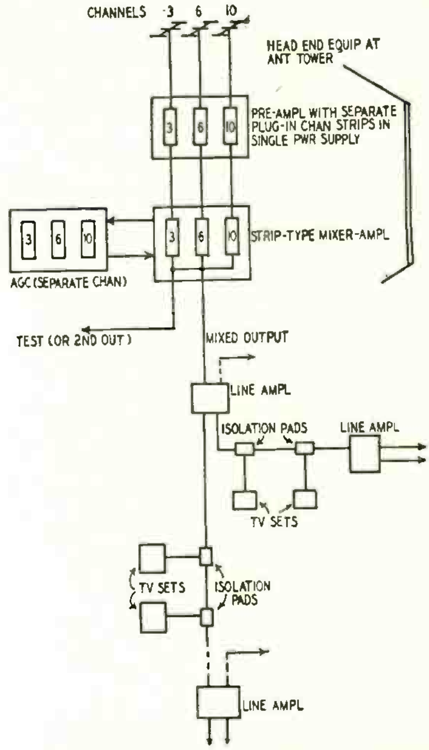


Fig. 3—Block diagram of Philco community-TV antenna distribution system.

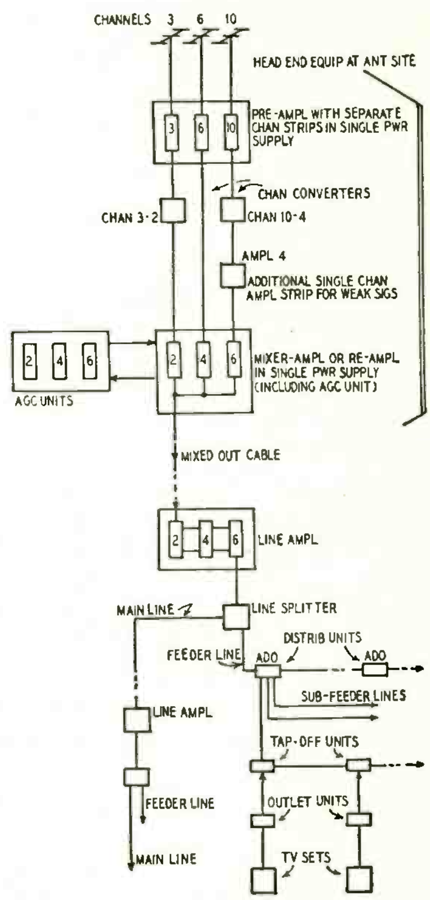


Fig. 4—Jerrold community-TV system. Channel converters eliminate high-band losses in transmission lines, and reduce adjacent-channel interference.

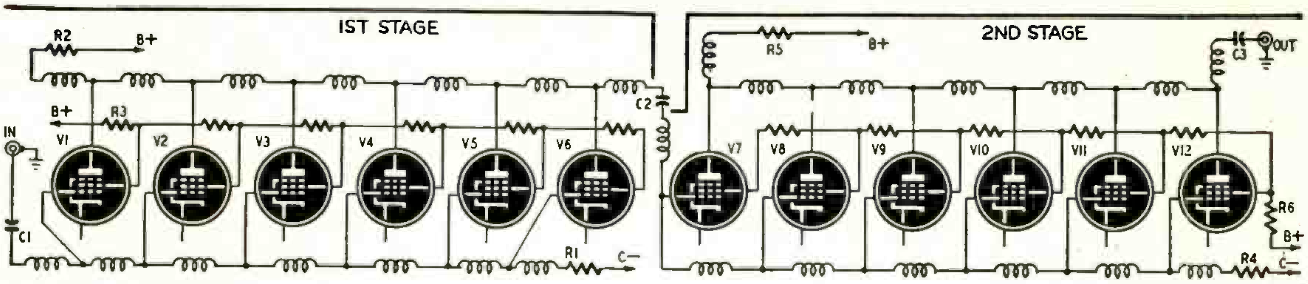


Fig. 5—The SKL "distributed" amplifier. Grid and plate networks delay signals so that all outputs are in phase.

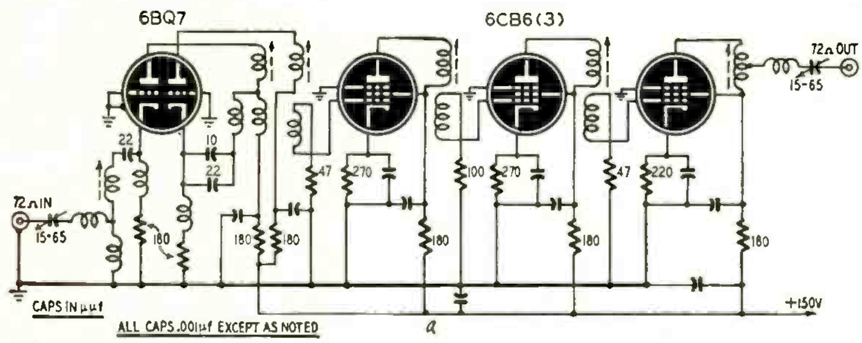


FIG. 6-a

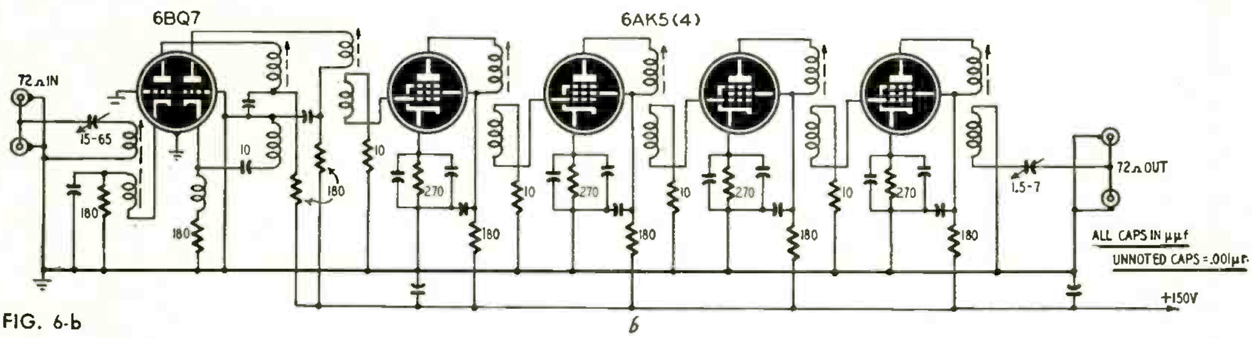


FIG. 6-b

Fig. 6—(a) Jerrold broadband amplifier for low-band TV channels (2-6). (b) High-band (7-13) version of the Jerrold broadband television amplifier.

Preamplifiers for community-TV systems generally have low-noise input circuits and voltage gains ranging from about 20 to 55 db. The object is the highest possible signal-to-noise ratio, since the first amplifier stage establishes the minimum system-noise level.

In a few cases a stage of amplification has been used in the form of a single-tube booster directly at the antenna terminals atop the tower. A unit like the Taco *Supercharger* provides a gain of up to 18 db with a single 6AK5 stage carefully tuned for maximum gain, narrow bandwidth, and high signal-to-noise ratio. Power is supplied from a small 24-volt transformer at the tower base.

Broadband preamplifiers have the advantage of covering several channels with a single unit, and provide moderate gain with a minimum number of tubes. Their disadvantages are: no gain control for individual channels; usually no method of adjusting level except by means of line pads with insertion loss; and no a.g.c.

The SKL amplifier

The SKL model 212TV chain amplifier (Fig. 5) is a two-stage "distributed" amplifier. Each stage consists of six 6AK5 tubes, with their plates and grids connected at intervals along artificial delay lines. Signals entering the input travel down the grid delay line, which is formed by inductances and the input capacitances of the tubes. Each wave of signals excites successive grids until it is finally absorbed by the grid terminating resistor. Meanwhile, an amplified wave is initiated in the plate line and travels toward the output. This forward wave increases in amplitude at each successive plate until it reaches the output.

Gain of this broad-band amplifier averages about 20 db over the entire band from 40 to 225 mc. One major advantage of this type of amplifier, in addition to its broad response, is its reliability. There is no appreciable frequency drift and failure of a tube does not mean the failure of the entire amplifier but merely a loss of about 1.6 db in gain. Drawbacks are: lower gain for a given number of tubes; no gain control for various channels, and thus the need for an equalizer; possible cumulative build-up in frequency-response errors as amplifiers are cascaded.

The Jerrold equipment

The Jerrold broad-band amplifier, model ABC-213, has separate amplifier strips for the low and high v.h.f. bands. Both have a low-noise grounded-grid 6BQ7 input stage (Fig. 6), followed by three 6CB6 double-tuned stages for the low band (*a*), and four 6AK5 double-tuned stages in the high-band strip (*b*). Both strips are peaked to give maximum gain at the upper end of each band. The gain of the low-band strip ranges from 28 to 37 db; high-band gain from 30 to 35 db. The output level of each strip is nominally about 0.5 volt r.m.s., but when used to amplify signals from several channels the output of each strip is kept down to about 0.2 volt to avoid cross-modulation.

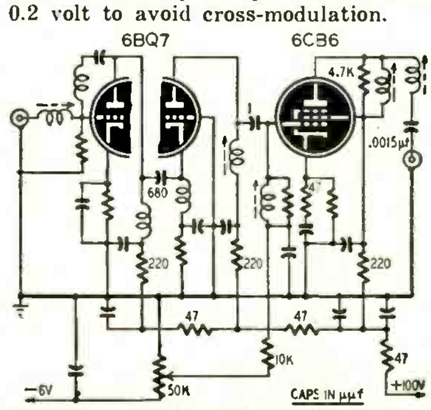


Fig. 7—Philco low-band preamplifier.

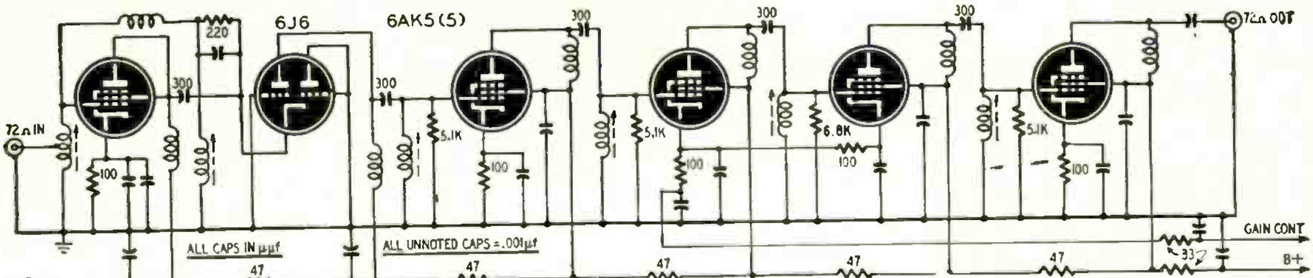


FIG. 8

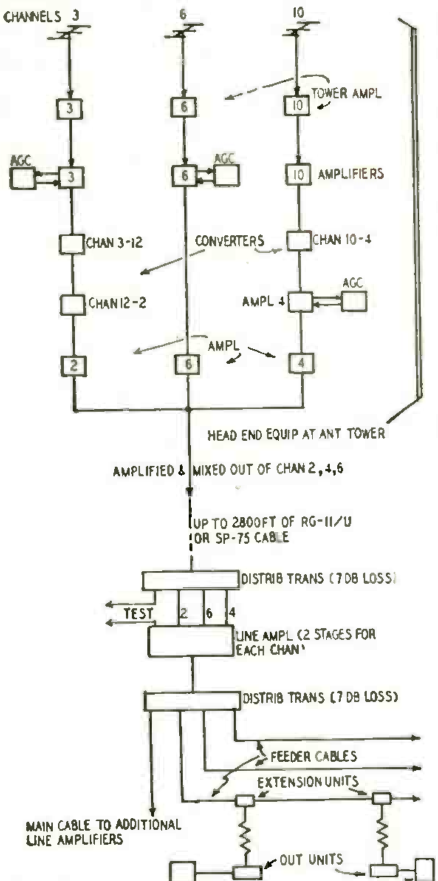


FIG. 9

Fig. 8—Jerrold single-channel preamplifier circuit (values for channel 2). Fig. 9—Block diagram of RCA community-TV antenna system. All head-end units are designed for single-channel operation. Note double-conversion arrangement for changing channel 3 to channel 12, and then back down to channel 2. Fig. 10—(a) RCA single-channel preamplifier strip for low band channels. (b) The RCA high-band single-channel preamplifier has extra r.f. stage to overcome generally lower signal levels and increased coaxial-line losses at high frequencies.

Advantages of this amplifier include fairly high gain with few tubes, compact design, and reasonably low noise figure. Disadvantages are: it is susceptible to cross-modulation in the presence of strong input signals from several channels; there is no gain control for individual channels; and failure of a single tube in either the high- or low-band strip results in loss of signals from all stations in the corresponding band.

Individual-channel preamplifiers

These are available from several manufacturers, including Philco, RCA, Jerrold, International Telemeter, and Lyn Mar Engineers.

Like the other manufacturers, Philco provides different amplifier-strip designs for the low and high v.h.f. bands. The low-band version (Fig. 7) has two tubes—a 6BQ7 cascode-type low-noise input amplifier feeding into a conventional 6CB6 r.f. stage. The high-band strip has the same input and 6CB6 stages, plus an additional 6AK5 output stage. Gain on both types of strip is controlled by varying the bias on the 6CB6 grid. Stagger tuning gives a 6-mc bandwidth, with an average gain of about 25 db. Strips are equipped with Jones plugs for easy replacement in the power-supply chassis, a desirable feature from the standpoint of maintenance.

The Jerrold strip-type preamplifier (Fig. 8) includes a low-noise cascode input stage with a 6AK5 feeding a grounded-grid 6J6, and four stagger-tuned 6AK5 amplifier stages. Nominal gain is about 54 db on low-band channels and 48 db on the high band. Major advantage of this preamplifier is its high gain and relatively low noise. Disadvantages include a tendency toward frequency drift and thus need for realignment; cross-modulation unless input and output levels are held within close limits; loss of reception from one channel in case of failure of one tube.

The RCA tower preamplifier is designed to operate with a channel converter, if required, and is planned for one-, two-, or three-channel operation. In a typical installation (Fig. 9), the preamplifier strips or input amplifiers (Figs. 10-a and 10-b) are stagger-tuned for a 6-mc bandwidth, and consist of three cascaded 6AK5 stages for the low band, with an extra 6AN5 output stage for added gain on the high band. Total gain of the RCA tower-amplifier system, including input-amplifier strip, converter, and output-amplifier strip (similar to Fig. 10-a), is about 60 db, with an output level of about 1.25 volts. Merits and demerits of these amplifiers are similar to those made by Jerrold, except that the stability of the RCA design is somewhat greater and there is gain in the converter stage instead of loss.

(TO BE CONTINUED)

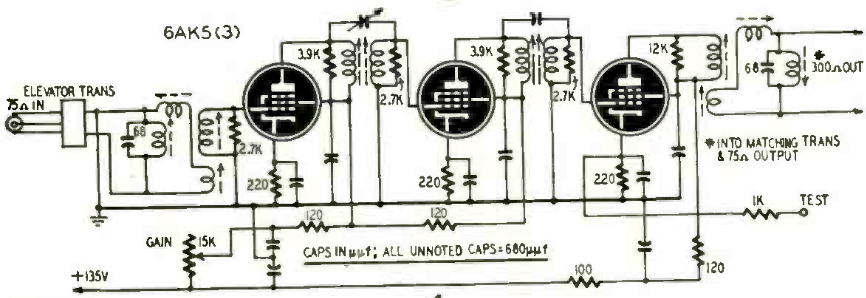


FIG. 10-a

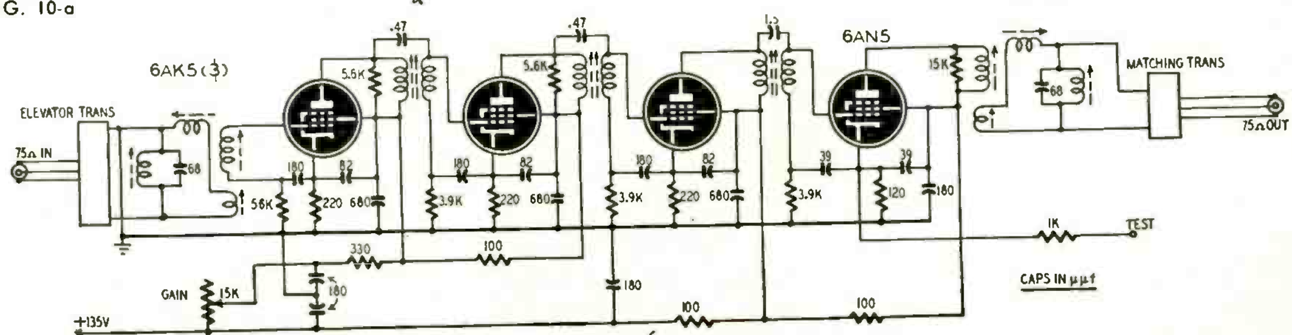


FIG. 10-b

TV SERVICE CLINIC

Conducted by
MATTHEW MANDL*

Left-hand foldover caused by excessive plate voltage on the horizontal oscillator in a Synchroguide sweep system.

A NUMBER of readers have asked about the advantages of tilting antennas in ultra-fringe areas. This may reduce fading and improve the signal strength for stations beyond the line of sight. The same holds true for nearer stations in mountainous terrain where the signal arrives at an angle above the horizontal. In some instances, tilting the antenna upward 15 to 20 degrees has improved reception to a considerable extent.

Several factors must be considered. A dipole antenna with a reflector has the vertical-directivity pattern shown in Fig. 1 (looking at the antenna from the side). Single-bay antennas have a fairly broad pickup so that the reduction in strength for a signal arriving at an angle *B* or *C* is not too severe. When directors are added to such an antenna to form a Yagi the pattern elongates and becomes narrower as shown in Fig. 2. Here an upward tilt would be very helpful if signals arrive at an angle above the horizontal.

When Yagi antennas are stacked, as shown in Fig. 3, the vertical directivity pattern becomes extremely narrow, and virtually no signal would be received if it arrived at the angle *C*. This is why stacked antennas sometimes give poor reception in ultra-fringe areas even though stacking gives a 3-db increase in forward sensitivity. For the same reason, increasing the antenna height may improve reception little unless it is possible to raise the antenna high enough to intercept the line-of-sight transmission.

The advantages of stacking of course can be realized by tilting the stacked array in the same way as the single-bay antenna. The vertical-tilt orientation will be more critical with a stacked array, though a 15-degree tilt is a good average for flat terrain beyond the line of sight. When the signal comes over a mountain top, the angle will have to be set experimentally for best average results. If the mountain is some distance from the receiver the tilt angle can be determined before the antenna is attached to the mast. One technician can hold the antenna and tilt it at several angles between 10 and 30 degrees, while another checks performance at the receiver.

A simpler method would be to use a field-strength meter on the roof-top. After the proper tilt angle has been established the antenna can be mounted 20 to 30 feet above the site without too great a change in the angle of the arriving signal.

W. S. Huffmire reports some interesting results in an area entirely surrounded by 500-foot hills. Vertical-tilt effects were obtained by installing horizontal antennas ½ or 1½ wavelengths above ground. This creates two main lobes at equal angles to the horizontal. (See Fig. 4.)

Trailing bars

In an RCA 17T201 receiver the picture is smeared horizontally by dark shadow bars running from edge to edge of the raster. These bars show when a white or very light object appears against a neutral background in a scene. Shadows appear as a faint gray in pictures of little contrast, but in pictures of great contrast the bars show up almost black. These bars are the exact height of the white object in the scene and follow any motion made by the object. This trouble does not appear until the set is in operation long enough to warm up. I would appreciate any advice you can give me regarding possible causes of this trouble. E. H., Corona, Calif.

Trailing smears and bars which follow the motion of objects on the screen are usually caused by troubles in the video-detector and video-amplifier circuits. The tubes should be checked and a new video-detector crystal should be installed. Also check the coupling capacitors in the video-amplifier circuits

*Author: Mandl's Television Servicing

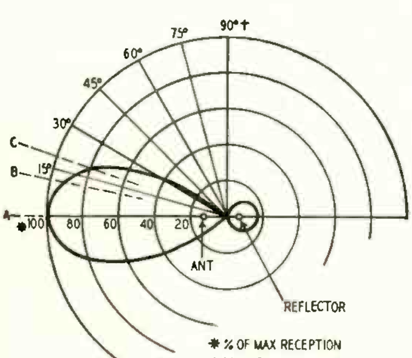


Fig. 1—Vertical-directivity pattern of a horizontal dipole with reflector. The principal lobe offers little discrimination against signals from B and C.

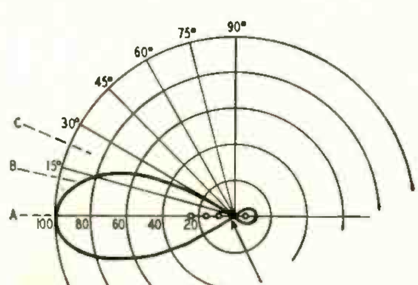


Fig. 2—Narrower vertical-directivity pattern obtained by adding director elements. The response to signals arriving from C has been reduced about 50%.

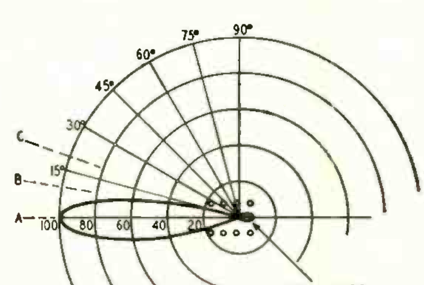


Fig. 3—Stacked Yagis boost forward gain, but the extremely narrow principal lobe reduces the response to signals arriving from other directions.

and values of the load resistors, particularly the one in the video-detector circuit. An abnormal increase in the value of load resistors or leaky coupling capacitors can affect the phase shift and frequency response enough to cause the condition you described. If these procedures do not help, check the peaking coils.

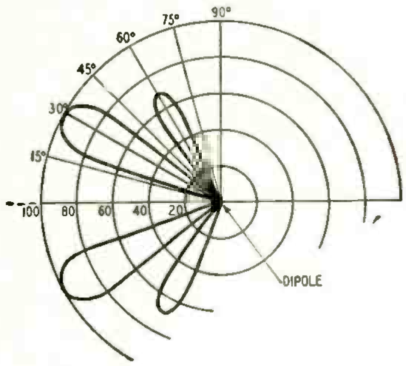


Fig. 4—Mounting a half-wave horizontal dipole at a multiple of one-half wavelength above the ground splits the main forward lobe into two or more tilted lobes. These improve pickup of signals arriving at vertical angles.

Operation on 50-cycle lines

We have encountered a difficult problem in television receivers in this area. Our alternating current is 50-cycle, and television receivers designed for 60 cycles have a 10-cycle flicker which is very annoying. Increasing the filter capacitance does very little to eliminate the defect. Many service technicians have been removing the power transformer, rectifier tube, and filter capacitors and placing them on a separate chassis. This, however, is expensive and an unsightly solution. We also have trouble with small radios as well as record players. What can be done with the latter to bring the speed up to normal and keep the heating down to a safe limit? F. B., Mexico.

The better-grade radios which are marked "50-60 cycle" operation will work on either frequency because the power transformer and filter components have been designed for such operation. In many cheaper sets the power transformer just barely meets the requirements for 60 cycles and overheats on 50-cycle operation. Proper operation at 50 as well as 60 cycles requires a transformer with a greater core area or a larger number of turns per volt. Windings designed for 60 cycles have less inductive reactance at the lower frequency and draw excessive current.

The problem is not too serious in a radio, provided the low-voltage power supply has adequate filtering. A record player with a 60-cycle synchronous motor trouble will not run at the right speed at a different line frequency.

The increase in the voltage-boost potential resulting from the conversion has upset the horizontal oscillator circuit. Check the voltages in the horizontal oscillator control and horizontal oscillator stages against those given in the service notes for this receiver. If the voltages are correct, align the synchroguide system with an oscilloscope according to the step-by-step procedure given in the service notes. The hold control will then give good stability at its center range. Do not adjust the hold control to position the picture, because this will cause the foldover again. Picture positioning must be done with the focus-coil assembly.

The only solution is to install a 50-cycle phonograph motor (or a non-synchronous, adjustable-speed type) and power transformer.

In television receivers the flicker results from the frequency and phase difference between the 60-cycle vertical sweep and the 50-cycle line voltage. Additional B plus filtering may help, but often sufficient hum is introduced by the fields of the filter choke and power transformer to produce the flicker. As you pointed out, service technicians have found a partial solution in rewiring the unit so that the power supply is separate from the main chassis. This puts sufficient distance between sensitive circuits and the fields generated in the power supply to minimize flicker.

Channel-49 Yagi

Please give me dimensions for constructing a channel-49 Yagi. Is it possible to modify an existing 8-element channel-13 Yagi for channel 49? J. P., Winchester, Ind.

There is a considerable difference in dimensions between the two types and the change-over entails entire rebuilding. Fig. 5 gives the dimensions for a channel-49 Yagi. The two inner directors should be 7.7 inches in length and the last director is cut slightly shorter for increased sound reception for this channel. When more directors are added, gain increases, bandwidth decreases, and orientation is more critical.

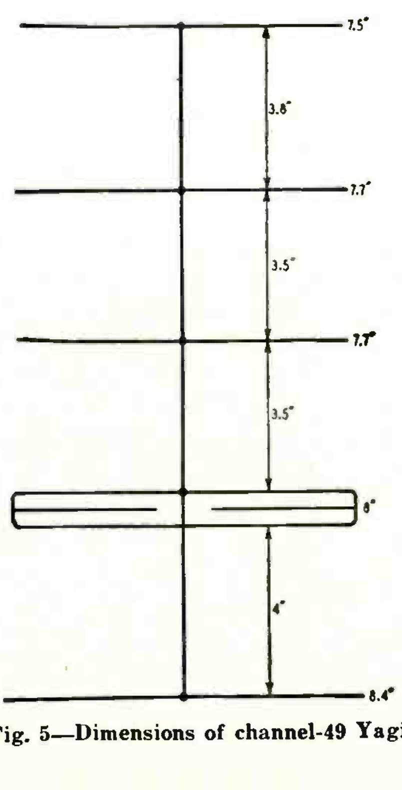


Fig. 5—Dimensions of channel-49 Yagi.

The double-folded dipole compensates for the drop in impedance which results from adding directors to a dipole.

No horizontal hold

The horizontal hold does not work properly in a Philco 49-1040 TV receiver. The picture slips and a black bar appears in the center of the screen. —J. D., Minneapolis, Minn.

From your description the trouble may be in the 270-μμf capacitor between a section of the horizontal oscillator transformer and the 7N7 blocking oscillator. Replace it with a 270-μμf mica or ceramic type. Replacing the 7N7 horizontal oscillator tube may also cure the defect. All the resistors in this circuit section are critical and should be of 10% tolerance or less. Adjusting both sides of the transformer is necessary after changes are made.

H.v. in Philmore

In a Philmore there is no high voltage. The 1B3-GT fails to light, when in the set, although it lights when tested externally. I have checked all the tubes from the horizontal oscillator through the horizontal output and high-voltage systems. All check good and the d.c. voltages on them are within normal tolerance. I have replaced the flyback transformer. What else could cause this? J. C., Pensacola, Florida.

As you have checked all tubes and voltages in the horizontal section the trouble must be caused by a defective component part. The horizontal oscillator is probably not generating the necessary sweep signals. If this stage is not oscillating there will be no horizontal sweep and no high voltage. There may also be a defective component in the discharge circuit which is preventing the formation of a sawtooth. The best way to isolate the defective stage is to use your oscilloscope to find out whether the loss of signal occurs after the oscillator or after the discharge tube. Then check resistors and capacitors until the defective one is found.

Attic antenna

We would like your opinion regarding the effect of a slate roof on an antenna installation in an attic. In an area where signal strength is high and indoor antennas work well, would the slate roof diminish signals to a considerable extent? In one installation we got considerable snow where a slate roof was overlaid with a layer of asphalt shingles. J. D., Agawam, Mass.

Slate diminishes signals to a much greater extent than asphalt shingles. The slate and asphalt combination you mentioned would give poor results. You would find a considerable difference in reception with an outdoor antenna even though it is no higher than the antenna under the slate roof. The slate acts as a partial reflecting surface for high frequencies. END

uhf growing pains mark first year of unfreeze

By ERIC LESLIE

A resumé of the TV industry's achievements—and mistakes—on the new television channels

JULY 1, 1952, was the historic date on which the FCC lifted the ban on new TV-station construction and brought in our present "third period" of TV expansion. On that date there were 109 TV stations on the air.

Only 11 days later, the first construction permits (coincidentally 11 in number) were granted. One of these was for Denver's KFEL-TV (channel 2) and one for Portland's KPTV (channel 27). These were the first post-freeze v.h.f. and u.h.f. stations to get on the air.

And it didn't take them long to get going. KFEL-TV hit the air with test programs on July 18, less than three weeks after the freeze was lifted. The first u.h.f. station, KPTV, started broadcasting September 18, and the third post-freeze station (Denver again, KBTV on channel 9) went on the air October 2. From then on, new stations started transmitting in such numbers that their openings attracted little attention outside their own service areas.

In spite of tests carried on for more than two years at Bridgeport and elsewhere, no one was willing to stick his neck out and predict what would happen on the new u.h.f. TV band. There was more than a little quiet skepticism about u.h.f. in the industry. The best indication of the broadcasters' attitude was a frantic rush for v.h.f. assignments and a relative coolness toward allocations in the u.h.f. spectrum.

But when KPTV started broadcasting, it became apparent that the situation was not going to be so bad after all. Coverage was actually somewhat greater than had been expected, though shadow effect was exactly as bad as had been predicted. It rapidly became clear that TV owners with a tall hill between them and the transmitter would have to keep on going to the movies for visual entertainment.

The antenna problem—another of the great unknowns—was not as hard to crack as expected. A simple u.h.f. antenna would—if the lead-in was not too long—bring in a satisfactory signal in good locations. Some TV owners near the station found it quite possible to get good pictures with indoor antennas—the old familiar rabbit ears.

Portland's success was somewhat marred because it immediately became a testing ground for all the new u.h.f. equipment developed up to that time, much of which was unsatisfactory. But it was a great triumph for u.h.f., and swung the spirits of the promotional experts from pessimism to extreme optimism. Customers in newer areas were assured that u.h.f. was a cinch—no outdoor antenna needed, no interference as on v.h.f.—in fact no problems at all! To which the outraged purchaser often had to add—no picture! Previous pessimism had harmed Portland by making dealers over-careful about stocking up on u.h.f. equipment, with the result that there was a near-famine when the station opened. Optimism did far more damage in later u.h.f. areas by letting down set owners who had been talked into inadequate setups by salesmen who knew no more about the facts of life on the u.h.f band than the customer did. Once he got the idea—from the results he got in his own home and at his own expense—that u.h.f. TV was *not* good, he became a very effective barrier to new sales to his neighbors, and it was only when his own installation had been straightened out that the overdue u.h.f. antennas blossomed out on other houses in the vicinity.

Transmitters contributed their share to the snarl. All started out with less power than had been considered sufficient for adequate coverage. And more than one had difficulty in maintaining even that power. Variations from day to day—or even hour to hour—as tubes or other components moved toward breakdown caused the customer to blame alternately his receiver, the conditions, the transmitter, and himself for letting himself be talked into u.h.f. TV.

A little experience straightened out most of the earlier problems. After the first few days of broadcasting the capabilities and limitations of various antennas, tuners, and converters were pretty well pinpointed. Within a month or so the transmitters were working with reasonable regularity. And the public had learned to be very skeptical of *anyone's* claims. Servicing u.h.f. receivers is still full of unsolved problems, but the technician has lost his fear of them. He knows that the bulk of the troubles occur in the body of the receiver and not in the front end—exactly as with v.h.f. sets. And when troubles do occur in the front end, they can be remedied merely by replacing a tube as often as in sets built for the lower frequencies.

The question of coverage has been at least partly settled—though possibly increases in transmitter power may reopen it in some locations, and the effect of foliage in heavily wooded areas may make the summer and winter patterns somewhat different. Experience with the first few stations indicates that a good signal may be expected up to about 30 miles over relatively flat, clear terrain. Good signals may be laid down even at 40 miles, in some places, but somewhere between those two distances we are likely to run into the limit of practical reception unless transmitter or receiver antenna sites are exceptional.

And above all things, u.h.f. *does not* render the outdoor antenna unnecessary. This fallacy was probably responsible for more unhappiness than any combination of other misconceptions. Not only is a good outdoor antenna needed in the majority of installations, but the boys who have been putting them up say that each u.h.f.-antenna installation is likely to be a highly individual job, with small variations adding up to big differences in results obtained. Even more than in the case of v.h.f., the antenna is the most important part of the receiver.

In the earliest installations, some of the best-publicized types of antennas and lead-ins gave very poor results, in spite of all the skill and care of the technician. But by now, the types that do not work well on u.h.f. have been pretty well weeded out, and are no longer likely to be an important factor. The same goes for converters. Some of those used at Portland worked—others did not. But because Portland by that very fact became the laboratory of u.h.f., manufacturers have been able to correct equipment weaknesses, and the technician is not likely to run into the same troubles with components in the future. Would that as much could be said for the claims of the "sales engineers" whose statements never seem to have been de-bugged, no matter how often contradicted by the evidence of actual reception.

All TV stations in operation as of May 26 are listed on page 44.

Alabama

WAFM-TV	Birmingham	13
WBRC-TV	Birmingham	6
WALA-TV	**Mobile**	**10**
WKAB-TV	**Mobile**	**48**
WCOV-TV	**Montgomery**	**20**

Arizona

KTYL-TV	**Mesa (Phoenix)**	**12**
KPHO-TV	Phoenix	5
KOPO-TV	**Tucson**	**13**

Arkansas

KRTV	**Little Rock**	**17**

California

KMJ-TV	**Fresno**	**24**
KECA-TV	Los Angeles	7
KHJ-TV	Los Angeles	9
KLAC-TV	Los Angeles	13
KNBH	Los Angeles	4
KNXT	Los Angeles	2
KTLA	Los Angeles	5
KTTV	Los Angeles	11
KFMB-TV	San Diego	8
KGO-TV	San Francisco	7
KPIX	San Francisco	5
KRON-TV	San Francisco	4
KVEC-TV	**San Luis Obispo**	**6**

Colorado

KKTV	**Colorado Springs**	**11**
KBTV	**Denver**	**9**
KFEL-TV	**Denver**	**2**
KDZA-TV	**Pueblo**	**3**

Connecticut

WICC-TV	**Bridgeport**	**43**
WKNB-TV	**New Britain**	**30**
WNHC-TV	New Haven	6

Delaware

WDEL-TV	Wilmington	12

District of Columbia

WMAL-TV	Washington	7
WNBW	Washington	4
WTOP-TV	Washington	9
WTTG	Washington	5

Florida

WFTL-TV	**Fort Lauderdale**	**23**
WMBR-TV	Jacksonville	4
WTVJ	Miami	4
WSUN-TV	**St. Petersburg**	**38**

Georgia

WAGA-TV	Atlanta	5
WLWA	Atlanta	8
WSB-TV	Atlanta	2

Hawaii

KGMB-TV	**Honolulu**	**9**
KONA	**Honolulu**	**11**

Illinois

WBBM-TV	Chicago	4
WBKB	Chicago	7
WGN-TV	Chicago	9
WNBQ	Chicago	5
WEEK-TV	**Peoria**	**43**
WTVO	**Rockford**	**39**
WHBF-TV	Rock Island	4

Indiana

WTTV	Bloomington	10
WFBM-TV	Indianapolis	6
WFAM-TV	**Lafayette**	**59**
WLBC-TV	**Muncie**	**49**
WSBT-TV	**South Bend**	**34**

Iowa

WOI-TV	Ames	4
WOC-TV	Davenport	6
KVTV	**Sioux City**	**9**

Kentucky

WAVE-TV	Louisville	3
WHAS-TV	Louisville	11

Louisiana

WAFB-TV	**Baton Rouge**	**28**
WDSU-TV	New Orleans	6

Maine

WABI-TV	**Bangor**	**5**

Maryland

WAAM	Baltimore	13
WBAL-TV	Baltimore	11
WMAR-TV	Baltimore	2

Massachusetts

WBZ-TV	Boston	4
WNAC-TV	Boston	7
WHYN-TV	**Holyoke**	**55**
WWLP	**Springfield**	**61**

Michigan

WPAG-TV	**Ann Arbor**	**20**
WBKZ-TV	**Battle Creek**	**64**
WWJ-TV	Detroit	4
WJBK-TV	Detroit	2
WXYZ-TV	Detroit	7
WOOD-TV	Grand Rapids	7
WKZO-TV	Kalamazoo	3
WJIM-TV	Lansing	6
WKNX-TV	**Saginaw**	**57**

Minnesota

WFTV	**Duluth**	**38**
KSTP-TV	Minneapolis-St.Paul	5
WCCO-TV	Minneapolis	4

Mississippi

WJTV	**Jackson**	**25**

Missouri

WDAF-TV	Kansas City	4
KSD-TV	St. Louis	5
KTTS-TV	**Springfield**	**10**

Nebraska

KFOR-TV	**Lincoln**	**10**
KOLN-TV	**Lincoln**	**12**
KMTV	Omaha	3
WOW-TV	Omaha	6

New Jersey

WFPG-TV	**Atlantic City**	**46**
WATV	Newark	13

New Mexico

KOB-TV	Albuquerque	4

New York

WNBF-TV	Binghamton	12
WBEN-TV	Buffalo	4
WTVE	**Elmira**	**24**
WABC-TV	New York	7
WABD	New York	5
WCBS-TV	New York	2
WNBT	New York	4
WOR-TV	New York	9
WPIX	New York	11
WHAM-TV	Rochester	6
WRGB	Schenectady	4
WSYR-TV	Syracuse	5
WHEN	Syracuse	8
WKTV	Utica	13

North Carolina

WBTV	Charlotte	3
WFMY-TV	Greensboro	2

North Dakota

WDAY-TV	**Fargo**	**6**
KCJB-TV	**Minot**	**13**

Ohio

WAKR-TV	**Akron**	**49**
WCPO-TV	Cincinnati	9
WKRC-TV	Cincinnati	12
WLWT	Cincinnati	5
WEWS	Cleveland	5
WNBK	Cleveland	4
WXEL	Cleveland	9
WBNS-TV	Columbus	10
WLWC	Columbus	3
WTVN	Columbus	6
WHIO-TV	Dayton	7
WLWD	Dayton	2
WLOK-TV	**Lima**	**73**
WSPD-TV	Toledo	13
WFMJ-TV	**Youngstown**	**73**
WKBN-TV	**Youngstown**	**27**
WH-12-TV	**Zanesville**	**50**

Oklahoma

KSWO-TV	**Lawton**	**7**
WKY-TV	Oklahoma City	4
KOTV	Tulsa	6

Oregon

KPTV	**Portland**	**27**

Pennsylvania

WFBG-TV	**Altoona**	**10**
WLEV-TV	**Bethlehem**	**51**
WICU	Erie	12
WHP-TV	**Harrisburg**	**55**
WJAC-TV	Johnstown	6
WGAL-TV	Lancaster	8
WKST-TV	**New Castle**	**45**
WCAU-TV	Philadelphia	10
WFIL-TV	Philadelphia	6
WPTZ	Philadelphia	3
WDTV	Pittsburgh	2
WEEU-TV	**Reading**	**33**
WHUM-TV	**Reading**	**61**
WBRE-TV	**Wilkes-Barre**	**28**
WSBA-TV	**York**	**43**

Rhode Island

WJAR-TV	Providence	11

South Carolina

WCOS-TV	**Columbia**	**25**

South Dakota

KELO-TV	**Sioux Falls**	**11**

Tennessee

WMCT	Memphis	5
WSM-TV	Nashville	4

Texas

KFDA-TV	**Amarillo**	**10**
KGNC-TV	**Amarillo**	**4**
KTBC-TV	**Austin**	**7**
KRLD-TV	Dallas	4
WFAA-TV	Dallas	8
KROD-TV	**El Paso**	**4**
KTSM-TV	**El Paso**	**9**
WBAP-TV	Fort Worth	5
KGUL-TV	**Galveston**	**11**
KPRC-TV	Houston	2
KUHT	**Houston**	**8**
KCBD-TV	**Lubbock**	**11**
KDUB-TV	**Lubbock**	**13**
KEYL	San Antonio	5
WOAI-TV	San Antonio	4
KFDX-TV	**Wichita Falls**	**3**
KWFT-TV	**Wichita Falls**	**6**

Utah

KDYL-TV	Salt Lake City	4
KSL-TV	Salt Lake City	5

Virginia

WLVA-TV	**Lynchburg**	**13**
WTAR-TV	Norfolk	4
WTVR	Richmond	6
WROV-TV	**Roanoke**	**27**
WSLS-TV	**Roanoke**	**10**

Washington

KVOS-TV	**Bellingham**	**12**
KING-TV	Seattle	5
KHQ-TV	**Spokane**	**6**
KXLY-TV	**Spokane**	**4**
KTNT-TV	**Tacoma**	**11**

West Virginia

WSAZ-TV	Huntington	3

Wisconsin

WBAY-TV	**Green Bay**	**2**
WTMJ-TV	Milwaukee	3

Stations in boldface type are post-freeze; earlier stations are in lightface.

Advanced SCOPE TECHNIQUES

help you interpret what you see—and broaden the range of jobs you can handle

By LOUIS E. GARNER, JR.

WITHOUT question, the cathode-ray oscilloscope is the most versatile piece of test equipment available to the radio-television technician, the experimenter, and the laboratory engineer. In laboratory work, the scope is generally used to the limit of its capabilities. Too often, however, the average experimenter and the service technician use the scope only for observing waveforms or measuring frequencies by means of Lissajou figures. This failure to take advantage of the scope's potentialities is due in part to the rather sketchy instructions generally supplied with the instrument, and in part to the operator's lack of familiarity with his instrument.

A review of scope techniques used in engineering laboratories may prove helpful. The use of Lissajou figures, which is adequately covered in standard texts and instruction manuals, will be omitted.

Deflection polarity

It is often important to know whether the upper half-cycle of a signal seen on a scope is the positive or negative half-cycle in the original. Referring to Fig. 1, if the upper half-cycle of

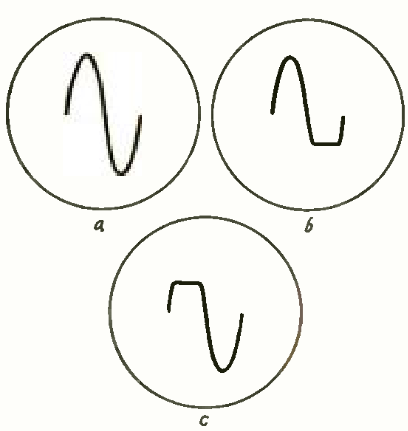


Fig. 1—(a) Sine-wave scope trace discussed in the text. (b) Clipped negative half-cycle due to excessive bias. (c) Clipped positive half-cycle caused by insufficient bias or low plate voltage. Traces *b* and *c* may be confused if scope's *deflection polarity* is not known.

the sine wave (*a*) is the positive half of the original signal, then the wave shapes shown in Figs. 1-b and 1-c indicate different causes of distortion. 1-b may be caused by excessive bias on an amplifier stage, so that the tube is driven beyond cutoff on negative half-cycles. 1-c may be caused by inadequate bias or too low plate voltage.

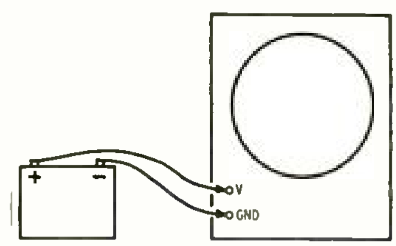


Fig. 2—Setup for checking deflection polarity of an oscilloscope. See text.

On the other hand, if the upper half-cycle seen on the scope is the *negative* half-cycle of the original wave, the causes for conditions 1-b and 1-c are reversed.

Thus, when using a scope, it is important to know whether a positive signal deflects the spot upward or downward. Either situation may exist, depending on the number of amplifier stages in the scope and exactly how the vertical-deflection plates are connected to the amplifier.

The simple technique illustrated in Fig. 2 may be used to determine the deflection polarity of any scope. Any ordinary dry cell or B battery can be used. Connect the negative terminal of the battery to the GND terminal of the scope, turn on the scope sweep, turn up the vertical-gain control, and center the trace. Next, touch the positive battery terminal to the VERTICAL-INPUT terminal, watching the scope face closely. The line will be deflected *momentarily* either up or down, then will return to center.

If the deflection is upward, then the positive half-cycle of any observed signal will appear on the upper part of the scope screen, and vice versa.

Keep your eyes on the screen when making this test, since the deflection occurs only at the instant the battery terminal is touched to the input.

A commercial oscilloscope with built-in 10-range voltage source and meter for peak-to-peak screen-scale calibration.

Calibrating the sweep in microseconds: In studying complex waveforms, it is often desirable to know the duration of a pulse, or even of a complete complex cycle, as shown in Fig. 3-a. In some types of analysis, the rise time of a sharp pulse (Fig. 3-b) must be known accurately.

Some expensive scopes have provision for making such measurements in the form of a sweep calibrated directly in microseconds per inch-deflection. However, even ordinary scopes can easily be calibrated for specific applications by using the technique shown in Fig. 4.

Connect an ordinary signal generator to the VERTICAL-INPUT terminals of the scope, set the frequency to the desired value, and adjust the scope sweep until one cycle occupies a fixed number of squares on the scope scale. When

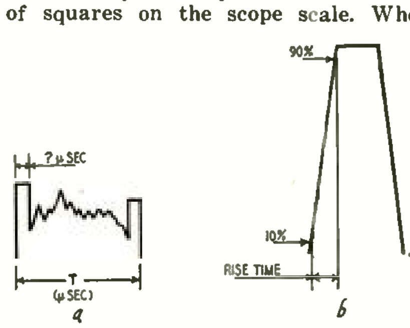


Fig.3—Representative waveforms whose duration may have to be measured. (a) Complex wave. (b) Pulse-waveform display levels for measuring rise time.

adjusting the scope sweep, use the smallest possible amount of sync, and obtain the single cycle by careful adjustment of the FINE-FREQUENCY control. This insures that the scope sweep is accurately on frequency. If too much sync gain is used, the signal to be checked may give a false indication by saturating the sync circuit. This will cause a change in the scope sweep frequency.

As an example, if the scope sweep is

adjusted until one cycle of a 100-kc signal occupies ten horizontal spaces on the screen, then each space represents 1 microsecond. If a sharp pulse is then observed (signal generator disconnected), and it rises from 10% to 90% of its peak value in the space of one-half a square, its rise time is 0.5 microsecond.

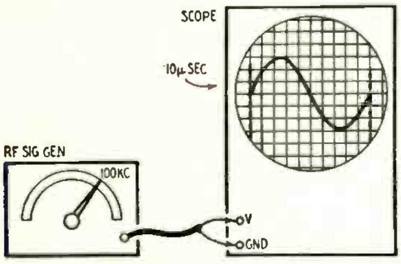


Fig. 4—Equipment setup for calibrating scope screen in time units. One complete cycle of a 100-kc signal is expanded horizontally to occupy 10 scale divisions. Each scale division then represents one microsecond. Higher or lower frequencies may be used for measuring other time units where required.

The relationship between the frequency of the calibrating signal and the time duration of one cycle in microseconds is:

$$T = \frac{1,000,000}{f \text{ (c.p.s.)}}$$

If the scope is to be calibrated so that ten spaces represent one microsecond, a single cycle of 1-mc signal is made to occupy that much space by adjusting the internal sweep. Other values are given below:

Time for One Cycle	Sweep Frequency
10,000 microseconds	100 cps
1,000 microseconds	1,000 cps
100 microseconds	10,000 cps
10 microseconds	100,000 cps
1 microsecond	1 megacycle
0.1 microsecond	10 megacycles

Most older scopes, and many of the less expensive scopes of today, use thyratron sweep circuits. These have an upper sweep limit of about 30 kc, so that a single cycle at 100 kc or 1 mc cannot be observed. However, a satisfactory calibration may still be obtained by adjusting the sweep till several cycles are observed, then expanding the trace with the HORIZONTAL-GAIN control until one cycle occupies the desired number of squares on the scope graph screen.

This brings up another important technique:

Obtaining linear sweep

In many scopes the internal sweep is not linear at its high- and low-frequency extremes. This condition distorts signals, and causes crowding at one or both ends of the trace, as illustrated in Fig. 5-a.

Generally, a portion of the sweep will be reasonably linear. The technique, then, is to expand the trace horizontally until it oversweeps the screen, as shown in Fig. 5-b, and to use only the desired linear portion. The sweep frequency can be increased until the smallest possible number of undistorted complete cycles occupy the full width of the cathode-ray tube screen.

Measuring peak voltages

The technique shown in Fig. 6 may be used for calibrating the vertical amplifier of an oscilloscope for direct measurment of a.c. voltages, and is particularly valuable for checking peak-to-peak voltages of complex signals such as are found in a TV receiver.

A known a.c. voltage (from a filament tranformer in this case) is applied to the VERTICAL-INPUT terminals of the scope, and the VERTICAL-GAIN control is adjusted until the signal occupies the desired number of vertical divisions on the graph screen. With the gain control left in this position, the deflection obtained with any other signal indicates the peak (or peak-to-peak) voltage exactly.

As an example, the peak-to-peak value of a 6.3-volt (r.m.s.) signal is 18 volts. If a 6.3-volt signal is applied to the scope input, and the VERTICAL-GAIN control is adjusted until the trace occupies 18 vertical divisions, each square represents 1 volt. Thus, if an-

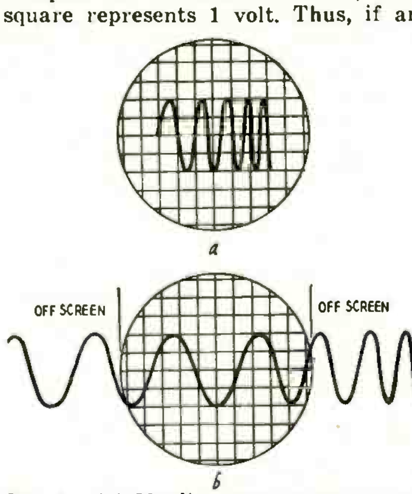


Fig. 5—(a) Nonlinear scope sweep compresses part of horizontal display. (b) Expanding the horizontal trace to show only undistorted cycles on the screen.

other signal is observed without changing the position of the gain control, and a deflection of two squares is obtained, the new signal has a peak-to-peak value of 2×1, or 2 volts.

To determine the peak-to-peak value of any calibrating voltage (and hence the value in volts represented by each square of the scope screen for a particular gain setting), simply measure the voltage with an accurate a.c. voltmeter and multiply the indicated voltage by 2.82 (3 may be used for most practical work). This assumes, of course, that a sine-wave signal is used for calibration.

Plotting curves

The scope may be used to plot any curve showing the relationship between two varying electrical quantities, or between any two related quantities that can be converted into proportional voltages. As an example, the setup shown in Fig. 7 may be used for obtaining a B-H or hysteresis-characteristic curve of a transformer core made of iron or other magnetic materials.

The voltage across R1 is proportional to the current in L1 and thus is proportional to the magnetomotive force. The voltage induced in L2 is proportional to the derivative of the magnetic flux . . . that is, to the number of flux lines produced. An integrating network consisting of R2 and C1 is used to obtain a voltage proportional to the

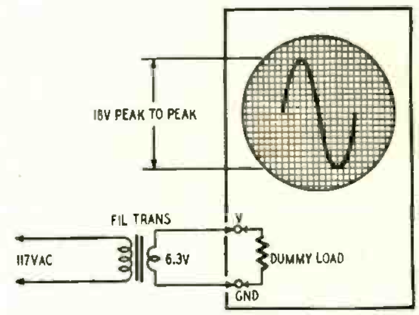


Fig.6—Calibrating the oscilloscope screen for peak-to-peak voltage measurements. Dummy load should be adjusted so that an accurate r.m.s. voltmeter across the input terminals reads exactly 6.3 volts.

lines of flux, and this is applied to the vertical input of the scope.

Thus, since the horizontal deflection of the spot on the C-R tube is proportional to magnetomotive force (input current), and the vertical deflection is proportional to the number of flux lines produced, a conventional B-H curve is traced on the scope screen.

In an actual setup, the input voltage to the transformer is controlled by a *Variac* or a large wirewound potentiometer (about 600 ohms at 50 watts). R1 should be kept as small as practicable—about 50 to 200 ohms generally being used. If preferred, a 75-watt lamp may be used in place of R1. R2 may have a value of 10,000 ohms, and C1 should be a 4-μf paper unit.

Satisfactory curves can still be obtained if the integrating network R2-C1 is replaced simply by a load resistor R3. This load is necessary to prevent core saturation with low exciting current in the primary. Without a load (or integrating network), the flux density

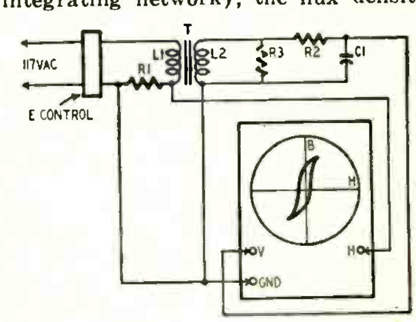


Fig. 7—Equipment setup for checking hysteresis characteristics of iron and transformer core. See text for details.

will be driven beyond saturation on peaks, and a distorted hysteresis loop will result. The exact load value can be determined experimentally for the transformer but 10,000 ohms is usually satisfactory for a start. END

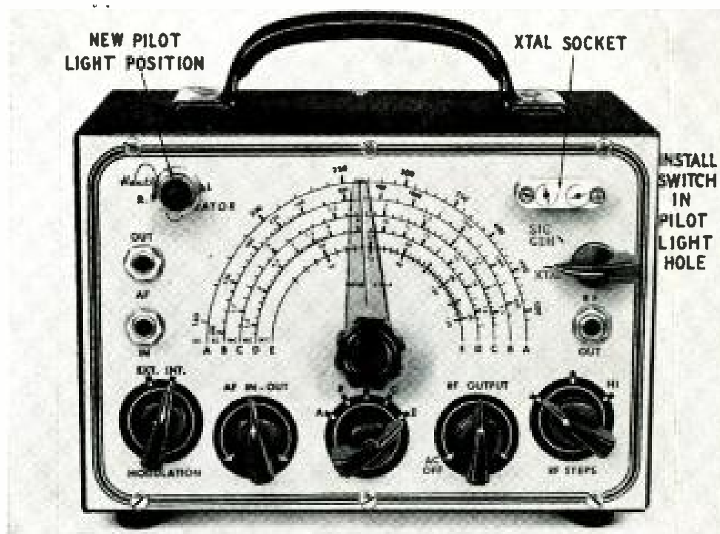
Test Crystals with your Signal Generator

By RONALD L. IVES

An easy modification that can also supply TV-marker frequencies

NEARLY every amateur operator and serious experimenter has a simple AM signal generator—usually a variable-frequency r.f. oscillator with a fixed-frequency audio oscillator for modulation. Amateurs especially generally need some type of crystal tester or harmonic generator as well. This is usually a "Rube Goldberg" assembly of junk-box parts, capable only of emitting the fundamental and harmonics of the crystal under test.

Typical circuits of a signal generator (*a*) and a crystal oscillator (*b*) are shown in Fig. 1. Since many of the components—including the power supply—are the same for both circuits, the signal generator can be made to perform all the functions of the crystal oscilla-



A *Heathkit* signal generator converted for normal or crystal operation. Most commercial generators can be adapted easily without seriously affecting accuracy of frequency-dial calibrations if additional r.f. wiring is done carefully.

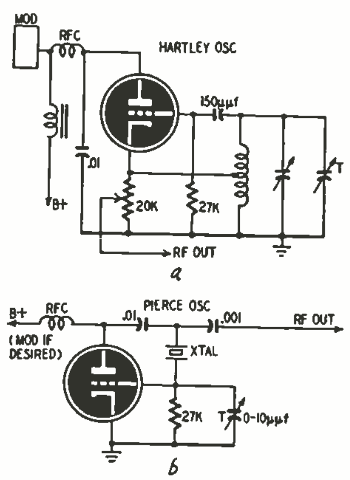


Fig 1—Typical oscillator circuits. (a) Hartley oscillator used in many signal generators. (b) Pierce crystal oscillator preferred for high harmonic output.

tor—and even modulate the crystal output—by simply adding a 4-pole, 2-position switch, a crystal socket, a small trimmer, and a fixed capacitor. The circuit of the combination signal generator-crystal oscillator is given in Fig. 2.

Arrange the components so that all leads carrying r.f. are as short as possible, to minimize changes in the calibration of the signal generator. The trimmer C1 is not always necessary with triodes, except with 6C4 tubes. About 5 μμf is adequate, but the adjustment is usually not critical. If this crystal circuit is applied to an electron-coupled oscillator, the grid-to-ground trimmer may be necessary for adequate feedback.

When the switch is in the SIG. GEN. position, the instrument functions as before modification, except for a possible slight shift in the calibration. This can usually be compensated for by adjusting the trimmer on the main tuning capacitor (C2) or the band trimmers.

When the switch is set for XTAL, the output contains the crystal fundamental, many of its harmonics, *and* some strong spurious frequencies.

To determine the fundamental frequency of a crystal, plug it in the oscillator socket, set the selector to XTAL position, and log all frequencies at which its output can be picked up on the receiver. If in doubt as to whether you are picking up the crystal output or the carrier from some other local oscillator, turn on the signal-generator modulation. This will permit definite identification. After logging, determine the common difference between the logged frequencies. This will be the fundamental of the crystal.

When, as is common, the successive differences are not quite the same, their average will give a good indication of the fundamental frequency of the crystal. With many receivers, differences up to 5 percent result from circuit and calibration vagaries.

The XTAL position is also highly useful for aligning communications receivers equipped with crystal filters. In some models the filter crystal can be removed from the receiver and inserted in the oscillator to provide the i.f.-aligning signal. After alignment, the crystal is replaced in the filter circuit, then phased, and the receiver is ready for operation.

The Pierce crystal-oscillator circuit used is a particularly good one for test purposes, as almost any crystal that will oscillate at all will operate quite well, and at its fundamental frequency.

Numerous tests with a signal generator modified in this manner (see photo) indicate that the modification is well worth the $2 and 2 hours it cost.

One additional kink in crystal testing: If the frequency of the crystal and its condition are completely unknown, quite a bit of time may be used up in looking for an oscillation, only to find,

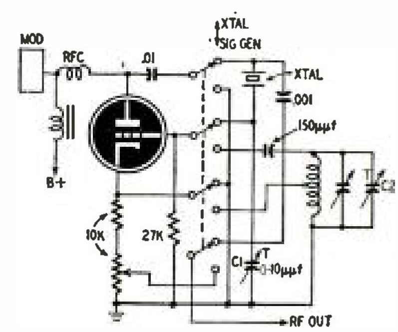
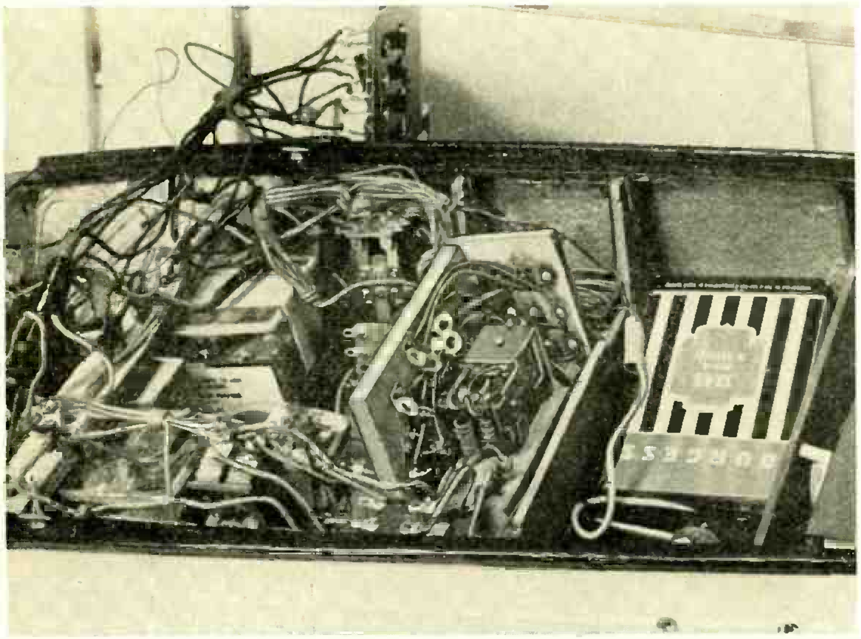


Fig. 2—Switching arrangement for adapting signal generator for crystal testing. Trimmer capacitor T1 is generally needed only with some small triodes.

later, that the crystal is dead. If you connect a vacuum-tube voltmeter across the output of the signal generator, it will read if the crystal is oscillating, and will not read if the crystal is dead. (Set the meter on its lowest a.c. range, and connect a capacitor in series with the input.) END

COVER FEATURE

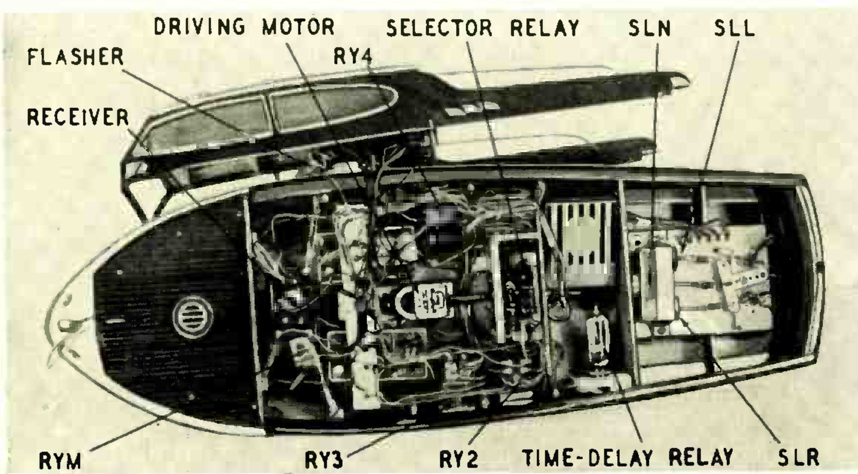
RADIO CONTROLLED SPEEDBOAT



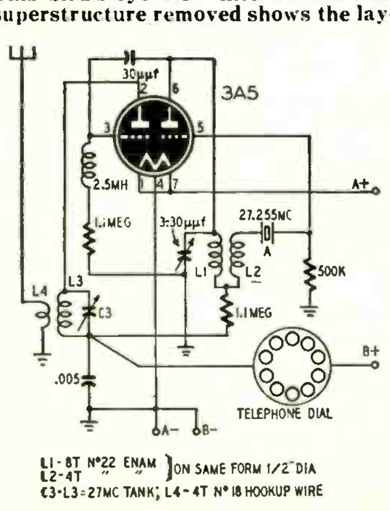
A closeup of the heart of the radio-control mechanism. The selector relay (SR in the schematic) is the partially walled-in unit at the left of the 45-volt B battery.

Telephone-dial control on the FCC's new license-free 27.255-mc channel

By M. GORDON MOSES



This bird's-eye view into the hold of the model cabin cruiser with the deck and superstructure removed shows the layout of the complete radio-control installation.



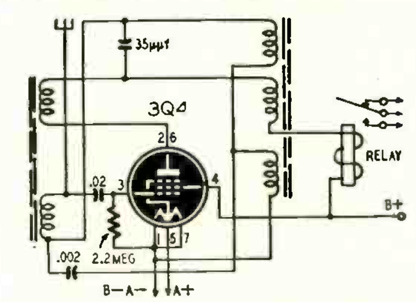


Fig. 1 (left)—Circuit of the *Telasco* 27.255-mc control transmitter. Power input to the final is less than 5 watts.

Fig. 2 (above)—Schematic of the regenerative receiver installed in the model speedboat. An extra feedback winding energizes the plate-load relay.

IN THE HEAT of summer, there is no better electronic project than one which can be pursued outdoors. Sailing a model power speedboat under radio control offers as much excitement and pleasure as actually being at the helm of a full-size water craft. Operation on a license-free band makes construction even more attractive.

The basic model

The boat chosen was a Sterling Model Company type B6M, a scale reproduction of a 32-foot Chris-Craft cabin cruiser. Dimensions are approximately 28 inches long and 9 inches wide at the beam. The cabin and rear decks are removable to facilitate a neat, compact radio control layout. Over-all height at the cabin roof is 10 inches, providing ample room in the cabin for additional control components. Actual "bathtub" tests on the finished model showed a displacement of over 14 pounds, more than adequate for the most advanced radio control work. The installation weighed 8½ pounds and the water line falls flush with the underside of the bangrails. A specially constructed rudder mechanism permits left-right-neutral rudder action with automatic limit switches to cut out power and conserve battery drain. The motor as shown is a No. 108, manufactured by K & O Company, Los Angeles. Since tests proved it to be short-lived, it will be replaced with a "Hi-Drive" unit made by Specialty Battery Division of the Rayovac Company. Several views of the boat showing placement of components are shown in the photos.

The transmitter

Fig. 1 is a schematic of the transmitter, a conventional 2-stage unit employing a Raytheon 3A5 h.f. twin triode. The first stage is a crystal-controlled oscillator and the second stage is an r.f. amplifier. These units have a final input of 4.8 watts, meeting FCC requirements for power on the new 27.255-mc band for radio control, and they are manufactured by American Telasco, Ltd., Huntington, Long Island. Routine form 555 (FCC) should be filled out and sent to the FCC before operation.

A modified telephone dial pulses the B plus. The unit is tuned with a 0–50-ma meter in the plate lead; a dip in current indicates optimum operation. For control under 100 feet, 67½ volts B plus is sufficient, but 135 volts assures reliable control over a radius of a half mile.

The receiver

A schematic of the receiver is shown in Fig. 2. A commercial regenerative unit built around a 3Q4 pentode, it employs an added loop of positive feedback to reinforce plate current change to a subminiature sensitive relay. The antenna is approximately 20 inches long. The unit should be tuned with the cabin top off while the boat is in the water due to the "loading" effect of the water. The receiver is also a Telasco, Ltd., unit.

The constructor of course can construct his own receiver, though FCC regulations make it advisable to use a commercial transmitter. A suitable circuit for such a receiver was published in the article "Model Plane Control" in the June, 1952, issue of this magazine.

The control circuit

Since operation is on one spot frequency only (27.255 mc±.04%) single-channel control must be employed. A time-delay circuit, utilizing a make-before-break relay and a lock-release relay as major elements, is shown in Fig. 3. Operation of the circuit is as follows:

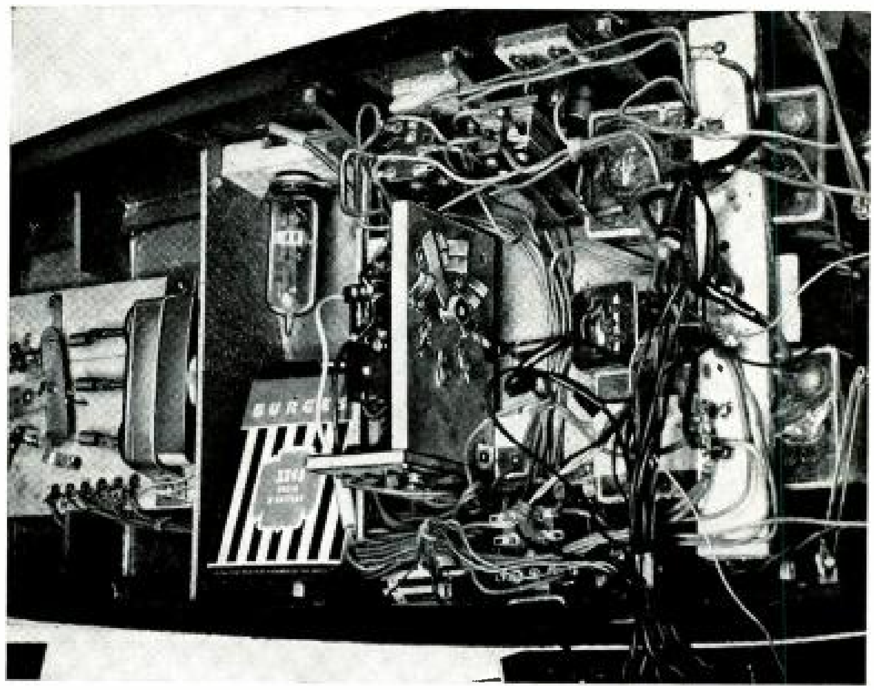
All spring relays (selector SR and automatic motor RYM excepted) are shown normally unenergized. When a signal is received from the transmitter, sensitive relay RY1 closes its contacts 1 and 2, energizing a d.p.d.t. relay RY2 (Potter & Brumfield KR-11, 6-volt d.c. coil). Contacts 2 and 3 on RY2 complete a 6-volt circuit to the release coil RYR4 on RY4 (Potter & Brumfield LK-11, 6-volt d.c. coils), and contacts 5 and 6 on RY2 operate selector relay SR (specially built—see P. 50) through batteries B1 and B2.

When the signal ceases, RY2 de-energizes, activating heater of time-delay relay TDR (Amperite No. 6NO5 or 6NO5T) through contacts on 5 and 6 on RY3 (make-before-break 2-stack, Guardian Electric Co.), 2 and 3 on RY4, 4 and 6 on RY2, by furnishing 6 volts from B1 via the B1 plus contact RY2-3 and B1 minus contact RY2-6.

After 5 seconds, contacts 1 and 2 on TDR close, activating RY3 coil and completing circuit to RYL4 (the locking coil) through RY3-1, RY3-3, and B1. Note that RY3-1 and RY3-3 complete the circuit to RYL4 coil and hold it closed until TDR heater cuts out when RY3-5 and RY3-6 open up.

When TDR heater cools, heater secondary contacts TDR-1 and TDR-2 open and release RY3. Now RYL4 is locked in and the heater is out through open contacts of RYL4-2 and RYL4-3. RYL4-4 and RYL4-6 are locked in, completing the circuit from the common inner ring of selector to B1 minus. The shorting bar SB will now complete the return circuit through the ship's function on which SB is resting, back through a 6-volt or 12-volt positive bus bar. All relays are now ready for the next cycle.

If the transmitter is pulsed consecutively within intervals that are reasonably less than 5 seconds, the circuit to the heater of TDR does not have


Locations of the principal control components in the model speedboat's hull. The rotary selector switch in the center controls all operations of the model.

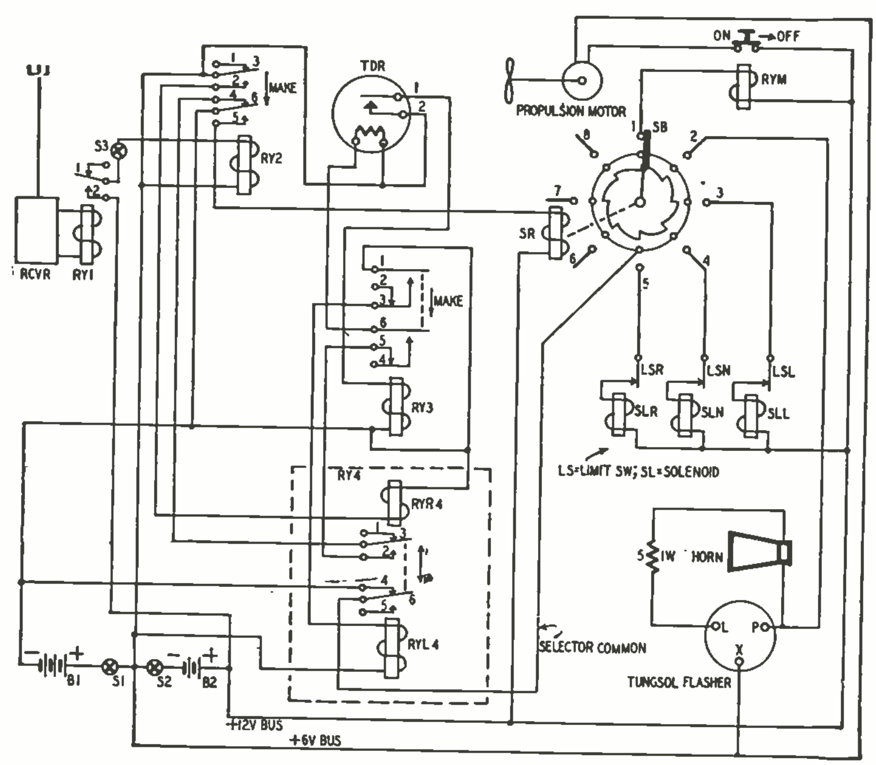
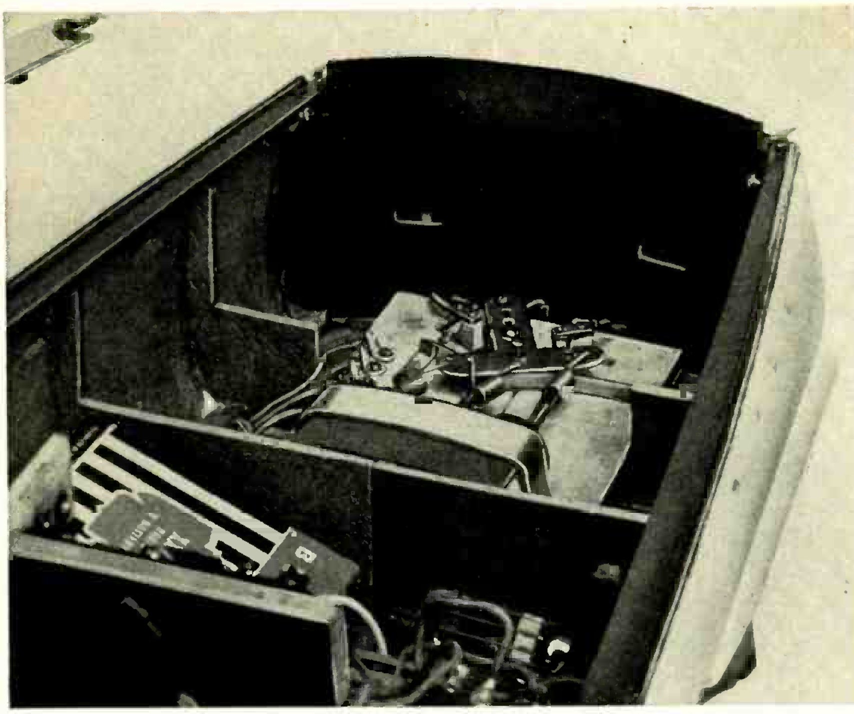
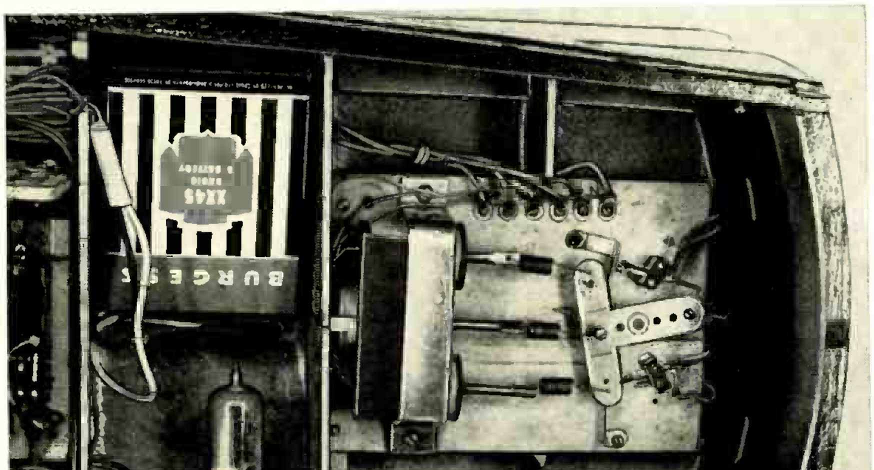


Fig. 3—Wiring diagram of the control circuits. The selector relay SR is a modified Lionel train-control unit. See the text for details of relay operation. There is an error in the relay wiring. Contacts 4 and 6 are transposed on RY3. Revise the wiring and numbering of RY3 so contacts 5 and 6 are normally closed.



The stern of the model speedboat showing the solenoid-operated tiller mechanism. The limit switches at port and starboard positions reduce battery drain.



This overhead view of the speedboat's stern shows the simple construction and mounting arrangements of the tiller, control solenoids, and plunger linkages.

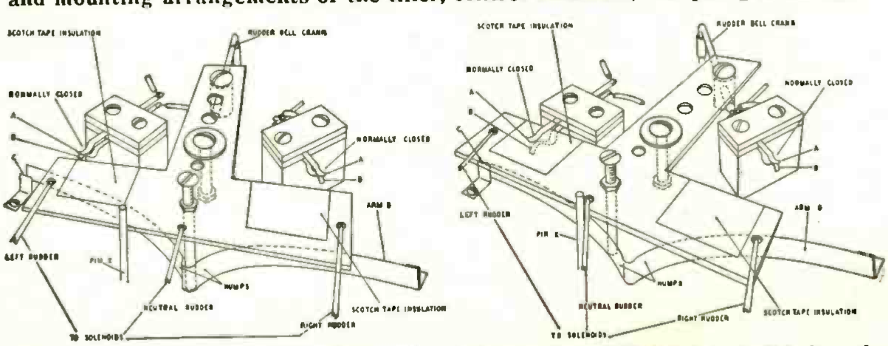


Fig. 4—Two views of the rudder action. When either full right or full left rudder is applied the A,B, switches are opened; at neutral rudder, switch C,D.

opportunity to energize, and hence the selector relay can be made to bypass undesired circuits. Leaving the shorting bar in any given position over 5 seconds will lock RYL4 in and complete the ship's function circuit corresponding to that position. By changing the heater characteristic of TDR (10-, 15-, or even 30-second units are available) more freedom of operation is gained at the expense of speed of response to the transmitter signal.

The ship's function circuits include a motor relay, RYM; three rudder solenoids, SLR (right rudder), SLN (neutral rudder), and SLL (left rudder); and a "beeping" horn. This accounts for five of the eight selector circuits. Plans are being made to install a set of running lights in the future. Time and ingenuity are the only limits to further ship's functions.

Rudder details

The rudder mechanism is shown in detail in Fig. 4. Very little power is required to turn the rudder, and the natural forward motion of the boat helps further to foster easy rudder action.

Materials for control unit

Relays: RY1—sensitive relay, Telasco 5-A or equivalent; RY2—Potter & Brumfield KR-11, d.p.d.t., 6-volt d.c. coil; RY3—Guardian, d.p.d.t., make-before-break, 2-stack, 6-volt d.c. coil; RY4—Potter & Brumfield LK-11 with 6-volt d.c. coils; SR and RYM—selector and motor relays, see text; TDR—Amperite 6NO5 or 6NO5T, time-delay relay, 6-volt heater, normally open type.
Miscellaneous: B1, B2—Willard NT-6 batteries, 6-volts, 2 ampere-hours; S1, S2, S3—s.p.s.t. slide switches; resistor (in horn circuit), 5 ohms, 1 watt.

Power is economized by the limit cutout switches A,B and C,D. A flat brass arm which acts as the tiller is forced between the A,B contacts at either full right or full left rudder, opening the active solenoid. A small pin X under the tiller presses against a spring-brass arm D to close C,D, except when the tiller is in the neutral position. The tiller arm was cut from stiff brass, the switch arms from thin spring brass. The solenoids are 1 inch in diameter and 1¼ inches long, fully wound with No. 22 double cotton covered wire.

Special components

Special attention is called to the selector relay (SR) and the motor relay (RYM). The selector relay is built around an automatic reversing relay sold by Lionel Electric Corp. These have 12-volt coils and a ratchet mechanism. By drifting the rotor pin out and inserting a longer shaft into the ratchet wheel, a unit can be made up as shown in Fig. 3 and the photos.

The same basic unit is used as a motor relay (RYM) by tying off the leads properly; the net result of the revamping is a s.p.s.t. switch which provides "on-off" alternate switch action with successive pulses. In this way, the motor can be kept on while other ship's functions are being actuated.

END

NOVICE TWO-TUBE SUPERHET

has full-band coverage on 40 and 80 meters

By RICHARD GRAHAM

THE mere thought of constructing a superhet receiver is enough to arouse a feeling of fear and frustration in the hearts of most budding hams and novices. Who can blame them, considering the tricky alignment and tracking problems which one finds in the average home-made superhet? It's no wonder that the novice who must build his equipment settles for an inferior t.r.f. or regenerative receiver. This need not be the case if you construct this simplified superhet which was designed with the novice and radio beginner specifically in mind.

The set has only two tubes, both of which perform dual functions. Tracking problems have been eliminated by using separately tuned oscillator and r.f. sections. Ready-made coils eliminate another bothersome headache for the beginner. The oscillator and i.f. adjustments are exceedingly simple, thus making this receiver ideal for the novice who wants something better than just a simple regenerative or t.r.f. type of receiver.

This super covers not only the 80-meter novice frequencies but also all the general class amateur frequencies on both 80 and 40 meters, thus preventing obsolescence. After all, today's novice will be of legal necessity, next year's general class licensee. As such, he'll probably be interested in both 80- and 40-meter c.w. operation. This extra band feature adds very little to the cost (one coil and one switch) and is certainly worth having, even as a novice, for it enables you to listen to what's going on on another band, dx, conditions, etc.

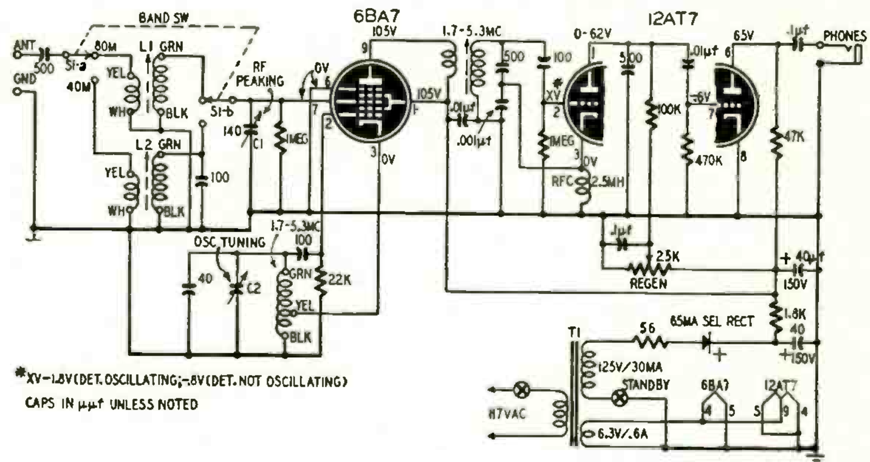


Fig. 1—Schematic of the superhet for the novice and budding ham. A regenerative second detector provides high sensitivity and serves as a b.f.o. for c.w.

The circuit is simple

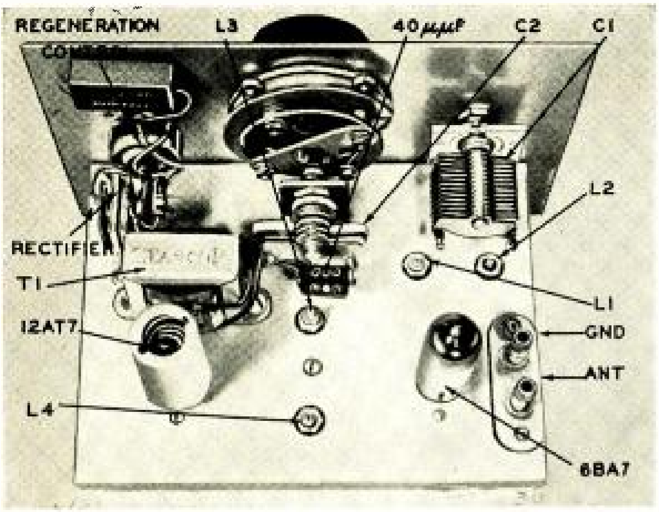
Circuitwise, the receiver consists of a 6BA7 mixer and oscillator, 12AT7 regenerative detector and audio amplifier, and a simple selenium-rectifier power supply. See Fig. 1.

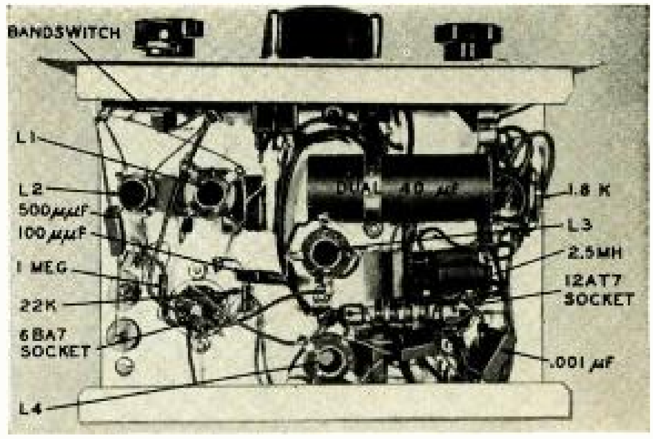
The mixer-oscillator circuit performs in the usual way. A signal appearing on the control grid of the 6BA7 (pin 7) beats with an oscillator voltage to produce another totally different frequency in the plate circuit. This latter frequency is called the i.f. (intermediate frequency). However in this particular circuit, we use what normally is an inherent disadvantage of superheterodyne reception—the image frequency—to provide two-band reception. When the local oscillator section of the receiver is working on 5.25 mc and the i.f. is peaked to 1.75 mc, either a 3.5-mc or a 7.0-mc signal can be heard. Thus the incoming signal can be either the sum of or difference between the i.f. and oscillator frequencies. Whether the sum or difference frequency predominates is determined by the r.f. tuned circuits L1-C1 (80 meters) and L2-C1 (40 meters). These circuits are switched in or out of the circuit according to which band is desired.

One-half of a 12AT7 double-triode is used as a regenerative detector to convert the i.f. signal to an audio signal. A regenerative detector is used because its sensitivity is higher than other types of detectors. This adds another panel control (the regeneration control); however the inconvenience is more than made up by the increased sensitivity. This particular circuit arrangement is slightly different from the usual regenerative detector. In this case it was dictated by the choice of the i.f. coil. In most cases, regenerative detectors use a tickler feedback system which involves another winding on the coil. This type of coil isn't easily obtainable, so I used a standard 1.7–5.3-mc r.f. coil in a Colpitts circuit. The Colpitts circuit is usually used as an oscillator. However a regenerative detector is only a modified oscillator which is made to just barely oscillate. The REGENERATION control is used to adjust the plate voltage on the detector to bring the circuit up to the fringe of oscillation. At this point a part of the amplified r.f. signal appearing in the plate circuit is fed back into the grid in the same phase as the original signal to increase the amplitude of the input signal. Thus the sensitivity of the detector has been increased tremendously.

This i.f. signal which has been detected or rectified is amplified by the second half of the 12AT7. The output of this audio amplifier is then fed into a pair of headphones. Use high-impedance phones or the audio output will appear weak.

To obtain the utmost in economy as well as safety, a simple transformer-fed half-wave selenium-rectifier type of power supply is used. Safety-wise this type of supply is a cut above the usual a.c.-d.c. type of supply, yet it retains the simplicity and most of the economy of this type supply without any sacrifice of safety. The transformer delivers





Top and bottom views of two-tube communications superhet. Note the simplicity of the parts layout and wiring.

30 ma d.c., which is adequate for this set. It also has a 6.3-volt winding which takes care of the heater requirements of the 6BA7 and 12AT7.

Constructing the set

The receiver is constructed on a standard 5 x 7 x 2-inch chassis, similar to the Bud type AC-402 chassis which has closed ends. The depth of the chassis is its most important consideration because coils L1, L2, L3, and L4 all extend approximately 1½ inches below the top of the chassis.

Keep all r.f. coil and capacitor leads short and direct. Other wiring such as the filament and d.c. wiring can be arranged to suit your convenience. The photographs of the unit showing the placement of the major components can be used by the constructor as a guide.

A 5-plate, 35-μμf variable capacitor was purchased for use as C2. However, I removed one plate to obtain more bandspread. This plate was easily removed by grasping it with a pair of long-nose pliers and bending. To make tuning even easier, it is suggested that the constructor purchase one of the vernier type of dials. The particular one used in this model was adapted from a surplus unit.

After the set is finished recheck the wiring against the schematic diagram before the set is plugged into the a.c. line. While plugging the set in immediately after it is finished without a recheck is an easy way to troubleshoot (just follow the smoke!), don't do it—it's usually expensive. If after you've finished rechecking the wiring, the set doesn't work, there is the possibility that some component is defective. Most beginning novices don't own a v.t.v.m., but more often than not, one can borrow or use a friend's meter. Often the local radio technician will prove a friend when you explain your predicament. At any rate the voltage of various points around the circuit is shown on the schematic as an aid to trouble-shooting if anything of this sort does develop.

Alignment of this receiver is quite simple and can be carried out with the aid of another communications receiver, or in the more conventional way with a signal generator. The method used will depend mainly on which instrument can be procured more easily.

To align the receiver with another receiver, first set the communications receiver to 1750 kc (1.75 mc) and place its antenna lead near coil L4 on the novice receiver. Advance the REGENERATION control on the novice receiver until a high-pitched squeal is heard in the headphones. Tune the adjusting screw on L4 until a carrier is heard in the communications receiver. Place the antenna lead farther away to prevent overloading of the communications receiver, and adjust L4 to the exact frequency of 1.75 mc. Lock the adjusting screw in this position with the lock-nut provided with the coil.

Next tune the communications receiver to 5,250 kc. (5.25 mc). Back off on the REGENERATION control so that the detector is not oscillating. Rotate C2 until the plates are almost all the way in. This will give us a little overlap on the band edges. Place the antenna lead from the communications receiver near L3 and tune the adjusting screw on coil L3 until a carrier is heard. Move the antenna lead farther away and tune L3 for exactly 5.25 mc.

The only remaining adjustments are those of L1 for 80 meters and L2 for 40 meters. Actually there is quite a bit of leeway in these particular adjustments, since any change in the inductance of L1 or L2 caused by these adjustments can be easily made up by adjusting the capacitor C1 to tune to resonance. Set the slugs in L1 and L2 so approximately six screw-threads are still exposed. Connect an antenna to the receiver. Advance the REGENERATION control until a rushing sound is heard in the headphones. Turn the big dial (C2) until a signal is heard. Rotate C1 for maximum volume. If the plates on C2 are all the way in for maximum volume, turn the adjustment screw of L1 (for 80 meters) or L2 (for 40 meters) in. This increases the inductance of these coils so less capacitance is needed to tune to resonance. Reverse the procedure if the plates are all the way out on C1 at maximum volume.

To align the receiver with a signal generator, place the signal generator output leads between pin 7 of the 12BA7 and ground. Tune the generator to 1.75 mc. Adjust L4 for maximum output in the phones. Next, transfer the generator output leads to the antenna and ground terminals. Tune the generator to 3.5 mc and switch the receiver to 80 meters. Tune the receiver so that the plates of C2 are almost all the way in. Adjust L3 for maximum output. Adjust C1 and L1 as necessary for maximum output. For 40-meter alignment, switch the set to 40 meters, set the signal generator to 7 mc, and tune in the signal with C2. (The plates of C2 should be almost fully meshed.) Peak the signal with C1 and the slug in L2. Vary the setting of the slug so the signal is maximum with C1 almost fully closed.

Materials for Two-tube Novice Receiver

Capacitors: (Mica) 1—40, 3—100, 3—500 μμf; 1—.001 μf. (Paper) 2—.01, 2—0.1 μf, 400 volts. (Electrolytic) 1—40 x 40 μf, 150 volts, dual. (Variable air-spaced) 1—35, 1—140 μμf.
Resistors: 1—56, 1—1,800, 1—22,000, 1—47,000, 1—100,000, 1—470,000 ohms, ½ watt; 2—1 megohm, ½ watt; 1—25,000 ohms, potentiometer.
Coils: 1—1.7–5.3-mc antenna coil (L1, Meissner 14-1061), 1—5.3–16.5-mc antenna coil (L2, Meissner 14-1064), 1—1.7–5.3-mc oscillator coil (L3, Meissner 14-1063), 1—1.7–5.3-mc r.f. coil (L4, Meissner 14-1062), 1—2.5-mh r.f. choke.
Switches: 1—2-position, 2-pole, single-deck rotary; 2—s.p.s.t. toggle.
Miscellaneous: 1—6BA7, 1—12AT7 tube; 1—65-ma selenium rectifier; 1—power transformer, 125 volts at 30 ma and 6.3 volts at 600 ma (Stancor PS-8415 or equivalent); 1—open-circuit phone jack, 2—9-pin miniature sockets (one with shield); 5 x 7 x 2-inch chassis (Bud AC-402 or equivalent); vernier dial, knobs, hookup wire.

For convenience, a paper scale can be made and the band limits marked for the settings of C1. In this case, these scales were made on a file card in india ink, then coated with colorless nail polish and cemented to the panel.

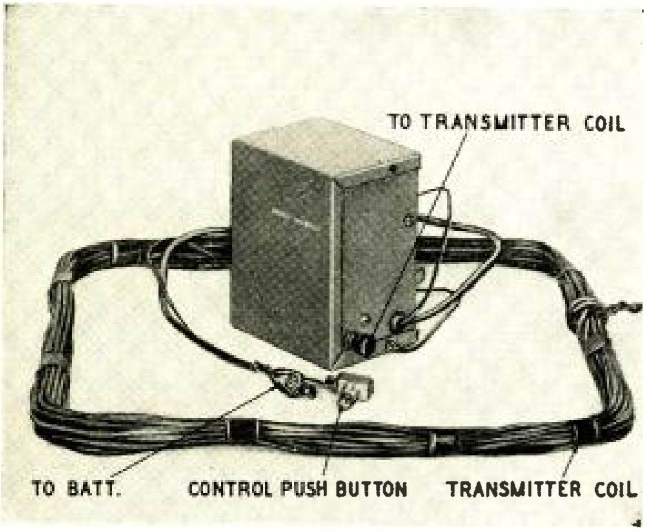
Tuning the receiver

As indicated before in the discussion of alignment, when tuning the receiver, keep the regeneration control adjusted so that a rushing sound is heard in the earphones (not a squeal). This indicates that the circuit is just barely oscillating and is the most sensitive condition. Peak up the signal by tuning C1 for maximum volume. END

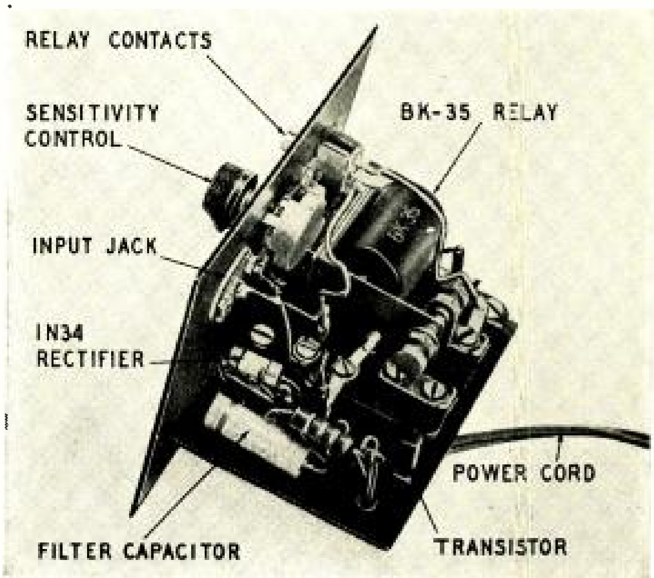
TRANSISTOR CONTROL RELAY

A tubeless gadget for remote switching with radio, light-beam, or magnetic-field control

By EDWIN BOHR



(Above)—The car-transmitter case and loop winding.
(Right)—Inside layout of the control-relay housing.



THE HEART of this tubeless remote-control relay is the new Raytheon CK-722 junction transistor. It will operate garage-door openers, lighting circuits, or alarms, or will perform almost any type of switching operation. The relay can be operated by a photocell, radio signal, thermocouple, or any device that will furnish .00025 watt of power.

Many transistor-operated circuits have been more novel than practical. We assure you this one is entirely practical—for two reasons. First, this transistor relay fills some honest-to-goodness everyday applications. Second, it costs only a little more than most vacuum-tube operated circuits.

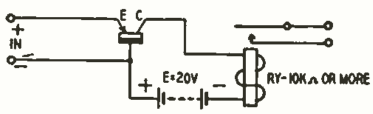


Fig. 1—Basic P-N-P junction-transistor relay circuit. Relay operates only when a positive signal or pulse is applied to the emitter electrode of the transistor.

The total cost of the unit—including the transistor—was only $13.15.

When you consider that the transistor will probably give years of service without attention, with negligible power consumption, also its ruggedness and small size, the transistor-operated circuit in this instance is a real buy.

Basic circuit

The basic circuit is shown in Fig. 1. Note that no bias is applied to the emitter circuit. Under these conditions only a few microamperes of collector *hole* current will flow through the relay. This type of operation is similar to biasing a vacuum tube to cutoff. With this P-N-P transistor, however, zero bias cuts off the emitter current and any further negative bias produces no effect.

The transistor will pass only the positive half-cycle of an a.c. input signal or a positive-polarity d.c. signal. These are desirable features in a relay circuit.

Since the current amplification of a junction transistor is a little less than 1 (see "Transistors," by John R. Pierce, in the June RADIO-ELECTRONICS), the power gain of the unit depends on the resistance of the relay in the collector circuit. For a given current change through the transistor, the voltage change across the relay coil depends on the coil resistance.

A relay with a high-resistance winding will operate on a much lower current than a low-resistance relay. But a 10,000-ohm relay, for example, that will operate on one milliampere of current, requires 10 volts across the winding, or a power input of 10 milliwatts. It is difficult to get this much voltage and power from a *radio* control signal, but it is entirely practical with low-frequency magnetic fields.

The transistor will amplify a signal current with a small voltage change to a much larger voltage change across the relay coil. A 10,000-ohm relay in the collector circuit will give a power gain of about 10. As the relay resistance is increased, the supply voltage also may be increased with a resulting greater power gain. If a 50,000-ohm or 100,000-ohm relay were available, the sensitivity could be increased 5 to 10 times.

(At this point it is well to remember that few components have been designed to match the characteristics of the transistor. We must still use vacuum-tube-engineered components. This situation will change in the months to come.)

The relay circuit

We found that a surplus relay—the BK-35—was the ideal unit for use with the CK-722 transistor. This relay has been advertised by several dealers for about $3, or it can be removed from a surplus 75-mc marker-beacon receiver. The relay will close on less than 0.5 milliampere without any readjustment and has a coil resistance of about 11,000 ohms.

A small power supply with a 1N34 rectifier was built for the relay circuit.

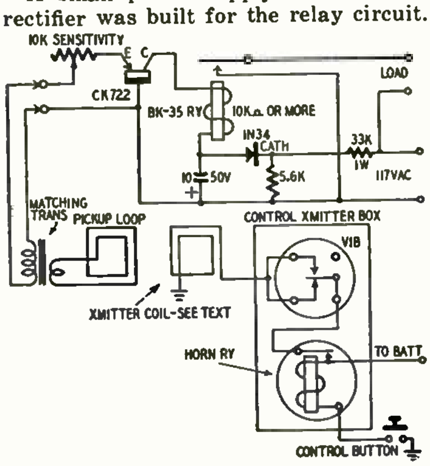


Fig. 2—Circuit of the transistor control relay and tubeless car transmitter. The units are linked by inductive coupling between the low-frequency magnetic field in the transmitter coil and the pickup loop imbedded in the ground.

The voltage divider across the power line assures that the 75-volts peak back-voltage rating of the 1N34 will not be exceeded.

A desirable feature of the power supply (in this case) is its *poor* voltage regulation. Its equivalent internal resistance is about 5,000 ohms. This resistance, together with the resistance of the relay, prevents the collector rating of the transistor from ever being exceeded.

The power-supply output voltage is negative to ground, since the collector must be supplied with a negative potential. Note that the a.c. input is applied to the *cathode* end (K or *cath*) of the 1N34, and that the *positive side* of the electrolytic is grounded. Check the output with a voltmeter for correct polarity before connecting it to the transistor circuit. A high positive voltage applied to the collector can ruin the transistor.

A series-resistance sensitivity control is inserted in the emitter circuit. It is needed where large control voltages—two or three volts—are likely to be encountered. This control corresponds to an adjustable cathode-bias resistor on a triode vacuum tube: increasing the series resistance increases the bias and limits the current through the tube.

The emitter input impedance of the circuit (grounded-base, zero-bias operation) was measured and found to be about 3,000 ohms for *very small* signals, and around 1,000 ohms for signals large enough to actuate the relay. A signal of 0.5 volt will actuate the relay, so this represents a power of .00025 watt. The BK-35 relay can very probably be adjusted to close on even less input power.

Operation

We have been using the relay to turn on the yard and garage lights at the touch of a button in an automobile. It could just as easily operate a garage-door opener.

The automobile transmitter uses no tubes and is very simple, inexpensive, and rugged. About two hours are needed to assemble and install the transmitter and the cost is roughly $6.

Magnetic coupling is used between the automobile and relay. A 6-volt vibrator interrupts the battery current flowing through a transmitter coil mounted under the car. Another coil—the pickup loop—buried in the driveway has a current induced in it by the coil mounted under the car. The current in the pickup loop operates the relay.

A horn relay mounted in series with the vibrator permits the push-button control to be wired with ordinary low-current hookup wire. This relay costs about 75 cents at most auto-supply stores. It is not necessary to ground the vibrator or relay, but connections between coil, vibrator, and battery should be as short as possible and made with heavy primary wire.

A convenient place to mount the transmitter coil is between the front-bumper braces under the radiator grill of the car. The coil itself is 100 feet of No. 14 wire, wound in a rectangle approximately one foot square. Ordinary weatherproof light wire is inexpensive and ideal for this purpose. More turns can be used in the coil to increase the field strength, but if too much resistance is added to the coil the advantage of additional turns will be neutralized by the reduced current.

The pickup coil is also 100 feet of wire, but is wound in a square 1.5 or 2 feet on a side. Smaller wire may be used for this coil—hookup wire will do. We used the wire from an old 6-volt speaker field for the pickup coil.

A matching transformer must be used between the pickup coil and the transistor input. An ordinary output transformer will do the job very well. The voice-coil winding goes to the pickup coil and the primary leads go to the transistor. If the transformer has several taps, try changing them to find the combination that gives the greatest sensitivity. An old vibrator or filament transformer also will work—sometimes even better than an output transformer—because of the lower winding resistance.

The operating radius of the unit is about two feet. The transistor relay is actuated as the automobile passes over the pickup coil. You may find it convenient to use a ratchet-type relay in conjunction with the transistor relay. This will allow *up-down* or *on-off* operation of the controlled device.

Pulses from the transmitter coil are unidirectional or polarized. If the relay fails to operate, or lacks sensitivity, simply reverse the leads between the pickup loop and the matching transformer, *or* the input leads to the transistor—*not both*. It is also possible to operate two separate transistor relays selectively by reversing the direction of current flow and pulse polarity through the transmitter coil.

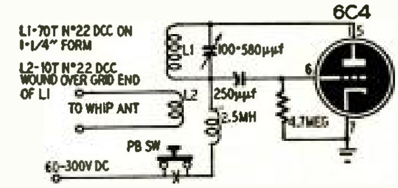


Fig. 3—Low-power 420-kc transmitter for r.f. operation of the control relay.

Construction

A standard five-prong in-line subminiature socket is used for the transistor. You can push out the second and fourth contacts, leaving three contacts with spaces between them. The raised dot on the socket should line up with the red dot on the transistor. Do not solder to the socket with the transistor in place, since the transistor's characteristics can be changed by excessive heat.

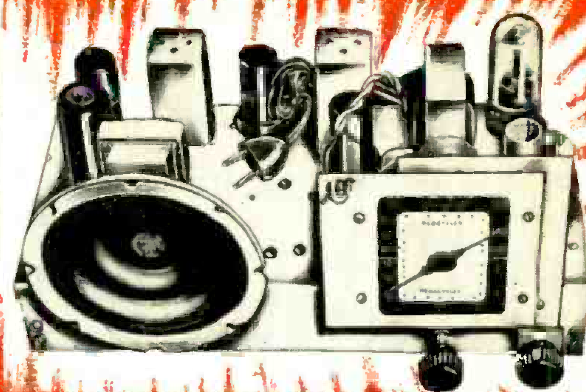
Materials for relay

Resistors: 1—33,000 ohms, 1 watt; 1—5,600 ohms, ½ watt; 1—10,000-ohm potentiometer.
Capacitor: (Electrolytic) 1—10 uf, 50 volts.
Miscellaneous: 1—CK-722 junction transistor; 1—5-pin, in-line subminiature socket; 1—BK-35 relay or equivalent (see text); 1—1N34 germanium diode; 1 plate-to-voice coil output transformer; 1—4-prong 6.3-volt vibrator; 1 horn relay; push-button switch; vibrator socket; chassis; wire; solder; hardware.

The wires from the pickup coil do not have to be shielded, as there is not much likelihood of picking up hum or other disturbances at these low impedances.

But, if the relay unit is more than about 20 feet from the pickup loop, mount the transformer at the loop end of the circuit to reduce line losses.

If a greater operating radius for the unit is desired, it can be obtained in two ways. Either add an extra transistor amplifier ahead of the relay stage or install a low-frequency r.f. oscillator in the car. An effective and simple transmitter operating at about 420 kc is shown in Fig. 3. At the relay end simply connect the transistor input to a parallel resonant circuit instead of to the pickup loop and matching transformer. The coil and trimmer can be the same as in the transmitter. END



A HIGH-PERFORMANCE PORTABLE

By CHARLES ERWIN COHN

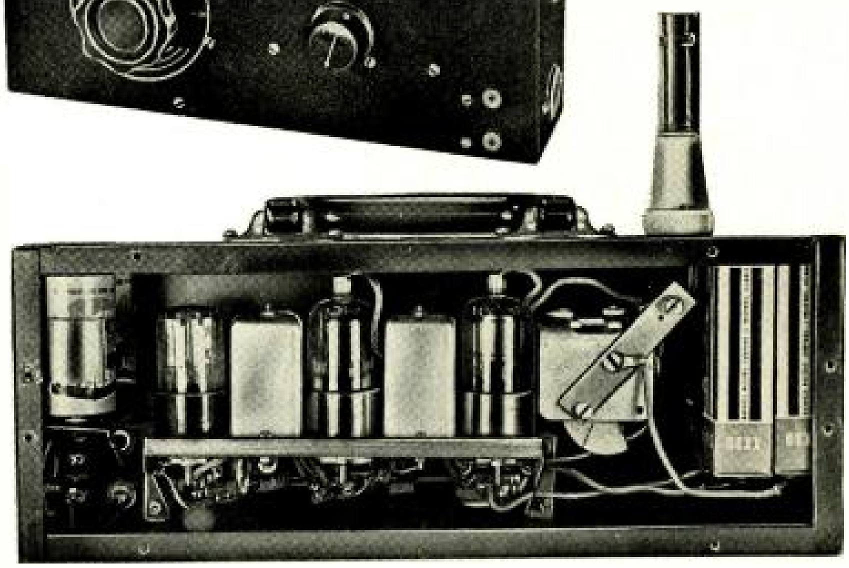


Photo A (left); Photo B (below)—Front and back views of the high-gain portable. The *Vari-loopstick* is mounted on the strap across the back of the tuning capacitor. The socket at the side can be used to check battery voltages, or for plugging in an external power supply.

FOR maximum utility a portable should have very high sensitivity, not only to give good performance in remote locations, but to take advantage of the low electrical noise levels in most outdoor areas.

The superheterodyne circuit used in practically every AM radio can be considered the ultimate in performance, simplicity, and low cost, so that any attempt to boost the sensitivity by improving the circuit cannot expect to proceed very far. There is much more room for improvement in the antenna and the sound reproducer. The usual loop antenna and loudspeaker, though convenient, are woefully inefficient compared to a whip antenna and a pair of headphones. In addition, headphones can give better tone quality than the tiny speakers found in average portables, and make it possible to eliminate the power-output tube with its heavy B-battery drain. While a speaker requires about a tenth of a watt to give fairly decent output, headphones can deliver the same volume at the ear with as little as 1/100,000 watt. This is a gain in sensitivity of 40 db, which is equivalent to *100 times as much voltage gain*. The effective gain would probably be even greater, as a loudspeaker must compete against ambient noise, which can be almost completely eliminated with headphones, especially if provided with suitable rubber pads.

By putting these ideas to work, even at the slight cost in convenience which they entail, I was able to build a simple receiver with extremely high sensitivity. The schematic is shown in Fig. 1, and is a conventional superhet with a few variations.

Circuit details

A *Vari-Loopstick* was used instead of

(CONTINUED ON PAGE 61)

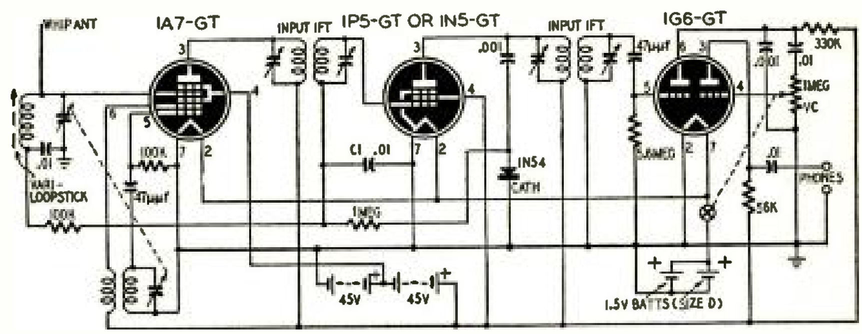


Fig. 1—Schematic of the high-performance portable. The ferrite-core antenna coil, whip antenna, and grid-leak detector give exceptional sensitivity and ample headphone volume without the extra drain of an audio power-amplifier stage.

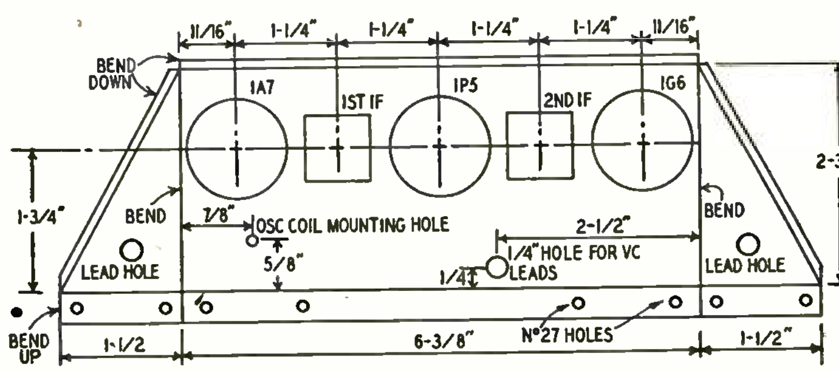


Fig. 2—Suggested layout for the chassis of the portable receiver. Mounting holes for the i.f. transformers and tube sockets will depend on the types used. The chassis can be formed from 22-gauge aluminum or cold-rolled steel.

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Provides choice of Wheatstone, Capacitance Comparison, Maxwell or Hay bridge circuits. Measurement of resistance-capacity-inductance-dissipation factor-storage factor. 1% precision silver mica capacitance standard ½% precision resistors.

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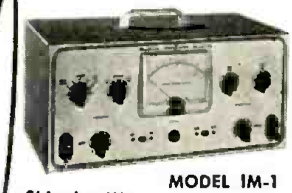

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Intermodulation distortion analysis is one of the most satisfactory methods of checking audio equipment. The IM-1 features two self contained high frequency generators (3,000 and 7,000 cycles) a 60 cycle low frequency source, intermodulation section, AC VTVM, and power supply all in one complete unit. Direct reading IM percentages on 3 calibrated scales 30%—10%—3%.

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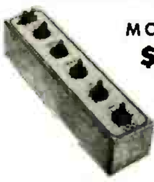

MODEL DR-1
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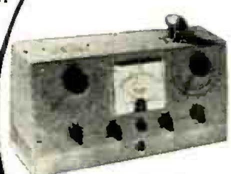
Individual switch selection of twenty 1% precision resistors in 1 ohm steps from 1 to 99,999 ohms. Sturdy ceramic wafer switches featuring silver plated contacts and smooth positive detent action.

Heathkit
Q METER KIT



A typical Heathkit invasion of the laboratory instrument field. Here is the first successful low priced Q meter ever offered in kit form. Oscillator supplies RF in the range of 150 KC to 18 mc. Reads Q directly on calibrated meter scales. Measures Q of condensers, RF resistance and distributed capacity of coils. Calibrate capacitor with range of 40 mmf to 450 mmf with vernier ±3 mmf. All measurements made at the operating frequency.

MODEL QM-1
$39.50 Ship. Wt. 14 lbs.

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Indicates audio frequency on large 4½" Simpson meter. Ranges 10 cycles to 100 kc at input voltage level of 3-300 volts RMS. The input wave shape is not at all critical. Useful in production line testing—indicating square wave frequency—determining generator output. Operation entirely electronic, no vibrating reeds.

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Switch selected 1% silver mica precision condensers providing capacity range of 100 mmf. to 0.111 mfd. in steps of 100 mmf.

MODEL DC-
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Heathkit
AUDIO GENERATOR KIT

A new extended range 18 cycles—1 megacycle audio instrument at a remarkably low price. Five continuously variable output ranges—600 ohm output impedance—low distortion figure, less than .4% from 100 cps through audible range.

MODEL AG-8
$29.50
Ship. Wt. 11 lbs.

Heathkit
BAR GENERATOR KIT

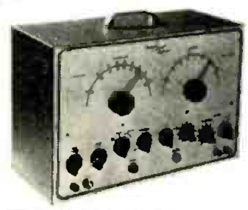
MODEL BG-1
$14.50
Ship. Wt. 6 lbs.

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing and the Bar Generator is the logical answer to the TV serviceman's problem in obtaining quick accurate adjustment information.

The Bar Generator produces a series of horizontal or vertical bars on the TV screen. These bars are equally spaced and will quickly indicate picture linearity of the receiver under test. Since picture linearity is independent of transmitting frequency, it is unnecessary to provide coverage throughout the VHF range, thereby holding down instrument cost.

The Heathkit Bar generator is simple to use and is extremely portable, providing a quick means of checking the television receiver either in your workshop or in the customer's home.

Heathkit
TELEVISION SWEEP GENERATOR KIT



Frequency coverage 10-90 mc and 150-230 mc. Variable sweep width 0-12 mc. built in absorption type marker, step and continuously variable output and blanking circuit.

MODEL TS-2
Ship. Wt. 20 lbs.
$39.50

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MODEL BE-3
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A variable 0-8 volt DC supply source rated at 10 amperes continuously and up to 15 amperes intermittently. Voltmeter, ammeter, automatic overload relay, fuse protection—heavy duty Mallory 17 disc rectifier.

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a conventional antenna coil, with its input lead connected to a whip antenna. The *Vari-Loopstick* was chosen rather than the cheaper *Ferri-Loopstick* because its screw adjustment makes for greater convenience and accuracy in alignment.

A 1A7-GT converter works into a 1P5-GT or 1N5-GT i.f. stage, which in turn feeds a 1G6-GT grid-leak detector and audio amplifier. This gives much more gain in one tube envelope than the usual diode-triode or diode-pentode.

A 1N54 high-back-resistance crystal diode serves as an a.v.c. rectifier, its back resistance serving as the usual load resistor.

Octal tubes were used instead of miniatures, both for their greater ease of wiring, and because there is no satisfactory miniature equivalent of the 1G6-GT. Overcompactness can only lead to trouble, as anyone who has worked with some of the commercial "personal portables" will agree.

Construction

The physical construction of the set is shown in Photos A and B, which show the front and back views of the equipment respectively.

Photo B shows the internal arrangement of the set. At the left are the A batteries, which are two size-D flashlight cells in parallel. They are mounted in a sheet-metal holder attached to the end of the cabinet. In the center is the chassis shelf which holds the tubes and i.f. transformers, as well as most of the wiring. This is made of sheet metal according to the pattern in Fig. 2, and is attached to the front panel with screws. All mounting and wiring on this shelf must be completed before it is mounted in the case. The volume control and switch are behind the 1P5 tube in the center. The i.f. transformers should not be bigger than 1 1/3 inches square and must both be the input type. Punch a small hole in the side of the first i.f.-transformer can, and bring the lead for the grid cap of the 1P5-GT out through the hole as shown. The oscillator coil is a standard battery-type (air core) and is mounted behind the 1A7 socket at the right side of the chassis shelf.

Next to the chassis shelf is the two-gang tuning capacitor. This is the superhet type with cut-plate oscillator section. The capacitor frame should have tapped holes in front so that it may be mounted through holes in the front panel and dial plate. The diagonal crosspiece on the back of the tuning capacitor is the bracket for the *Vari-Loopstick*. Install the capacitor with the trimmers on top, and drill holes in the top of the case so that these trimmers and the i.f. trimmers can be reached for alignment. These holes can be closed with snap buttons between alignments. To the right of the capacitor are the B batteries, two Burgess XX30, which are held against the end of the case with a bracket.

The whip antenna was purchased for $2.49 from the Burstein-Applebee Co., under their catalog number 19B764. It collapses to a length of 9 inches and extends to 5 feet, and is prepared for mounting by drilling out the eyelet on the bottom, removing the soldering lug, and tapping the hole with an 8-32 thread. The antenna can then be screwed on top of a hollow porcelain insulator, as shown in the photos. A soldering lug under the head of the mounting screw inside the insulator serves as a connection point, with the lead brought down through a hole in the top of the cabinet under the insulator. For ease in wiring, it is advisable to clip off the antenna lead supplied with the *Vari-Loopstick* and use a separate lead.

The wiring of this set is simple and noncritical, and follows standard practice. All fixed capacitors should be ceramic types. They are so much smaller than corresponding paper or mica units that they are essential in such a compact layout. If possible, use a pencil or gun-type iron for soldering, especially for making connections after the chassis shelf is in place. The case is a standard 5 x 13 x 3-inch steel chassis turned on its side. Its top surface is the front panel, and the bottom plate serves as a back cover. The tuning and volume knobs and the phone-tip jacks can be seen on the front panel in Photo A. On the right-hand end of the cabinet are a Fahnestock clip for a ground wire and an octal socket. This socket is not connected up at present, but can be used for operating the set from an external power supply, or as a group of test points for checking the internal batteries without removing them from the case.

Alignment procedure

Alignment of this set follows standard superhet practice. Either audible or output-meter indication can be used. A 0-1 d.c. milliammeter connected across the 330,000-ohm detector plate resistor can serve as an output meter, stronger signals being indicated by *lower* meter readings. Before alignment disable the a.v.c. by shorting out the .01-μf a.v.c. capacitor C1. The set can be aligned on stations, although a signal generator is preferable if available.

The first step is to align the i.f.'s by connecting the signal generator to the top cap of the 1A7 and peaking the i.f. trimmers.

For the r.f. alignment the signal generator must radiate its signal into the set through a short antenna wire connected to its probe. The whip an-

Materials for portable

Resistors: 1—5.6 megohms, 1—1 megohm, 1—330,000, 2—100,000, 1—56,000 ohms, ½ watt; 1—1-megohm potentiometer (audio taper) with s.p.s.t. switch.
Capacitors: (Ceramic) 4—.01, 2—.001 μf, 2—47 μμf. (Air variable) 1—2-gang broadcast tuning capacitor, with cut-plate oscillator section.
Miscellaneous: 1 *Vari-loopstick;* 1— battery-type broadcast-band oscillator coil; 2 input-type 455-kc i.f. transformers (see text); 1—1N54 germanium-crystal diode; 1— 1A7-GT, 1— 1P5-GT or 1N5-GT, 1—1G6-GT; 4 octal sockets; 1—5 x 13 x 3-inch metal chassis with bottom plate; 1—collapsible whip antenna (see text); 1 pair—high-impedance headphones; 2—45-volt B batteries (Burgess type XX30 or equivalent); 2—D-type 1.5-volt flashlight cells; 1—carrying handle; knobs, terminals, wire, solder, hardware.

tenna must be fully extended. During the adjustments, the hand must not come too close to the antenna, or it may introduce hand capacitance and throw off the alignment. Due to the lack of an oscillator-padder adjustment, the i.f. determines the lowest signal frequency to which the receiver will tune. This frequency must be determined by trial and error. To *lower* this minimum frequency, the i.f. must be *raised*, and vice versa. After these adjustments are complete, peak the oscillator at the *maximum* signal frequency by turning the gang all the way out and adjusting the oscillator trimmer.

The low-frequency r.f. adjustment is the slug of the *Vari-Loopstick*, which is peaked up on a signal near the low end of the dial. Then adjust the r.f. *trimmer* on a signal near the high end of the dial. Due to the large capacitance of the antenna, you may have some difficulty getting this trimmer to peak. In that case, either reduce the maximum frequency or accept a compromise adjustment.

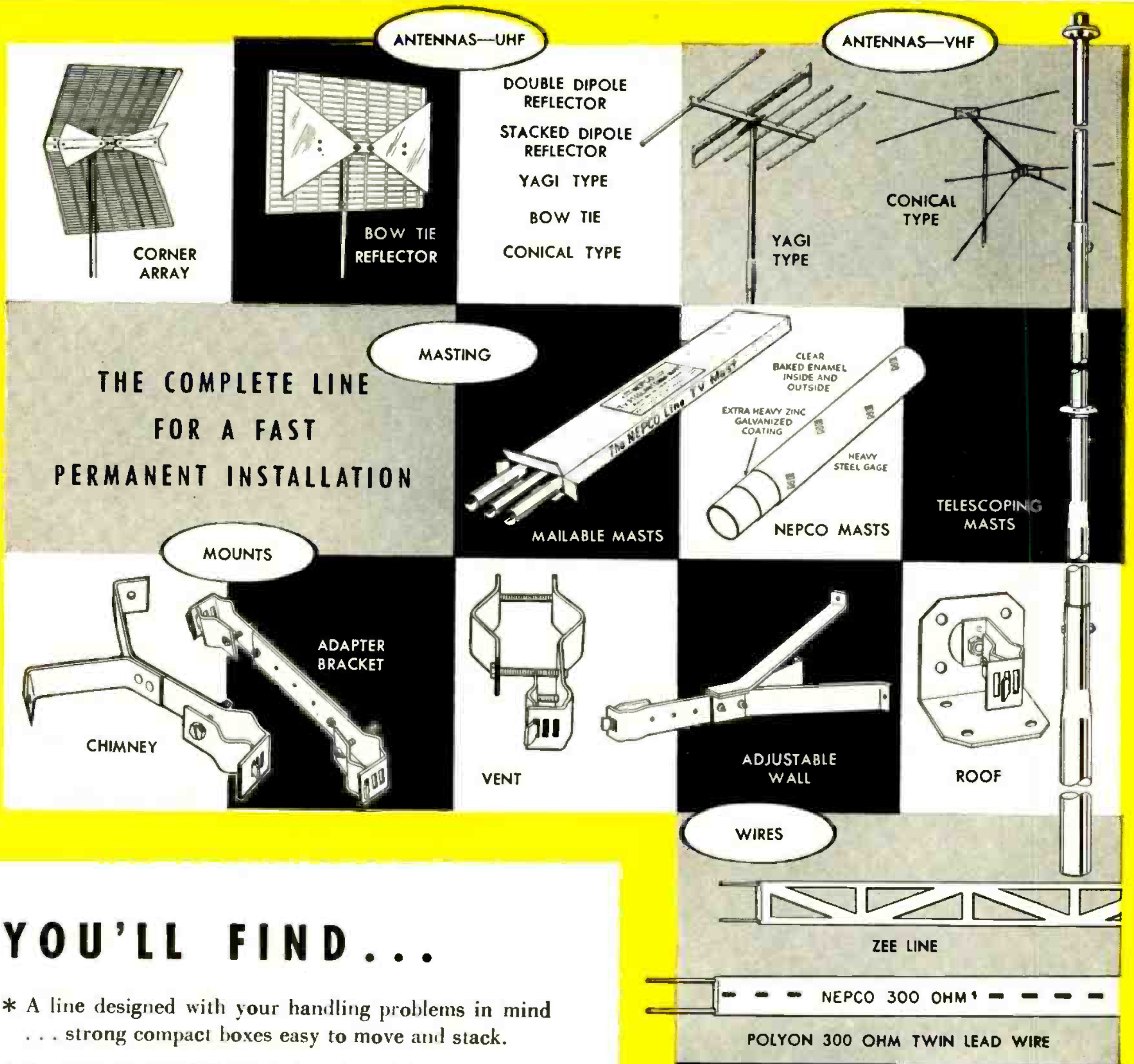
The sensitivity of this set has come up to the highest expectations. With the antenna fully extended in an outdoor location in Chicago it will receive over 25 stations with listenable volume, some as far away as 150 miles. Selectivity also is good, although the strong a.v.c. action may make it seem broad on very strong signals. A ground connection is not needed outdoors, but is helpful in some indoor locations. Since parts for this set, even all new, should not cost more than $20, it represents a real bargain in performance. END

INSULATING R.F. CHOKES

To protect the metal ends of a r.f. choke from accidental contacts in a crowded radio chassis, I cut the rubber tips off old medicine droppers and slip them over the ends of the choke.

This kink can be especially helpful in preventing many of the intermittent troubles which develop in crowded electronic chassis because of accidental shorting of the choke to ground or because of a fault of some other component in the circuit.—*John A. Comstock*

"So *that's* the way your television set acts up?—I'll go see if I can fix it."



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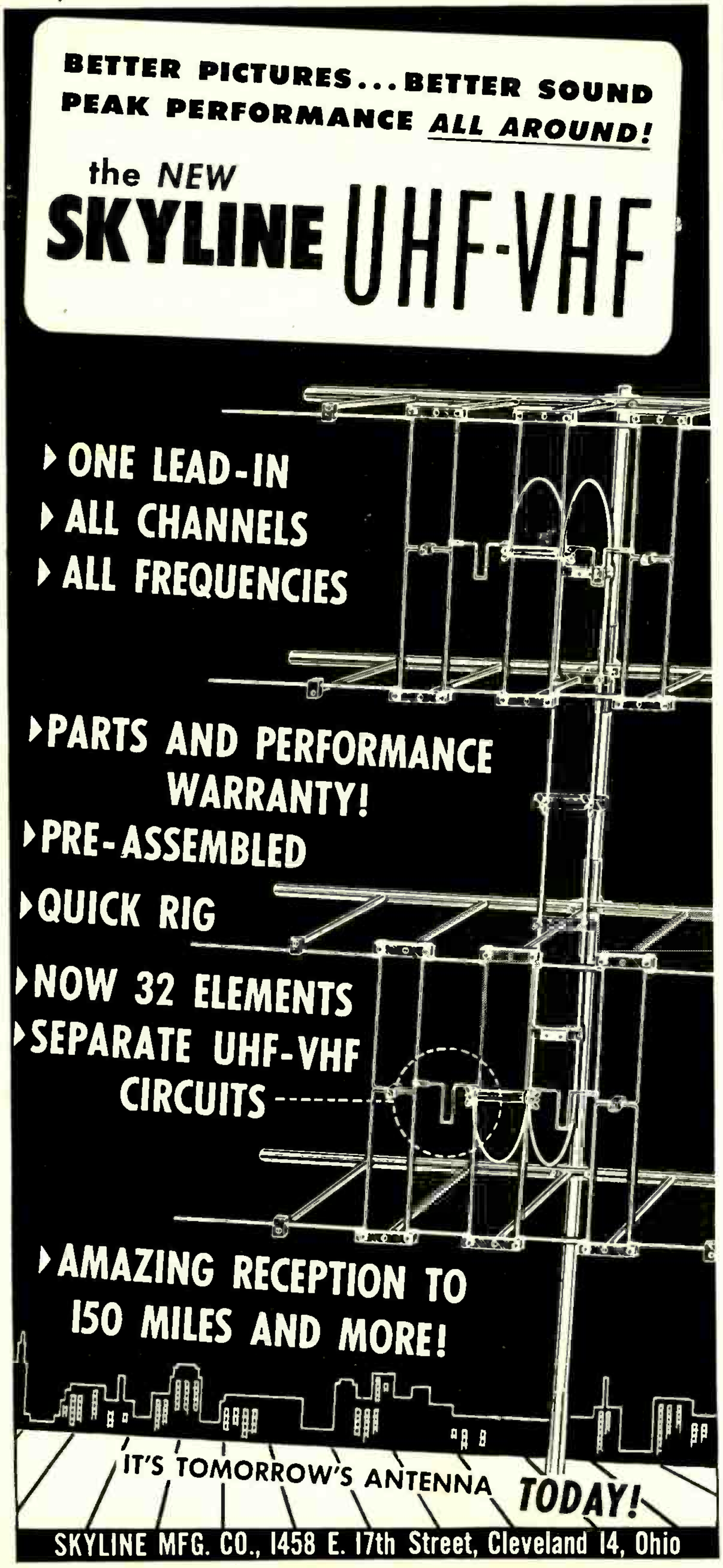


Broadcasters To Meet Defense Emergencies

Conelrad (*Con*trol of *El*ectronic *Rad*iation) is a plan to protect the country in case of enemy air raids. It permits some broadcasting stations to remain on the air during attacks to broadcast important civil defense information, yet prevents enemy planes from "homing" on the signals and using them as guides.

According to the FCC Conelrad regulations, certain stations will prepare themselves to transmit on one of two frequencies, 640 or 1240 kc. These stations will be grouped in *clusters*, all of which are interconnected by wire lines and all of which will operate on the same frequency. A number of clusters will operate in a *division*. These will correspond to the USAF Air Divisions.

All stations which participate in the plan will be required to install equipment which will permit them to operate at reduced power on one or both Conelrad frequencies, and to turn the station on or off on receipt of signals received over wire *control lines*, which may also carry the programs transmitted during air alerts.

If an air raid alert is sounded, all AM broadcast stations not in the plan, and all FM and TV stations, will notify listeners that they are discontinuing normal broadcasting for an indefinite period, and that listeners can receive civil defense information at 640 or 1240 on their regular radio sets. Non-Conelrad stations will then close down.

The Conelrad stations remaining on reduce their power—probably to not more than 5 kw—and transmit in a peculiar random fashion calculated to confuse planes attempting to use their signals as direction indicators. The stations of a cluster will transmit one at a time for periods of from 5 to 40 seconds. As one station ceases transmission, another picks up without a break in the program. In a normal cluster any one station would be on the air from 5 to 40 seconds and off from 2 to 6 minutes. Most listeners would receive information without interruption, but planes trying to home on the evasive signal would be hopelessly confused.

With reduced station power there may be situations where a receiver near the edge of a cluster might fail to receive one or more of the stations in the cluster, and other situations where only one broadcast station might be available to cover a wide area. The first trouble is not likely to be common. With only two possible frequencies to tune to, the sensitivity control of the receiver can be turned up all the way. Automatic volume control will take care of the loud stations, and in most cases the weak ones will come in with sufficient volume.

Where only one station is available, it will operate in short bursts of 10 seconds or so, going off the air for a minimum of 30 minutes between bursts. Thus urgent messages can be sent without aiding enemy planes. END

IN THE home-receiver field, the only new tube announced this month is the Sylvania 6BQ6-G. This is a large-bulb version of the familiar 6BQ6-GT, with better heat dissipation and higher plate-voltage ratings of 600 volts d.c. and 6,000 volts positive peak. Basing and other ratings are the same as those for the 6BQ6-GT.

Transistors are the real headliners this month. RCA announced four new commercial types—two contact transistors and two junction transistors. The 2N32 point-contact transistor is intended for pulse or switching applications, and can handle switching frequencies as high as 2.7 mc when used as a current amplifier, or as high as 900 kc as a voltage amplifier. (In this case the frequency limits or cutoff points are the frequencies at which the output is down 3 db from the response at 100 kc.) The 2N32 has a current gain of 2.2 and a power gain of 21 db when operated at a collector voltage of –25, and an emitter current of 0.5 ma, with a 10,000-ohm collector load, a signal-source impedance of 500 ohms, and a signal frequency of 5,000 cycles.

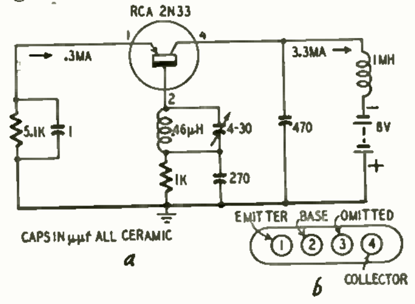


Fig. 1—(a) 50-mc oscillator using 2N33 transistor. (b) Basing of the four new RCA transistors described in the text.

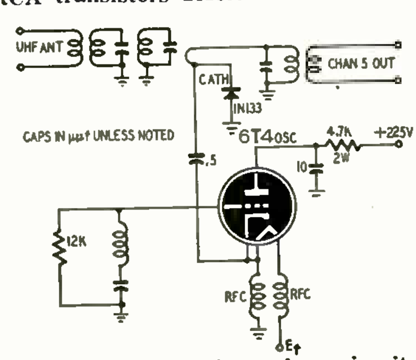


Fig. 2—Typical u.h.f. mixer circuit.

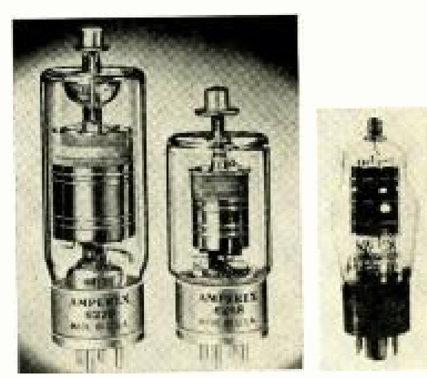
The 2N33 point-contact transistor is designed especially for oscillator service in the 50-mc region. A test circuit suggested by RCA for this transistor is given in Fig. 1-a. The 2N33 can deliver approximately 1 mw of r.f. in this circuit.

The RCA 2N34 and 2N35 are P-N-P and N-P-N junction transistors respectively, designed for low-level a.f.-amplifier service. Their characteristics are identical except for their opposite input and output polarities and operating voltages. This makes it possible to obtain push-pull output from a matched pair by feeding them from a common single-ended source (see "I.R.E. Convention 1953" by Fred Shunaman, in the June RADIO-ELECTRONICS). Both types have an *alpha* (current gain) of 0.98, and a power gain of 40 db at 5,000 cycles, with a collector load resistance of 30,000 ohms, and a signal-source impedance of 500 ohms. These ratings are with 6 volts d.c. on the collector, a collector current of approximately 10 microamperes, and an emitter current of about 1 ma.

The ratings given for all four RCA transistors are based on an ambient temperature of 25° C. All have the same 3-pin *Linotetrar* base shown in Fig. 1-b. Four of the new units just fill an ordinary thimble.

Mixer crystal

CBS-Hytron is producing a new germanium mixer diode—type 1N133—for u.h.f.-TV tuners. The 1N133 has a glass-filled phenolic case less than ½-inch long with notches at the cathode end for quick identification, and copper-clad steel connecting leads. In the representative mixer circuit shown in Fig. 2, the 1N133 has an average conversion gain of 0.5 and a noise figure of 16 db at 850 mc.



(Left) New Amperex hydrogen thyratrons. (Right) Sylvania's new heavy-duty 6BQ6-G horizontal-output tube.

Industrial types

Two improved hydrogen thyratrons have been introduced by Amperex. These are the 6268 and 6279, which are completely interchangeable with the older 4C35 and 5C22 respectively. The new tubes have self-regulating sources of hydrogen, and have a minimum life expectancy of over 1,000 hours—almost double the life expectancy of the earlier types.

END

How to make PICTURE-TUBE SUBSTITUTIONS EASILY

New CBS-Hytron Substitution Chart for Television Picture Tubes helps you pick logical substitutions easily, quickly. It's a cinch to use this complete, up-to-date Chart. An Index of types leads you to proper Substitution Group listing all readily interchangeable types. You pick an available type . . . with the least number of necessary service adjustments. That's it. No other references required. You save time . . . money. You need this indispensable CBS-Hytron TV Substitution Chart. Get it from your CBS-Hytron distributor. Or write direct today.

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1. *General Introduction* outlines scope and purpose.
2. *Introductory Notes* give details on tabulation.
3. *Typical Substitution* shows how to use Chart.
4. *Index* indicates Substitution Group for each type.
5. *Substitution Groups* narrow choice to logical substitutions.
6. *Basing and Outline Drawings* give basing and dimensional data.

FEATURES

- All necessary data given for all electromagnetically deflected types, regardless of make.
- Directly interchangeable types indicated.
- Other popular substitutes and required service changes high-lighted and explained.
- Substitution, not conversion, emphasized.

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Crystal Diode Guide describes 92 types. Includes 7 dimensional diagrams. Indicates typical application for each type.

TV Picture-Tube Guide lists 164 types, 19 basing diagrams for all magnetically deflected picture tubes.

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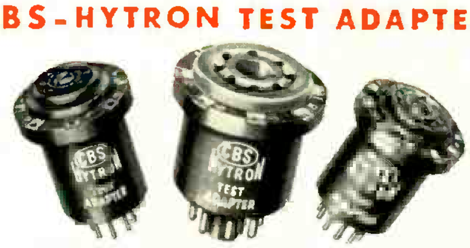
Not just an identification. But a colorful decal that sells for you! *Sells* your magic ability to recapture new-set sparkle. Let this decal pull customers to you. Get it today from your CBS-Hytron distributor.

NOW 3 CBS-HYTRON TEST ADAPTERS



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You can now test *all* sockets dynamically . . . "topside." Without wrestling with heavy chassis. Without disturbing wiring or parts. Just plug tubes into Test Adapters and Adapters into sockets. Presto, socket connections are topside . . . ready for your test prod. You check voltage, resistance. gain, intermittents, oscillation. Trace signals, etc. All the e-a-s-y topside way. Order *all three* Test Adapters from your CBS-Hytron distributor today.

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G-E HOLDS SERVICE LUNCH

Problems of the service technician were discussed with the technical press at a luncheon given April 9 in New York City by the General Electric Co. Present were editors of all the magazines interested in radio and TV service.

G. A. Bradford, advertising manager of G-E's tube department, summarized what General Electric had done in the effort to sell the service technician to the set-owning public. He cited the well-known ads in national magazines, mailers made available to service organizations, the booklet distributed to set owners, and surveys made under the direction of the G-E tube department.

The meeting became a round table, at which problems of the service technician and the possibilities of reducing them through the joint efforts of the service technician and his associations, the manufacturers, and the service, trade, and technical magazines, were discussed.

N.H. TO BAN QRM?

An act introduced in the New Hampshire Legislature would give town and city councils the right to fine persons or corporations who unreasonably or unnecessarily disturb or interfere with radio or TV reception.

The bill provides that on receipt of a complaint, the town or city authorities shall investigate, and where the complaint is justified, shall give notice to the person, firm, or corporation to eliminate the cause of such unreasonable or unnecessary disturbance. If the disturbance is not eliminated within the time fixed in the notice (provided it can be corrected at a cost of not more than $15) the willful violator would be subject to a $50 fine, to be administered by the municipality.

The bill refers to persons or firms "having authority to transact business in this state" and presumably would not apply to a private citizen ruining neighbors' radio or TV reception with a radiating TV receiver. However, it might be applied to radiating community-antenna systems, which would be operated by concerns "having authority to transact business in the state."

SERIAL NUMBER BILL KILLED

The New York State bill which would have made it a misdemeanor for a dealer to sell electrical appliances from which identification numbers had been removed was vetoed by Governor Dewey.

The Governor pointed out that New York already has a law which makes the willful defacing of serial numbers a criminal act. This law, he pointed out, is intended to punish those who tamper with serial numbers to prevent the detection of a crime or to defraud the manufacturer or purchaser of the device.

The proposed law, he said, was weaker than the present one, since it specifically excepts second-hand sales.


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*4402 | Dual Stack | 11.0 | 14.25
*4404 | 4 Bay Stack | 14.5 | 35.00
Corner Reflector 4450 | Single Bay | 11.2 | 14.50
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Stolen articles are usually found in the second-hand market. Thus the bill would have slight relation to detecting thefts or frauds, and might easily become a device to help enforce manufacturers' restrictive sales policies, or fair trade laws. It is not the function of a penal statute, Governor Dewey believed, to do this, since "injunctive relief or civil remedies are available to aggrieved manufacturers, and the criminal courts should not be a forum for the settlement of essentially economic disputes."

LOS ANGELES ARREST

The Los Angeles authorities are continuing an energetic—though possibly sometimes spotty—campaign against dishonest TV practices in that city. Lewis S. Scott was reported arrested recently on suspicion of grand theft. According to detectives, a set which had been checked in the police laboratory and found perfect was put out of order by installing two defective tubes and was taken to Scott's store. The bill was $69.16. No details as to what repairs were claimed to have been made were given.

A little later, however, it was reported that Maurice Rappaport, the operator who had been sentenced to 150 days in jail for selling an old set for $200 as "new" (RADIO-ELECTRONICS, May, 1953, page 116) was released after six days because he "was in financial difficulty and had a wife and children to support." In spite of his financial difficulty, however, a $75 fine was levied.

CALIFORNIA LICENSE BILL

A bill which would create a board of radio and television examiners, and license all radio and TV technicians and apprentices has been referred to an interim committee of the Legislature for study.

Harry Ward, well known among South California technicians as active in radio and TV associations, was one of those who pleaded the cause of the licensing bill at the hearings.

The bill proposes:

1. To create a board of radio and television examiners in California and require the licensing of all radio and television technicians and apprentices. The board would consist of five members appointed by the Governor.

2. To give an examination to all persons applying for a technician's license.

3. Every license would have to be renewed prior to January 15 of each year.

4. The fees would be as follows: Application for registration for an apprentice, $2; application for registration for technician, $5.

5. The annual registration fee as a qualified technician under one or more classifications would be $5. The annual license fee for service dealers and service organizations would be $25 for the first year and $15 thereafter. END

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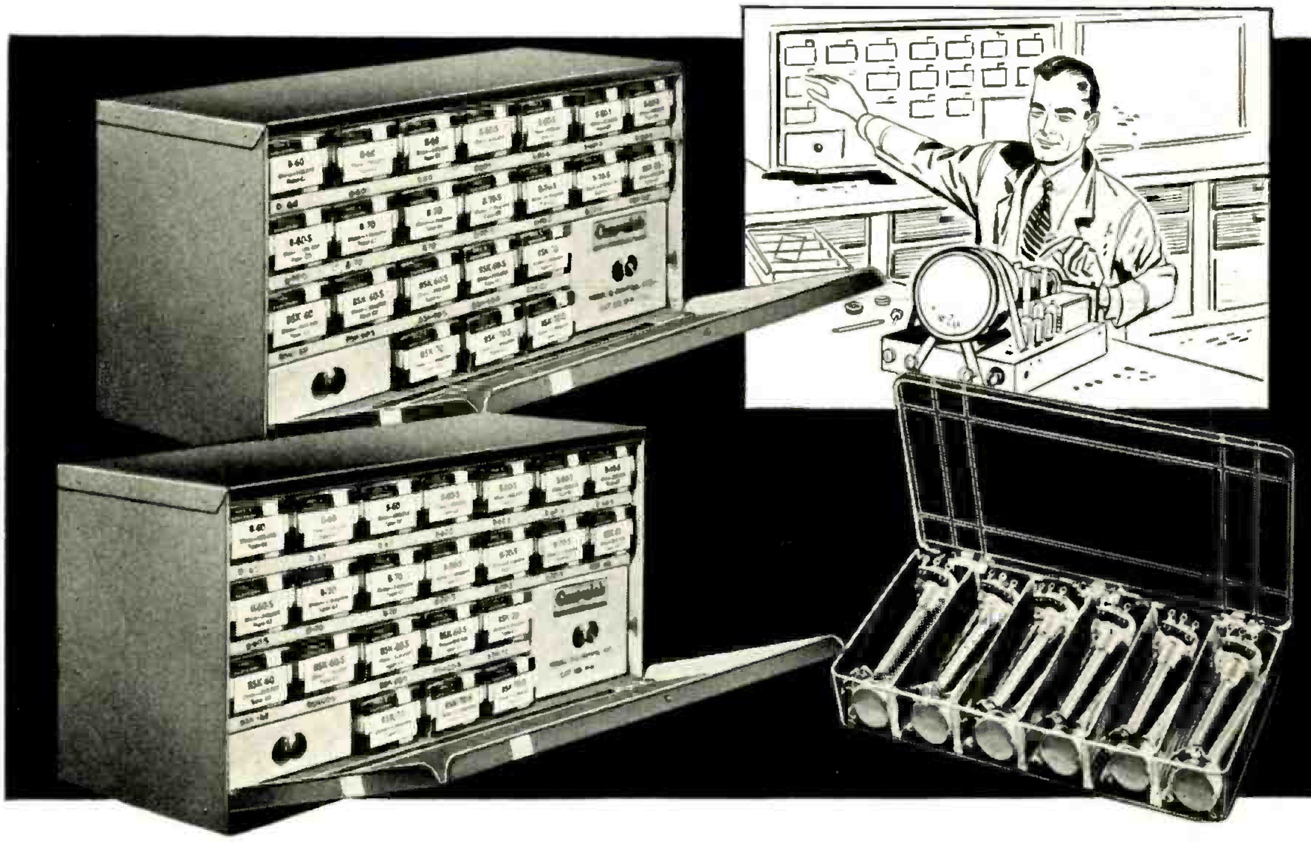

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Three kit deals are available: B-A Kit contains 22 controls (8 types) in ½ and 1 megohm. All units C2 (audio) taper. Newest, revised Kit B-B has 22 controls (15 different types), plus 4 "Fastatch"* type KB line switches. Ten handy Plasti-Pak Kits of 12 controls each also save time. You pay for parts only — no charge for containers.

You can count on your Centralab Distributor for exact Blue Shaft replacements to keep kits well stocked. So see him soon — he'll be glad to supply the kits you need.

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Kit Deal B-A — 22 controls. ½ meg and 1 meg. B types have standard 3" shafts, full-length fluted mill. BSK types have 2⅛" split-knurl shafts. In handy metal cabinet.

PLAIN TYPE				SWITCH TYPE			
3	B-60	½ meg.	C2	5	B-60-S	½ meg.	C2
2	B-70	1 meg.	C2	3	B-70-S	1 meg.	C2
2	BSK-60	½ meg.	C2	3	BSK-60-S	½ meg.	C2
2	BSK-70	1 meg.	C2	2	BSK-70-S	1 meg.	C2

Plus one metal cabinet

Kit Deal B-B (Revised) — 22 controls and 4 "Fastatch" switches. All have standard 3" shafts, full-length fluted mill. In handy metal cabinet.

PLAIN TYPE

1	B-5	1,000	C1
1	B-10	5,000	C1
1	B-26	25,000	C1
2	B-31	50,000	C1
2	B-40	100,000	C1
1	B-59	500,000	C1
2	B-69	1 meg.	C1
1	B-75	2 megs.	C1
2	B-83	2.5 megs.	C1
1	B-84	3 megs.	C1
1	B-87	5 megs.	C1

SWITCH TYPE

3	B-60-S	½ meg.	C1
1	BSK-60-S	½ meg.	C2
2	B-70-S	1 meg.	C2
1	BT-80-S	2 megs.	
	T-600K		C13

"FASTATCH" SWITCHES

2	KB-1	SPST
1	KB-2	DPST
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Handy Plasti-Paks — 12 controls. 10 individual kits, also B type. Plain and switch type. C2 (audio) taper. Split-knurl shafts. In useful plastic containers.

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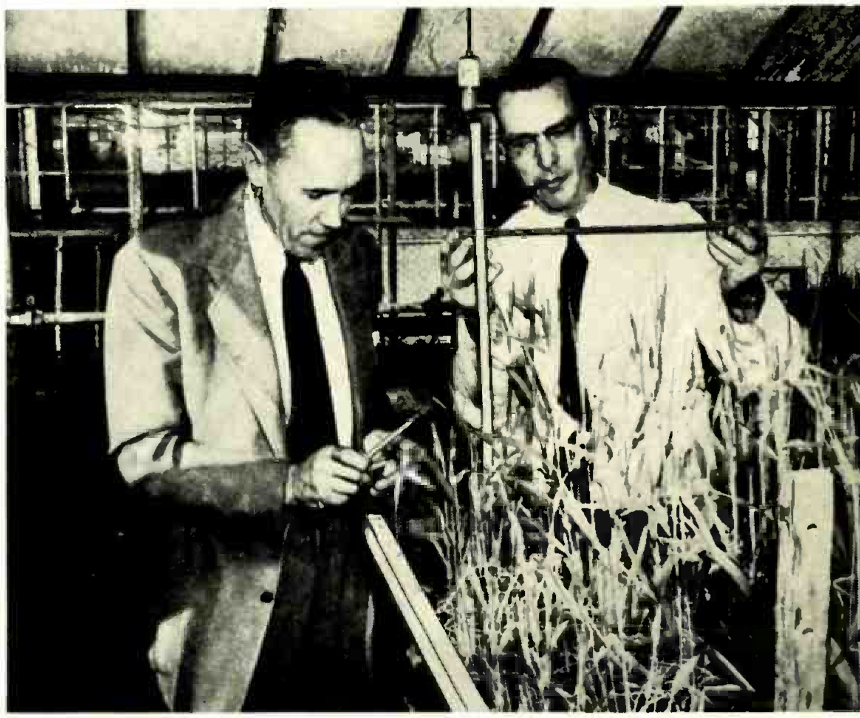
Stimulation of Plant Growth by ULTRASONIC WAVES

By GEORGE OBOLENSKY

Seeds treated with 800-kc vibrations show record yield



The author with Dr. L. P. V. Johnson of the University of Alberta checking development of cereal grains grown from seeds treated with ultrasonic vibrations.

ULTRASONICS, the science of generating and using mechanical vibrations at frequencies of several hundred thousand or even millions of vibrations a second, has already opened new fields of research in chemistry, physics, and medicine. Chemists have used it for desooting smoke in smokestacks of big industries. U.S. Navy research physicists have found that ultrasonic waves can de-gas liquids, and even disperse and suspend in water, despite the force of gravity, everything from cooking fats to aluminum!

Ultrasonics can do things as diverse as breaking the molecule of water into its constituent elements, hydrogen and oxygen, and also sterilizing milk. In the field of physiology, it has been found that bacteria killed by ultrasonic waves release enzymes that would not be released if the bacteria were killed by any other method. In medicine, deep massage with ultrasonic waves is used successfully for relieving such ailments as rheumatism and arthritis.

In addition to these applications in medicine and industry, physicists have found that ultrasonic waves can also stimulate the growth of plants. Although this field of scientific research has received relatively little publicity, its importance can be seen from the fact that the French Government has set up a special research station for acoustical physiology which will do work in agricultural ultrasonics, and in Germany the University of Hanover is conducting important experiments in this field.

In the more specialized field of plant cytology (cell structure), Doctors Wallace and Newcomber of the University of Connecticut succeeded in changing the chromosomes of sunflower plants with ultrasonic treatments. Other research workers treated potato tubers and found a significant increase in plant development and yield. According to their analysis, the ultrasonic waves seemed to have a physiological effect—the starch changes to sugar at a faster rate than usual—therefore the increased growth and yield.

At the Department of Plant Science of the University of Alberta, in western Canada, which is one of the great grain-producing areas of the world, the author conducted a series of experiments to determine the effect of ultrasonic treatment on the seeds of important cereal grains.

The purpose was not so much to observe the different growth developments, as to see the effect of different time exposures to ultrasonic waves.

The first experiments were made on "Olli" barley, an early-ripening variety, with a German machine—the Lehfeldt *ultra-vibrator*—which had a single crystal-controlled output frequency of 800 kc, and a maximum power output of 5 watts per square centimeter.

The seeds were first divided into three equal groups. These were then soaked in distilled water for two reasons:

1. To start the seeds germinating, as dormant plant cells do not respond to shock waves as well as germinated cells.
2. The water absorbed by the seeds is a much better conductor of ultra-

TABLE I

Time of Treatment in minutes	Average Height of Plants (in centimeters)			
	24-hour soaking		48-hour soaking	
	1st Rep.	2nd Rep.	1st Rep.	2nd Rep.
10	68.2	34.8	75.6	56.1
15	65.5	44.0	75.7	56.1
20	65.9	52.4	65.1	45.8
No treatment			52.9	

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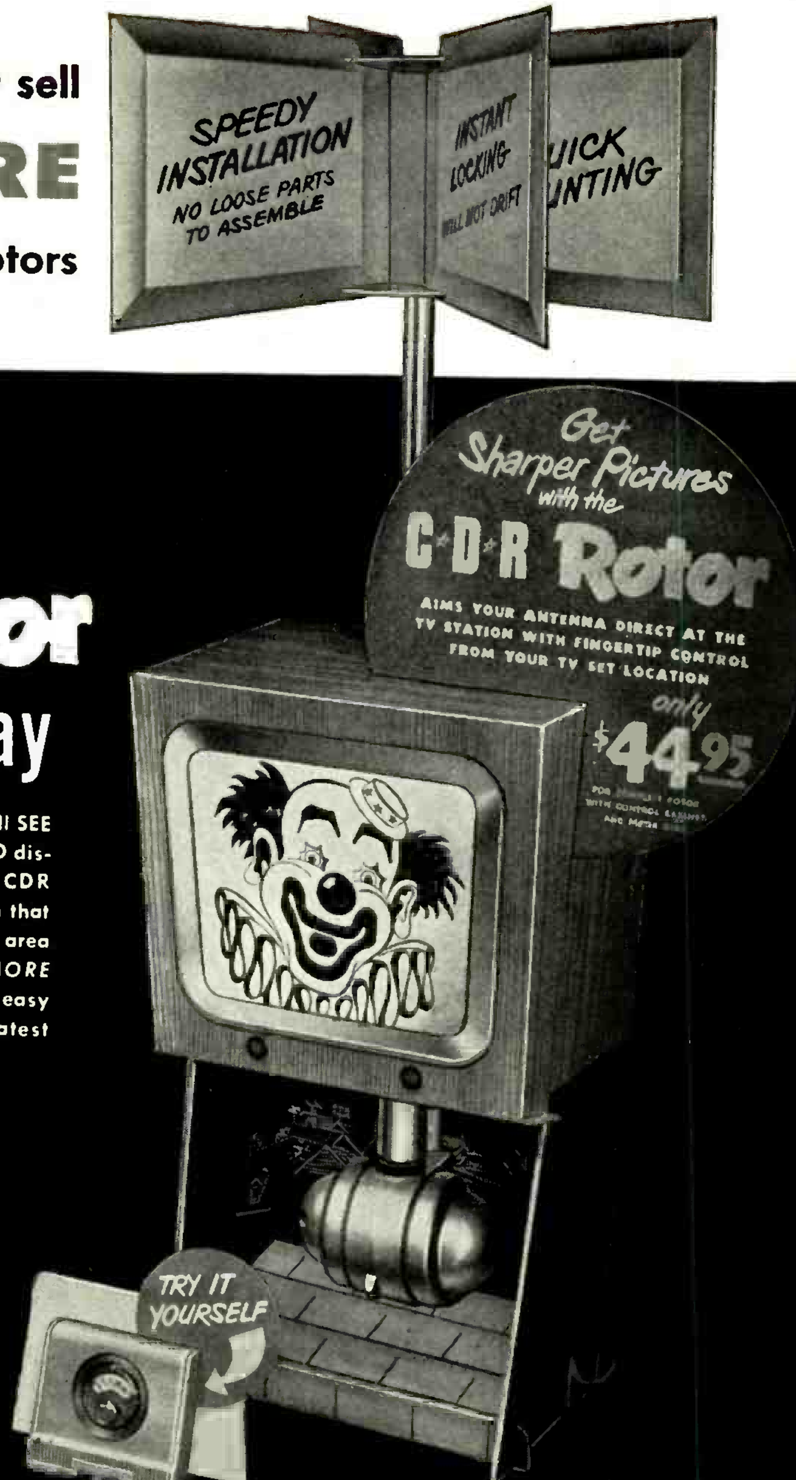

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WATCH FOR THE AUGUST ISSUE OF RADIO-ELECTRONICS ON THE NEWSSTANDS JULY 24

sonic waves than air and gives a better impedance match to the crystal.

One group was soaked for 24 hours, and the other two groups for 48 hours.

In accordance with standard experimental practice, one of the groups was set aside as a *control* and was not subjected to ultrasonic treatment. Each of the two remaining groups was then divided into three equal subgroups. These were given ultrasonic treatment for periods of 10, 15, and 20 minutes respectively. The treated seeds were then divided again into two *replicates* (a term used in agricultural science to indicate seeds planted in different types of soil, or raised under different conditions for comparison purposes). All the seeds were then planted and allowed to mature. The results of the experiment are given statistically in Table I. The growth figures for both replicates are highly significant, and show unmistakably the added growth of the treated seeds.

In another test some sunflower seeds of the variety Mennonite were dehulled. The seeds were then given 1-minute, 3-minute, 6-minute, and 10-minute treatments by the methods previously described. At complete maturity the diameter of the sunflower heads were measured. The results are given in Table II.

TABLE II

Time of Treatment (in minutes)	Average Diam. of sunflower head (in centimeters)
1	13
3	15.2
6	13.3
10	18.0

It would seem that within certain ranges longer treatments produce greater effects. The exact position of the borderline of increase has yet to be determined. The growth can be expressed in terms of the number of watt-seconds used. The machine used was capable of producing 5 watts per square centimeter maximum. Thus 10 minutes treatment at 5 watts would be 50 watt-minutes per square centimeter. Using more energy does not always induce more growth. In the opinion of the author there is an ideal frequency for each type of plant which will give the best results. Different plants seem to require different frequencies and far different amounts of energy.

Some sunflower seed was obtained from Dr. Wallace of the University of Connecticut. These were progenies of treated seed of the Giant Russian variety. In this region (Edmonton, Canada) this variety ordinarily grows to a height of 10 feet or slightly less. The first and second generation from the original seeds are at present averaging about 14 feet and are still growing. The stalks of these plants produce a tremendous amount of fiber which has many industrial possibilities. Several research groups are interested in ana-


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lyzing its potentialities. According to German sources the dry matter in the stalks usually contains 40% to 48% alpha-cellulose. This can be converted to a good-quality paper and also can be used in the textile industry.

It is interesting to note that some of the seeds treated are producing albino plants. These plants die early because they have no chlorophyl to produce food by photosynthesis. This indicates that, in some cases, ultrasonic waves are inducing mutations.

There is a great field for work on vegetable seeds like tomatoes and onions, because only small amounts of such seed are required for large acreages. Future study should be directed toward discovering whether ultrasonic treatment would make the crops mature earlier. At the present time, an experiment is being conducted to see if ultrasonic treatment can be used for killing loose smut, which is a common disease in cereal grains.

The author has treated potato tubers and found the same increases in the rate of growth and development as the other researchers mentioned above. Other preliminary work conducted with various breeds of oats and wheat has also shown promising results.

At present, the author is handicapped by lack of a precision ultrasonic generator that will give him an unrestricted choice of frequency and high output power. He cannot change the frequency of the Lehfeldt generator without changing a costly quartz crystal for another one equally expensive. He would like a machine capable of producing 20 watts or more ultrasonic power per square centimeter, but he is not an electrical engineer. He hopes that his problem will be solved in the very near future by electrical engineers. END

BROADCASTERS' "CAN-CAN"

New boons to broadcasters with more than a hint of forthcoming "technological unemployment" for large numbers of station personnel are foreshadowed by two recent announcements from widely different sources. The FCC upheld its recent rule relaxing license requirements for radio operators in many 1-kw and less broadcast AM and FM stations, and permitting remote-control operation of certain broadcast AM and FM stations with powers up to 10 kw.

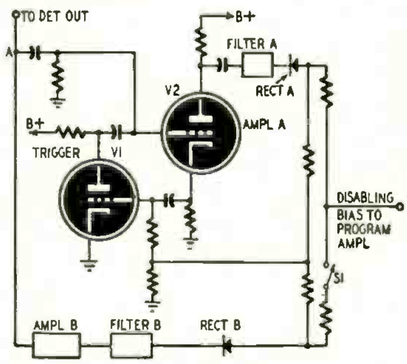
The other announcement is the development by Ampex Electric Corporation of a continuous tape player which permits a station to broadcast an 8-hour all-tape program automatically, even including recorded station breaks and local announcements cut in by synchronized clock mechanisms. The new machine runs at 3¾ inches per second, and has flat response to 7,500 cycles. Special tape-duplicating equipment developed by Ampex for the new system enables a single operator to duplicate 1,200 hours of canned program in an 8-hour day. END

COMMERCIAL SILENCER

Patent No. 2,630,525

William M. Tonberlin, North Hollywood, Calif.; Louis G. MacKenzie, Inglewood, Calif.; Paul K. Bennett, Pasadena, Calif.
(Assigned to Musicast, Inc., Los Angeles, Calif.)

This patent covers an invention permitting a receiver to be silenced through commercials or—if desired—certain periods of recorded music as well, by an ultrasonic signal transmitted by the broadcast station. The invention applies to "storecasting" and similar schemes, in which a factory, for example, may be supplied with music without commercial announcements, and the vacant spaces in the program utilized for silent periods or announcements originating in the plant (or school, waiting room, or other establishment). If longer silent periods or more extensive local announcements are desired, the transmitted signal may be cut out automatically during selected musical periods—every fourth record for example, or during a lunch hour.



The r.f. circuits of the receiver are conventional. The detector output is fed simultaneously to the receiver's a.f. amplifier and to muting circuits which silence the set. These muting circuits (see diagram) consist of selective amplifiers and rectifiers for control frequencies A and B. The rectifiers produce negative voltages across series-connected load resistors. These voltages are used to bias the receiver's a.f. amplifier to cutoff during the commercial or (in one application) where a certain undesired musical selection is being transmitted.

V2 is the amplifier for control signal A. It operates with high bias so that its gain is low. V1 operates as a high-gain zero-bias amplifier. Since it is shunted across the input of V2, it serves as a low-impedance path which lowers the signal on V2 to the point where it will not develop enough negative bias to disable the main program amplifier.

When a B-frequency pulse is received, it is amplified through the B amplifier. The output is rectified and applied to the mid-point of the V1 grid resistor in the form of a negative pulse strong enough to block the tube. If an A-frequency signal is being transmitted, the output of V2 then rises, and is rectified and applied as a disabling signal to the main program amplifier, which is silenced. The increased signal at the cathode of V2, applied through a capacitor to the grid of V1, is sufficient to keep that tube cut off till the A-frequency signal ceases. Then V1 starts to conduct, and no signal can get through V2 till another B-frequency pulse is received from the transmitter.

During certain periods (say every fourth record) the B-frequency is sent continuously. If switch S1 is closed, the resulting rectified output is applied direct to the main amplifier, causing it to be cut off during these periods as well as when the A-frequency is transmitted. (Since no A-frequency signal is coming in, sets with S1 open will receive normally.)

These additional silent periods may be utilized for local announcements or other special purposes, or may simply provide interruptions in those industrial applications where discontinuous music is considered better than a continuous program for maintaining employee morale or production rates.

The inventor claims that unauthorized use of the equipment can be prevented by changing the ultransonic frequencies occasionally. Components are made in plug-in form to make this easier. Further, due to its waveform and short duration, the B-frequency signal is hard to tune in and identify as to frequency. This makes piracy even more difficult.

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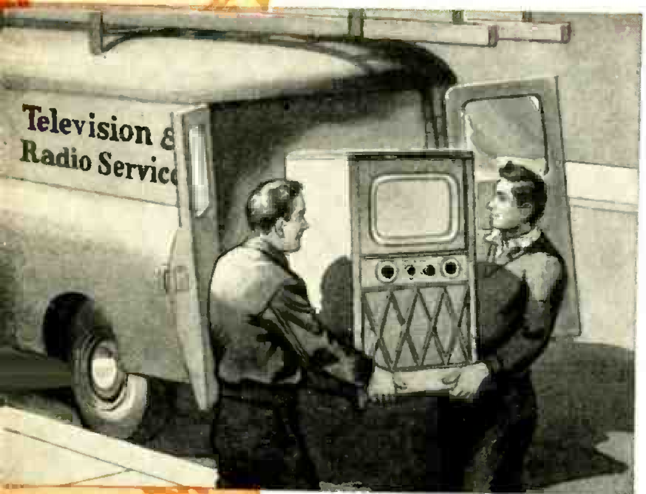

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NEW PATENTS

HUMIDITY MEASUREMENT

Patent No. 2,629,054
Leo S. Craig, Shrewsbury, N. J.
(This invention may be used by the U.S. Government without payment of royalties)

This device is a humidity-controlled audio oscillator for modulating radiosonde transmitters. The tones produced by the oscillator indicate the relative humidity. The circuit is designed around a hygroscopic (humidity-sensitive) resistor. The resistance of the hygroscopic unit varies inversely as the humidity and varies the frequency of the oscillator.

Fig. 1 shows the hygroscopic unit, R1, in a blocking oscillator circuit used in a conventional radiosonde. When the tube conducts, grid current flows through R1 in the direction shown by the solid arrows. When the tube blocks, capacitor C1 discharges through R1 in the same direction as the grid current. The discharge path is shown by dashed arrows.

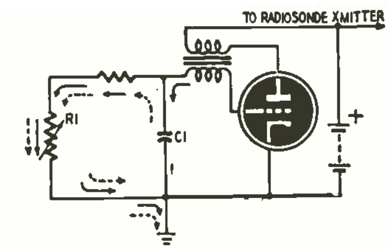


Fig. 1—Standard circuit for transmitting indications of relative humidity.

When unidirectional currents are passed through electrolytic resistors (the hygroscopic units) they become polarized and cause erroneous indications. Polarization does not occur in a.c. circuits.

The improved circuit in Fig. 2 is designed to produce bidirectional currents through R1. When the tube is conducting, C1 and C2 charge until the charge on C2 drives the tube to cutoff. (The solid arrows show the direction of currents through R1 when the tube is conducting.) C1 and C2 discharge in the directions shown by the dashed arrows. The charge and discharge currents flow through R1 in opposite directions, producing the same effects as would be obtained with an a.c. supply.

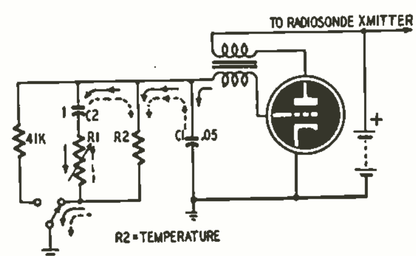


Fig. 2—Improved circuit cancels the effect of direct current through R1.

When the humidity is low, R1 is practically an open circuit and the oscillator frequency is controlled by C2 and R2. When the humidity is high, the resistance of R1 is low and C1 is effectively shunted across C2 to produce a lower operating frequency.

The improved circuit can be compensated for temperature variations. Electrolytic resistors have a positive temperature coefficient. The circuit can be compensated by using suitable negative-temperature-coefficient resistors for R2. The performance of the circuit is checked by throwing the switch to substitute the 41,000-ohm resistor for the humidity-sensitive unit.

GUIDED MISSILE

Patent No. 2,629,289
Paul B. Hunter, Metuchen, N. J.
(Assigned to Sperry Corp., Great Neck, N. Y.)

When firing a gun or releasing a bomb, correct aim alone does not assure a direct hit. Target motion, wind resistance, and other factors must be reckoned with. The probability of a hit may be improved by guiding the missile while it is in flight. This invention permits a certain amount of "steering" by remote control.

A microwave transmitter sends a pencil-like beam in a line toward the target. The missile is equipped with a microwave receiver and several antennas on the fins. So long as each antenna receives the same power from the transmitter, the course of the projectile is unchanged. If the missile goes off the beam, one antenna receives a stronger signal than the others do. This causes the release of compressed gas from one side of the shell or bomb and its course is adjusted toward the center of the transmitted beam.

The microwave transmitter is situated near the gun position. Its antenna is highly directional and is coupled through a servomechanism to a telescope. Thus the telescope and antenna always point in the same direction.

When the missile is fired, an observer keeps it in view and, by pointing the telescope, directs the missile to the target.

TRANSISTOR TRIGGER

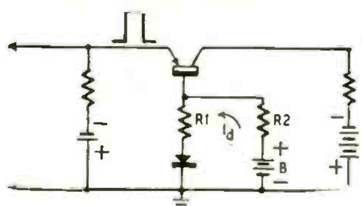
Patent No. 2,622,211

Robert L. Trent, Far Hills, N. J.

(assigned to Bell Telephone Labs., Inc.)

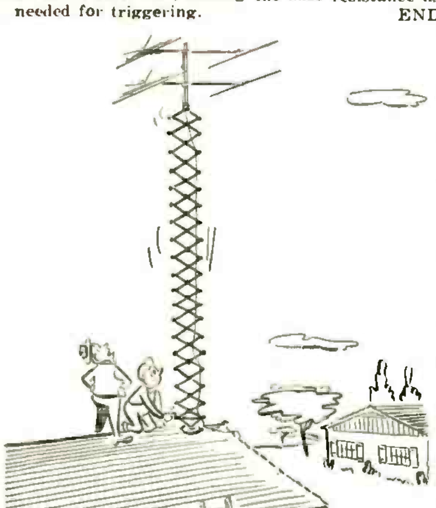
High efficiency and small size make transistors desirable as trigger elements. But nonuniformity of base current often makes them impractical because the base current (in any transistor) is apt to vary considerably with temperature. Trigger circuits require a large base resistor; so small changes in base current cause a large change in bias voltage. This may change the mode of operation of the trigger circuit and amplitude of the pulse required for triggering may vary widely. Operation of this new transistor trigger circuit is almost independent of base current.

A crystal rectifier and a battery B are used in the base circuit of the trigger. The rectifier is biased by B for conduction. The current I_d must be larger than the static base current that flows. Thus I_d overcomes the normal base current and maintains the rectifier in a conducting state. R1 may be about 500 to 1,000 ohms. This value is too low to affect transistor bias, even if base current varies in some undesired manner.



If a sufficiently large positive pulse is impressed on the emitter, the bias current will be greatly increased. It biases the rectifier to cutoff. When this happens, R2 becomes the base resistor. It may be 10,000 ohms or more. Due to the high base resistor, the input resistance of the transistor goes negative as needed for trigger operation.

In effect, this circuit switches R1 in and out. Normally the base resistor is low because current flows through R1. When the circuit is triggered, R1 is switched out, raising the base resistance as needed for triggering. END



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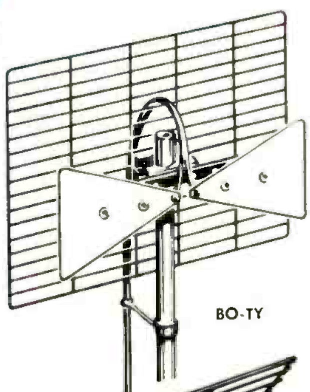
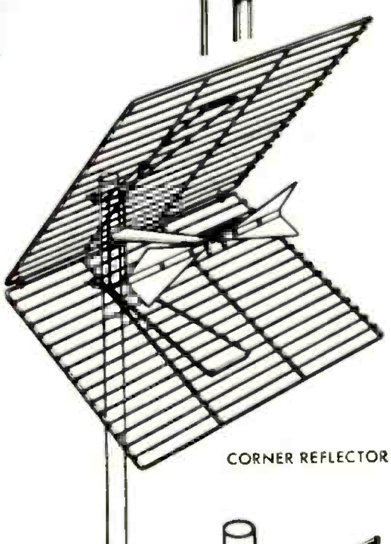


BO-TY



CORNER REFLECTOR

for VHF. For over four years the dependable INLINE has provided top viewing satisfaction to its users. With excellent gain and directional response, the INLINE is also available in a Stacked Array for additional gain in fringe areas and in a Piggy Back for multi-directional reception.

for UHF. Keeping pace with this expanding new market are a full line of AMPHENOL UHF antennas.

BO-TY and Reflector. With its rejection of unwanted signals off the back and sides, the BO-TY is excellent for major signal areas. Where additional gain is desired in fringe areas, two BO-TYs can be easily stacked.

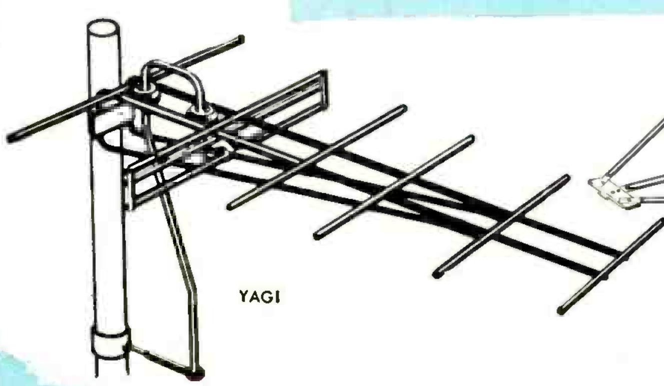
CORNER REFLECTOR. The high ascending and strong forward radiation pattern of the new CORNER REFLECTOR make this AMPHENOL antenna ideal for fringe areas. Of exceptionally sturdy construction, the CORNER REFLECTOR also has the advantage of being mounted in *front* of the mast to insure no signal interference from the mast or accessories.

RHOMBIC. Another AMPHENOL antenna built to give the high gain needed for UHF in outlying districts. It also features rejection of ground reflections, an important consideration in UHF.

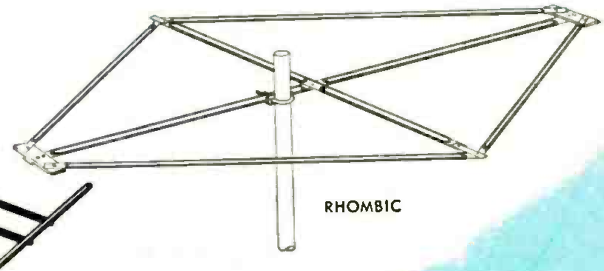
YAGI. There are 11 custom models of the YAGI for top reception across the entire UHF band. Each features extremely high gain on its assigned channels as well as a strong forward radiation pattern.

The above listing should make the choosing of the right antenna an easy task. For UHF or VHF, AMPHENOL *antennas assure top reception.*

AMERICAN PHENOLIC CORPORATION AMPHENOL
Chicago 50, Illinois



YAGI



RHOMBIC

TV SET COUPLER

RCA Victor Tube Department, Harrison, N. J., has announced a small coupling device which permits the simultaneous operation of two receivers from the same antenna.

Designed for use with antennas having 300-ohm ribbon-type transmission line, the coupler, RCA-240AL, is a quick-service item. It requires only a screwdriver and a few minutes of time for installation and features a self-contained wood-screw which facilitates mounting on wall or baseboard.

It is designed to eliminate wire-cutting and splicing operations. Transmission line connections are made by placing the lines in prepared grooves in the body of the coupler. Attachment of screw-type caps to the top and bottom of the coupler forces the lines against built-in contact points which pierce the insulation and make contact with the wires.

4-BAND RECEIVER

The National Company, Inc., of Malden and Melrose, Mass., has announced production of a new broadcast and short-wave receiver—the World Master, model NC-88.

Designed especially for short-wave listeners and radio amateurs, the receiver covers all frequencies from 540 kc. to 40 mc. in four bands. Features include calibrated bandspread, advanced a.c.-powered superhet circuit using 8 miniature tubes, a tuned r.f. stage, two i.f. stages, and a high-fidelity audio output stage.

WORK TABLES

Cooper Industries, 4953 W. Fullerton Ave., Chicago, Ill., has a new line of heavy-duty steel work-tables. The tops are all-steel with 1/2-inch masonite hard-surface cement-bonded to steel panels for a smooth, lasting work surface. Drawers, ledges, risers, and shelves are also furnished by Cooper for the tables.

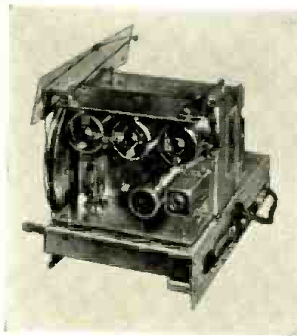
Twenty stock sizes are available. The tables are easily dismounted and the legs may be removed for storage.

U.H.F. TUNER

Radio Receptor Co., Inc., 251 W. 19 St., New York 11, N. Y., has announced the new u.h.f. *Cavi-Tuner*, as well as a u.h.f. converter which incorporates the *Cavi-Tuner* and a power unit. The tuner permits reception of v.h.f. and u.h.f. stations.

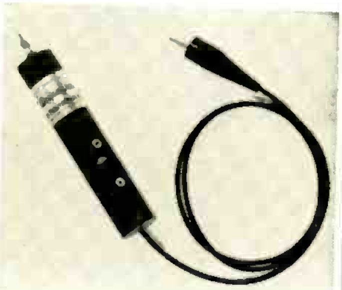
The resonant-cavity principle with variable dielectric tuning is used in the tuner. The *Cavi-Tuner* consists of three cavities, two functioning as a bandpass preselector, while the third controls the local oscillator frequency. The preselector is essentially an over-coupled double-tuned transformer. Two antenna inputs are available for use either with the common 300-ohm flat lead-in (balanced) or the shielded 75-ohm coaxial lead-in (unbalanced). The local oscillator, a Colpitts type, tunes below the signal frequency for double superheterodyne or converter applications. Mixing takes place in a low-noise diode, with an i.f. appearing at v.h.f. channels 5-6. Tuning is controlled by a single knob which functions as both a channel selector and fine-tuning control.

The i.f. output of this unit has a frequency of 76 to 88 mc (channels 5-6) but equipment is being developed to operate at 41 mc.



TEST INSTRUMENT

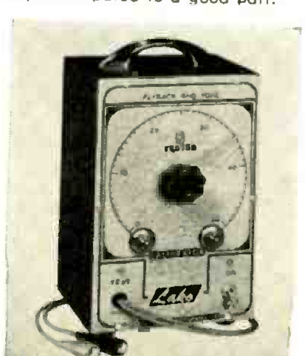
Century Electronics Co., 8509 21st Ave., Brooklyn, N. Y., has introduced its *Dynotracer*, a portable self-powered instrument designed to trace or inject signals through video, sound, sync, a.f.c., or vertical or horizontal sweep circuits. The *Dynatracer* uses an ingenious system of picking up its signal from one section of the receiver and feeding it through a network to other portions of the set. It will also trace voltages and locate open, shorted, or intermittent components.



"Q" TESTER

Lako Manufacturing Co., 506-520 E. Townsend St., Milwaukee, Wis., has announced the model 400-A Q-tester. This instrument tests deflection yokes, width coils, and horizontal transformers without removing them from the set.

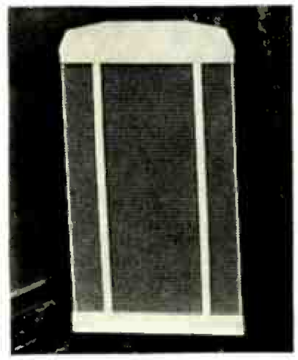
The unit drives the test part at proper waveform and frequency and measures the output voltage. Since the output is a function of the Q, a single shorted turn will result in almost negligible output compared to a good part.



NEW DEVICES

KLIPSCH ENCLOSURE

G & H Wood Products Co., 75 N. 11th St., Brooklyn 11, N. Y., has released a Klipsch corner-horn enclosure design for 12- and 15-inch speakers, known as the Klipsch Rebel IV by Cabinart.



Available as a complete unit or in kit form, the Klipsch features large-enclosure performance within a minimum area. Cabinet design makes for easy accessibility to speaker and simplifies external installation. The built-in removable panel allows a variety of speaker combinations. The unit is available in limed oak, honey walnut, French mahogany, and black lacquer.

CABLE HANGER

Atlas Sound Corp., 1451-39th St., Brooklyn 18, N. Y., has released its model CH-1 cable hanger. Designed to be used with all types of microphone floor stands, the CH-1 enables the mike cable to be coiled and looped over the hook when moving, storing, or transporting the microphone and stand. All parts are finished in chrome.

ELECTRIC GUNS

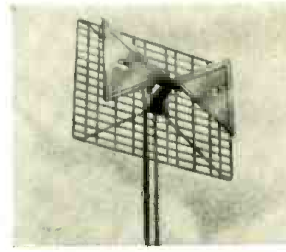
Weller Electric Corp., Easton, Pa., has announced a new line of electric guns. The four new guns feature increased power up to 275 watts. Pistol grips are centered under the housings for better balance. Dual heat is provided on both heavy- and light-duty models, and all are equipped with two pre-focused spotlights.

Two accessory tips are provided with each model, a hot knife-blade cutting tip and a trowel-shaped smoothing tip.

UHF ANTENNA

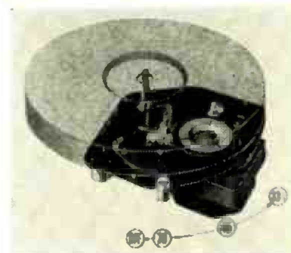
JFD Manufacturing Co., 6101 Sixteenth Ave., Brooklyn 4, N. Y., has introduced the model UHF611 *Bowtie-Flector* antenna, which receives channels 14–83. It is provided in stocked models with free *Baline* matching transformers for fringe and remote areas.

The antenna features rigid wire-frame screen reflectors, to minimize vibration, and *Bronzidite*, a military-specified plating, to prevent rust and corrosion in nonaluminum parts.



PHONOMOTORS

General Industries, Elyria, Ohio, has announced the addition of two new manually operated 3-speed phonomotors to its line.



Model SS, with 2-pole motor, is a compact phonomotor incorporating vertical idler shifting principle.

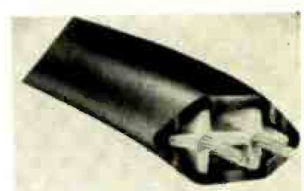
Model DSS, with 4-pole motor, is designed for high-fidelity applications in which compactness is secondary to need for absolute minimum stray field radiation. It is suited for all types of pickups, including magnetic.

TRANSMISSION LINE

Plastoid Corp., 42-61 24th St., Long Island City 1, N. Y., has announced a tubular twin-lead for u.h.f., designed for negligible attenuation under all weather conditions.

Known as *Synkote Ultratube*, the line has the leads spaced several millimeters within the tube, equidistant from the outer insulation. The ends may be sealed on the job by heating with a match and then clamping them shut with a pair of pliers.

The line is recommended for v.h.f. in stormy weather & fringe areas, and sea-coast areas where moisture and salt spray are factors.



UHF CONVERTER

David Bogen Co., 29 Ninth Ave., New York 14, N. Y., has introduced a u.h.f. converter, the Bogen UCT. The unit features single-knob continuous tuning for channels 14–83. Its broad-band output operates through either channel 5 or 6 on the TV set. The input and output impedances are 300 ohms.

The converter is connected to the antenna input terminals of the u.h.f. receiver and measures 8 x 4⅞ x 4¾ inches.

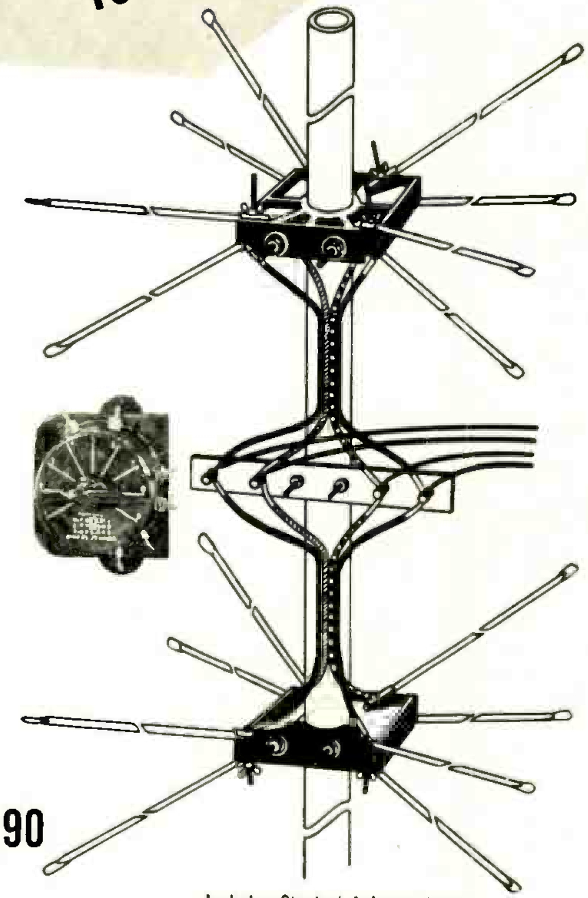
END

All specifications given on these pages are from manufacturers' data.

Concord Radio presents the world's most powerful TV antenna!

22 Db gain over tuned dipole!

motorless all-direction ALL-CHANNEL UHF-VHF-FM reception



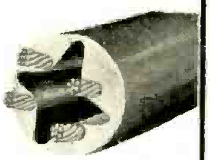
- Guaranteed 10 times more powerful than stacked 10 element Yagis.
- Receives channel 2-83 from all directions without a rotor.
- Broadband UHF-VHF and FM, motorless all direction reception.
- All aluminum flip-out assembly.

The only TV antenna that instantly beams the television set directly to the signal without a rotor. This antenna brings strong UHF and VHF signals from all directions to weak signal areas instantly . . . with a flick of the nine position switch located near the television set.

NEW!

FOUR CONDUCTOR AIR DIELECTRIC
Tubular Matched Impedance
TRANSMISSION LINE

Improves Both UHF and VHF Performance of any ALL-CHANNEL Antenna!



100 Ft.	$8.90
150 Ft.	$13.90
200 Ft.	$17.50

Minimum quantity 100 ft.

Mfg. solely by

ALL CHANNEL ANTENNA CORP.

under license Pat. No's 2,585,670. 2,609,503. 2,625,655. others pending.

$21.90 Dealer Price

LIST PRICE **$36.50**

Includes Stacked Antenna Array. 9 Position Switch. Completely Wired Stacking Harness. A.I.M.—Automatic. Impedance Matching Coupler.

MONEY BACK GUARANTEE To out-perform all other antennas (using rotor motors) on both UHF and VHF, including stacked ten element Yagis, stacked corner and bow-tie reflectors, four bay conicals, etc.

CONCORD RADIO 54 Vesey Street, New York 7, N. Y.

Please send me................amount at $36.50 list price.
Please send me................amount at $21.90 dealer net.
Dealers order on letterhead.
Please send me................feet of 4 conductor tubular at
Name________________
Address________________
City________________State________________
☐ Check Enclosed ☐ Money Order Enclosed
☐ C.O.D. enclosed please find 25% of total purchase price . . . check . . . Money Order.
☐ Please put my name on your "Special Bargain" mailing list.
( ) Enclosed find $________in full. Send prepaid.

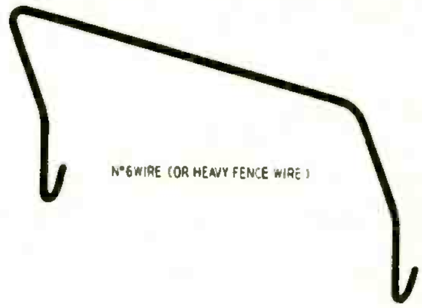
Concord Radio

54 Vesey Street, New York 7, N. Y. • DIgby 9-1132

TRY THIS ONE

HANDY CHASSIS HOLDER

A pair of these chassis holders will help you to avoid scratching or cutting your hands while carrying heavy radio and TV chassis. The handles are bent



to the approximate shape shown from No. 6 or heavier wire. Use a stiff wire which will not deform under the weight of the chassis.—*J. Alibanowicz*

CRACKLE TOUCH-UP

Small chipped areas on black crackle metal chassis and cabinets can be easily hidden by carefully marking those areas with a black *Listo* or a similar type of marking pencil. The touched-up areas are very difficult to detect.

This suggestion will be particularly useful to those who are likely to chip the paint while punching or drilling black crackle metal stock.—*R. J. Sandretto*

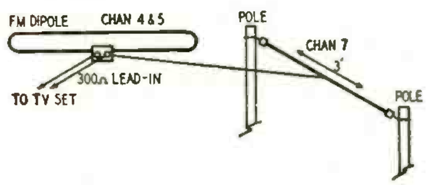
TRANSPARENT TUNING TOOLS

Clear-plastic aligning tools are easily mislaid because their transparency makes them hard to see even when they are directly under one's nose. To make them more visible on the workbench stripe the outsides of these tools with red nail polish.—*Charles Erwin Cohn*

FM DIPOLE FOR TV

Recently I had occasion to use an FM dipole on a TV set in an area where stations were operating on channels 4, 5, and 7. The dipole worked fine without any alteration on channels 4 and 5, but on channel 7 there was a fuzzy picture. I experimented somewhat to sharpen 7, and found that I got the best picture with the hookup shown in the diagram. I got the clearest picture by putting a 3-foot length of wire between two poles on the roof, with the wire oriented so that it was broadside to the channel-7 signal.

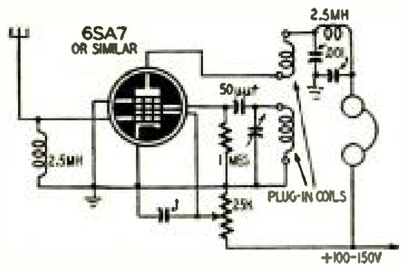
Almost any heavy antenna wire will do. I attached this antenna by a short length of wire to one of the end leads of the dipole.—*B. W. Welz*



(This was a cut-and-try solution in a particular spot, and the same arrangement might not work as well in other locations.—*Editor*) END

NOVEL REGENERATIVE RECEIVER

The correct amount of coupling between the antenna and a regenerative detector is often a critical factor which determines the performance of regenerative receivers. If the coupling is too loose, signal transfer is poor and sensitivity is low. If the coupling is too tight, the detector is loaded heavily and the antenna may cause dead spots in the tuning range. This trouble can be minimized by using electronic coupling between the antenna and detector. This provides good signal transfer and good antenna isolation.



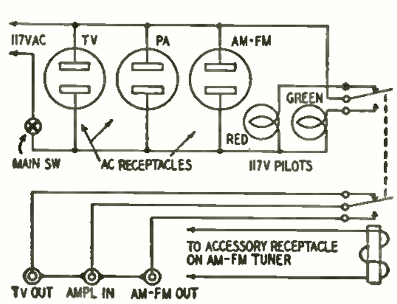
The diagram shows how a 6SA7 or similar converter-type tube can be used as a regenerative detector with one of the control grids used for electronic coupling to the antenna.

The antenna is connected to grid 1 and returned to ground through a 2.5-mh r.f. choke. The signal is amplified in the plate circuit and fed through the tickler into grid 3 through the tuned winding. This circuit is more sensitive than the usual regenerative job. If strong signals overload the set, replace the r.f. choke in the antenna circuit with a tuned antenna coil. Standard plug-in coils may be used.—*John Sareda*

MUSIC-CENTER CONTROL BOX

My radio equipment consists of the Radio Craftsmen AM-FM and TV tuners and a separate power amplifier. With this equipment connected in the normal manner the tubes in the radio tuner are turned on while the TV set is in use.

Since the TV set is usually on for long periods of time, I decided to do something about the needless waste of power in the radio tuner which was not being used. After trying several schemes, I developed the switching circuit shown in the diagram. The wiring is installed in a 4 x 5 x 6-inch metal box with the receptacles on one side and the switch and pilot lamps on the other.



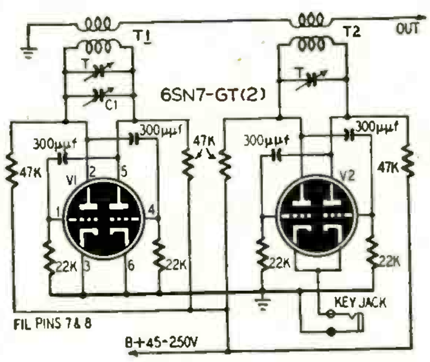
The radio and TV tuners and the amplifier line cords are plugged into the receptacles. The tuner output and amplifier input leads are fitted with RCA-type phono plugs which go into mating sockets in the control box. The d.p.d.t. 115-volt a.c. relay is wired so the TV sound feeds into the amplifier through its normally closed contacts. The relay coil is fed from the accessory receptacle on the rear of the radio tuner chassis. Pilot lamps show that the amplifier is on and indicate which tuner is operating at any time.—*Anthony Pusateri*

Materials for control box

Miscellaneous: 3—a.c. receptacles (Amphenol 61F. 61-F1, or equivalent); 1—s.p.s.t. toggle switch; 1—control box approximately 4 x 5 x 6 inches; 1—115-volt, 60-cycle, d.p.d.t. relay; 1—115-volt pilot-lamp assembly with lamp and green jewel; 1—115-volt pilot-lamp assembly with lamp and red jewel; 3—RCA-type phono pin-plug and jack assemblies; 2—117-volt appliance cords.

CODE PRACTICE SET

This dual-purpose code practice set is useful to the would-be ham and the new licensee because it can be used for normal sending and receiving practice as well as serving as a b.f.o. for receiving c.w. signals on home-type all-wave sets. The unit consists of two multivibrators with 455-kc tank circuits connected across their outputs. The output coils feed 455-kc signals into the i.f. circuit of a superhet receiver. T2 is tuned exactly to the center of the receiver's i.f. pass-band and T1 is tuned to a frequency a few hundred cycles away. When the key is closed the receiver detects the signals from V1 and V2 and produces a beat note which is the difference between the two frequencies. T1 is fitted with a small panel-mounted trimmer, C1, which is used to adjust the pitch of the audio note.



When the unit is used as a b.f.o., the key is opened so V1 operates alone. Its signal beats with the incoming c.w. signal to produce an audible note. The pitch of the note can be adjusted with the variable trimmer.

T1 and T2 were constructed from 455-kc capacitance-tuned i.f. transformers in the original model described in *Radio-Gen* (New Zealand). The trimmers were removed from the secondary windings which are connected in series and used as the output windings. C1 is a small air trimmer (about 35 μμf) connected across the primary of T1.

The Picture Tells the Story

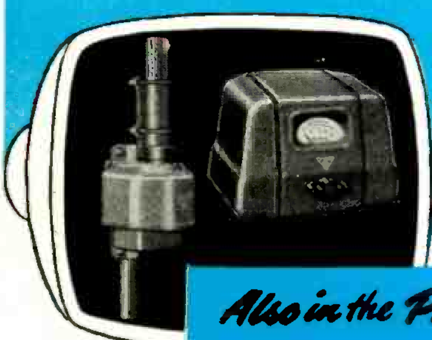
TV Antennas exist for one reason — to provide a clear, strong, sharp picture!

TRIO ZIG-ZAG* TV Antennas perform so well in this all important respect that they are America's most wanted.

Yes, a picture — the TV picture — tells the TRIO story more eloquently than anything else! Where all other antenna designs fail, high gain TRIO ZIG-ZAG TV Antennas consistently lock in sharp, clear pictures — from Maine to Texas, in city or country!

TRIO TV antennas look different, work different — provide a magnificent DIFFERENCE in picture quality!

*Patent Pending



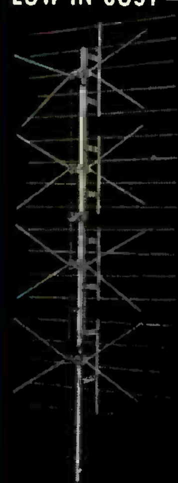
*New insulating sleeve, with longer leakage path and elimination of slit, does away with assembly errors — elements cannot short out. For maximum strength, new steel, electro-plated element clamps have been introduced.

Also in the Picture

The TRIO Rotator and Direction Indicator are the most dependable ever built. Developed after $50,000 research. Fully guaranteed for a FULL two years!

Best Buy in UHF Antennas

LOW IN COST — HIGH IN PERFORMANCE



NEW TRIO UHF BOW-TIE with reflector

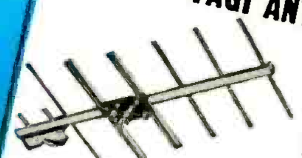
Sturdy, broadband antennas of uniformly high gain that have been thoroughly field tested. Phasing strips installed, pre-assembled — a jiffy to attach reflector screen. Available in one, two and four bay models. Usual high-quality TRIO construction.

Model UBT-4
Supplied With
4 Foot Mast

Model UBT-1
Supplied With
2 Foot Mast

Model UBT-2
Supplied With
3 Foot Mast

NEW TRIO UHF MULTI-CHANNEL YAGI ANTENNAS



Broadband yagis developed by TRIO now successfully applied to UHF. Four models cover all UHF channels, rarely more than two needed for any one area.

These high gain six element yagis have sharper directivity, thereby eliminating ghosts. Thoroughly field tested. Entire antenna mounted in front of mast removes metal from field of reflectors or antenna elements. Mast clamp supplied. Completely assembled.

Model 6-UBY 14-26 for Channels 14-26
Model 6-UBY 27-42 for Channels 27-42
Model 6-UBY 43-60 for Channels 43-60
Model 6-UBY 61-83 for Channels 61-83

TRIO MANUFACTURING CO.
GRIGGSVILLE, ILLINOIS

The unit operates with an insulated output lead placed close to the i.f. amplifier tube in the receiver. If this does not provide enough coupling, wrap two or three turns of the output lead around the grid lead of the i.f. amplifier tube.

To adjust the unit, tune in a station, set C1 to the center of its range, then adjust the semi-fixed trimmer on T1 until you get a zero beat. Now, disconnect the antenna from the receiver or tune the receiver to a dead spot on the dial. Key V2 while varying the trimmer on T2 to produce a note of about 400 cycles.

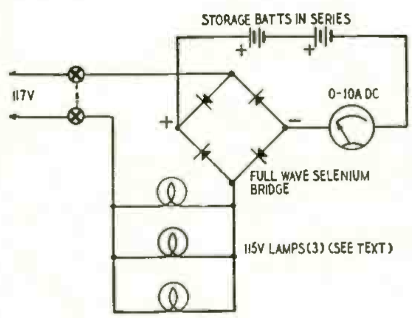
When the adjustments have been completed the unit can be used as described earlier. C1 operates as the pitch control.

Materials for code practice set

Miscellaneous: 4—47,000-, 4—22,000-ohms, ½-watt resistors; 4—300-μμf mica capacitors; 2—6SN7-GT tubes; 2—455-kc capacitance-tuned i.f. transformers; 1—midget variable air trimmer, about 35 μμf. Sockets, key jack, hookup wire.

SIMPLE BATTERY CHARGER

The battery charger shown in the diagram has been in service for the past two years and has given excellent service during this period. We use it for charging storage batteries which power some of our portable equipment. Up to six 6-volt or three 12-volt batteries can be connected in series for charging.

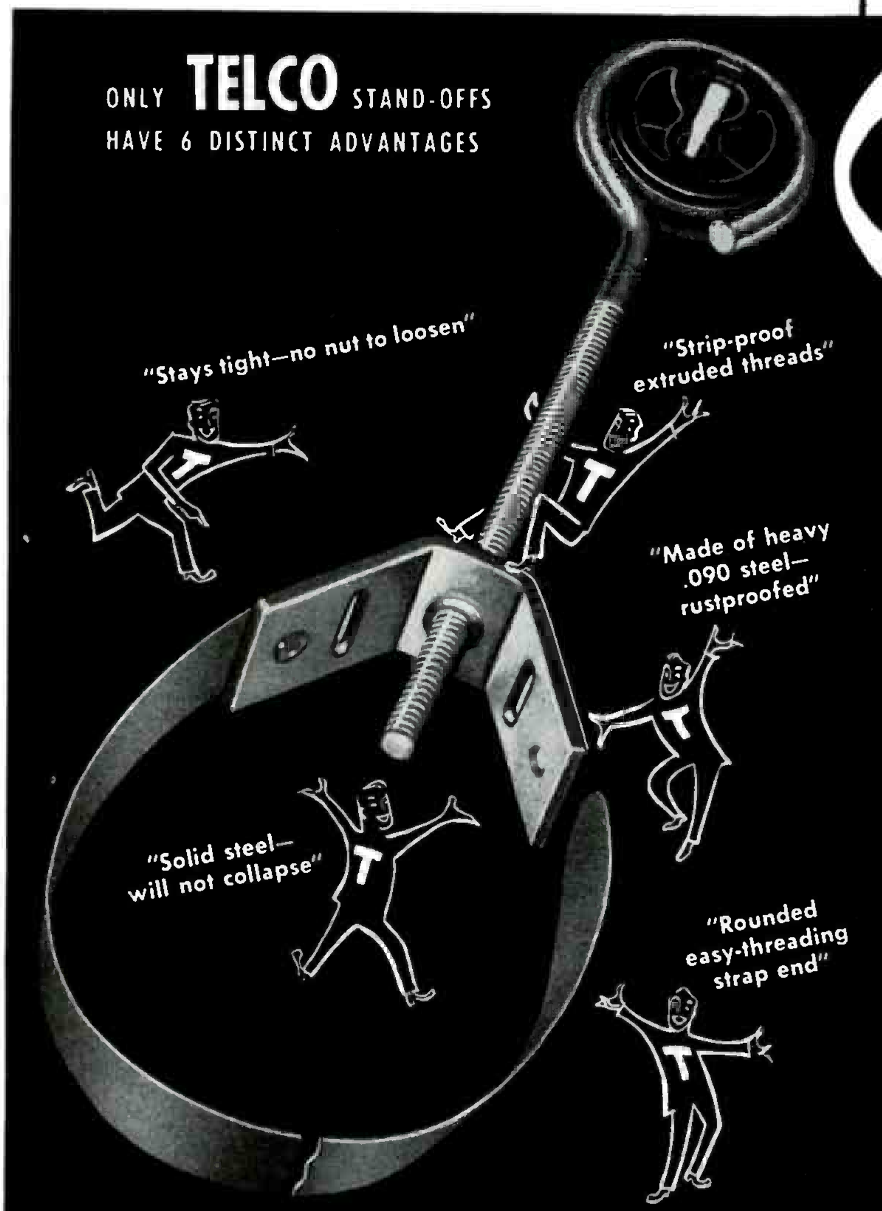


The batteries are charged by the output of the 120-volt, 5-amp full-wave bridge-type selenium rectifier. Charging current is regulated by inserting lamps in the sockets provided for them.

To use the charger, connect the batteries, then insert a 25-watt, 115-volt lamp into one of the sockets. Leave the other two sockets empty. Close the line switch and read the charging current on the meter. If the current is too low, change to a higher-wattage lamp or insert lamps in the other two sockets. The lamps act as line-dropping resistors. The charging current increases as the sum of the lamp wattages is increased.—*Geo. R. Anglado*

(Mr. Anglado does not state the size of the portable batteries he was charging, nor for what type of equipment they were used. However, with the lamps specified, the charging rate would range roughly between ¼ and ¾ ampere. A more flexible unit could be built with a 10-ampere rectifier and one or two more sockets. Then by using different lamps, large and small batteries could be charged.—*Editor*) END

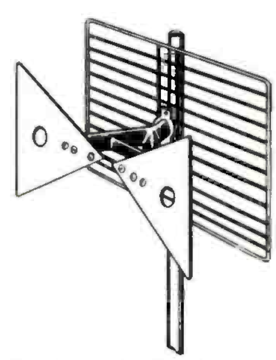
Now... One Name... One Source... for Top Quality TV Hardware!



TELCO

TELCO means Television Hardware . . . hundreds of finest quality items needed for TV installation. Here's everything you need in antenna mounts; also every type of antenna, both UHF and VHF and more real value for your money than ever before. Ask your parts distributor about TELCO . . . he's got these money-saving products.

TELCO No. 8642
UNIVERSAL UHF LIGHTNING ARRESTOR
This one arrestor fits all twin leads, mounts anywhere. UL approved. Hi-dielectric bakelite. All hardware included. List $1.25



TELCO UHF WISHBONE BUTTERFLY ANTENNA
Newest design for all-channel reception. Tested and proved best in actual UHF areas. Highly directional. Rugged aluminum construction, low wind resistance.
No. 8965 Telco Wishbone Butterfly Antenna. Single Bay with Tie Bar. List $7.75

OVER 135 MILLION TELCO STAND-OFFS NOW IN USE

- Finest Polyethylene Insert
- Smooth, Rounded Bracket Slots . . . Never Cut Strap
- 29 Telco Stand-Off Styles Available
- The Strongest Stand-Offs Ever Made

TELCO

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DIVISION OF GENERAL CEMENT MANUFACTURING CO.

AUTO-RADIO CONVERSION

? *I have converted a Mopar 802 (Philco C-4608) auto radio for use in an a.c. operated home-type console. I replaced the vibrator pack with an a.c. power pack which delivers the same B voltages as the original unit. My difficulty is that I cannot get the speaker to work because I don't have a supply for its field coil. Is there a simple supply that I can use with the speaker field?—E. E. S., Florence, S. C.*

A. Most electrodynamic auto radio speakers have 4-ohm fields which require approximately 1.5 amp at 6 to 6.5 volts d.c. Suitable supplies are shown in Figs. 1 and 2. However, the cost of the supply components is likely to be greater than a medium-priced extended-range 8- or 12-inch PM speaker which we would recommend for a console radio.

A full-wave center-tapped rectifier is shown in Fig. 1. This circuit can be

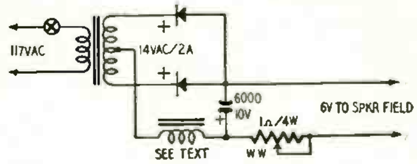


Fig. 1—A simple full-wave rectifier.

used as a trickle charger for light-duty storage batteries. In this case, the filter choke and capacitor may be eliminated. The rectifier may be a FTR (Federal Telephone & Radio 104D2943S or equivalent.

Although the full-wave bridge rectifier (Fig. 2) is more expensive than the center-tap type having the same current and voltage ratings, it is usually more readily available from dealers'

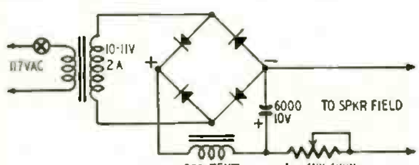


Fig. 2—Circuit with bridge rectifier.

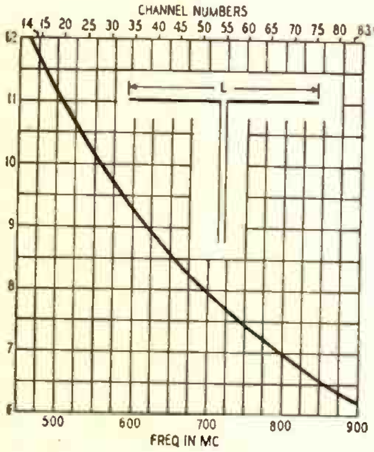
stocks. The rectifier may be a Mallory 1B12C1J, *Seletron* U1B1S1B, or equivalent. Filter chokes in Figs. 1 and 2 should have an inductance of about .05 henry and a current capacity of at least 2 amp. These are not generally available on the open market. You can construct a suitable choke by removing the winding from a 100-ma receiving-type choke and replacing the winding with No. 14 cotton-covered enameled wire. Adjust the air gap for best filtering action.

These two supplies can be used to power heavy-duty 6-volt relays, for light electroplating, and as heater supplies for high-gain voltage amplifiers.

ANTENNA CALCULATIONS

? *I want to experiment with antennas for the u.h.f. TV band but I can't be sure of the correct formula for determining the length of a dipole (one-half wavelength) radiator. I have seen a* *number of different formulas for finding the length of one-half wavelength. For example, in one formula, one-half wavelength in inches is found by dividing 5,540 by the frequency in megacycles. In another, the constant is 5,900. Are both formulas correct? If so, why the difference?—E. S. T., New Haven, Conn.*

A. Dividing 5,900 by the frequency in megacycles gives the *free-space* length of the element. The free-space length is the length required to resonate the element if it were situated a great many wavelengths away from the earth and all other objects. When the antenna is relatively close to the earth and other objects, its physical length (as measured with a ruler) is somewhat shorter. Formulas which use a constant smaller than 5,900 have been corrected to compensate for physical factors which cause the physical length of the dipole to be shorter than its free-space length.



Antennas with thin-wire conductors supported by insulators at the ends are shorter than the free-space dimension because the insulators act as capacitors connected to the dipole ends. The added capacitance causes the dipole to resonate below the design frequency. The added capacitance is called *end-effect* and must be compensated for by multiplying the free-space constant (5,900) by a decimal constant K. Below about 35 mc, K is approximately 0.95 for most applications.

When dipole dimensions make it practical to do so, we often use rods and tubes as dipole elements. This minimizes the end-effect and introduces another factor which also causes shortening of the physical length of the dipole. Free-space length is reduced by a factor which is determined by the ratio of the diameter of the dipole element to the wavelength. This constant varies from about 0.98, when one wavelength is 10,000 times the conductor diameter, to about 0.92, when the diameter is one-tenth of wavelength.

When a dipole is installed in an array, or when parasitic elements are added, the configuration of the antenna also affects the length of the dipole. Thus, no formula for dipole length is exact unless it specifies the type of antenna, the ratio of conductor diameter to wavelength, and the number, length,

QUESTION BOX

and spacing of adjacent elements—if any—which may be part of the antenna.

In the u.h.f. TV band the average dipole has sufficient bandwidth to cover two or more channels on each side of the center frequency, so you should have good results by cutting the dipole to the free-space formula for one-half wavelength in inches: 5,900/f, where f is the frequency in megacycles; or 5,900/6N + 389, where N is the u.h.f. channel number.

The formulas above apply only when the dipole is used alone. If you add parasitic or driven elements to the dipole, or use dipole elements of unusually large diameter or shape, then you should not rely on the accuracy of the formulas. Instead, you may use them as a starting point for experiments leading to the results that you want. You can use the graph to determine the approximate electrical length of a dipole for the u.h.f. TV channels. This chart is taken from installation instructions for the Westinghouse model H-803 all-channel u.h.f. tuner.

RECEIVER QUERY

? *Please prepare a diagram showing how I can connect a T-30 surplus throat mike through a small a.c.-d.c. receiver which has a phono input jack for an RCA 45-J2 record player. I would also appreciate details on connecting two sets of headphones to an Admiral 20T1 TV receiver so the speaker cuts out when the phones are plugged in.—R. T. G., Cheektowaga, N. Y.*

A. The diagram (Fig. 1) shows how a microphone transformer can be used to connect your throat mike to the input

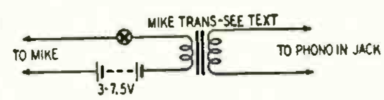


Fig. 1—Hookup for throat microphone.

of your receiver. The transformer should have a primary of about 50 ohms and a secondary of 10,000 ohms or higher.

Fig. 2 shows how the voice-coil circuit of your TV set can be modified for use with headphones. A Mallory 704A or equivalent jack and a 5-ohm,

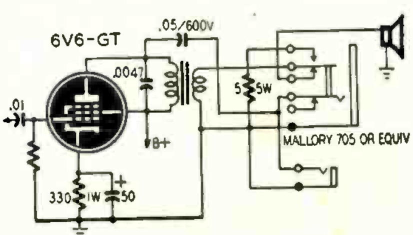
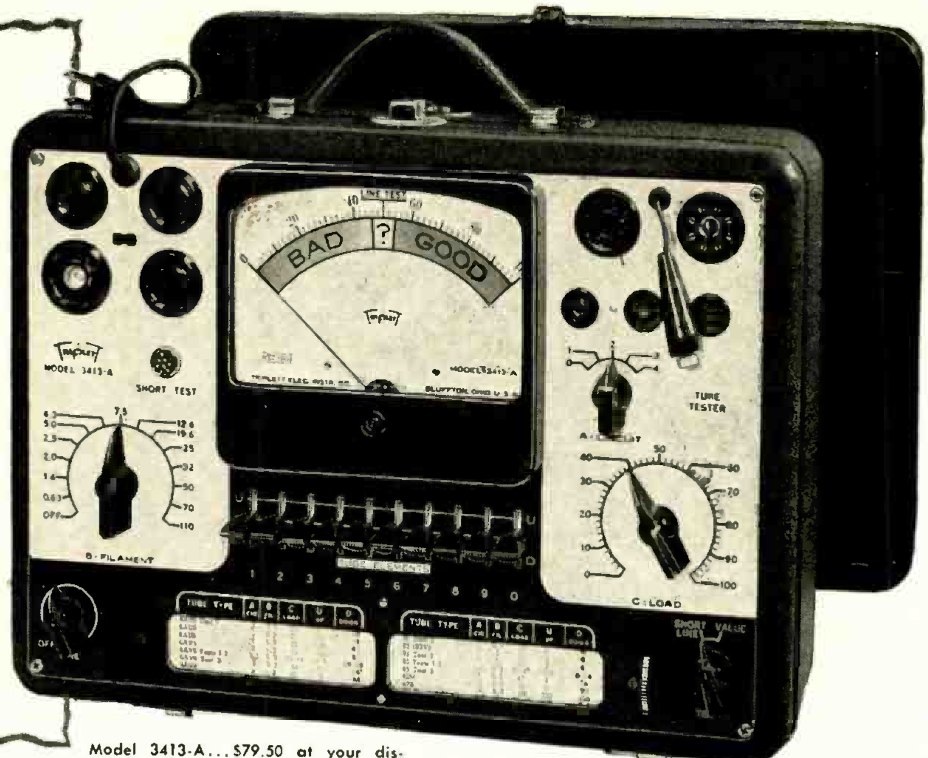


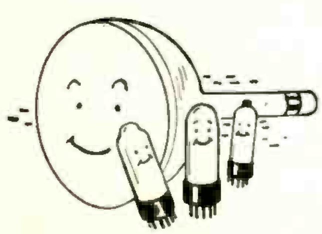
Fig. 2—Safe way to hook up headphones to the output of a TV receiver.

5-watt resistor are wired in as shown for the first headset. The second pair of phones is connected in parallel with the first through a simple open-circuit type jack. These phone jacks can be mounted in a small box connected to the receiver circuit through a convenient length of cable. END

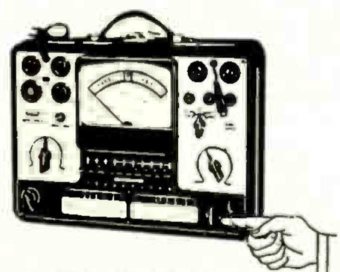
For accurate flexible and quick tube testing at low cost... model 3413-A



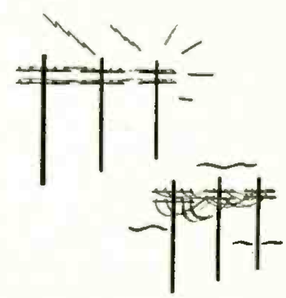
Model 3413-A...$79.50 at your distributor. (Price subject to change.) BV Adapter, $7.90 Add'l.



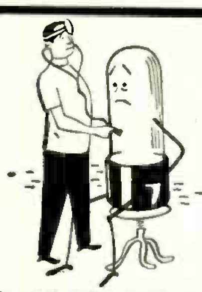
1. **YOU CAN TEST MORE TYPES** of tubes, also appliances for shorts and open circuits.



2. **JUST SPIN THE KNOB**—for correct, last-minute data, on the speed roll chart. Lists 700 tubes.



3. **YOU CAN COMPENSATE** for line voltage—just throw snap-action switch.



4. **YOU CAN TEST EACH ELEMENT** in each tube—by a simple flip of the switch.

5. **YOU CAN TEST THE NEW TUBES**—including those with low cathode current.

6. **YOU GET NEW TUBE DATA**—immediately, while it is still news. No waiting.

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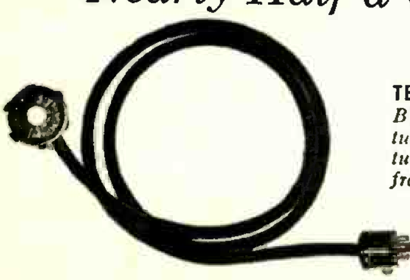


TESTS PICTURE TUBES, TOO! *With this BV Adapter, Model 3413-A tests every tube in a TV receiver,* including *the Picture Tube—without even removing tube from receiver or carton! Saves time!*

FOR THE MAN WHO TAKES PRIDE IN HIS WORK

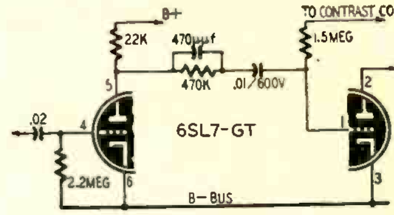
Triplett

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U. S. A.

TECHNOTES

G-E TV RECEIVERS

Vertical instability accompanied by excessive contrast, horizontal pulling, and little or no effect with variation of the contrast control may be the complaint in the G-E 16T1, 16T2, 16C103, 16C110, and similar sets. These trou-

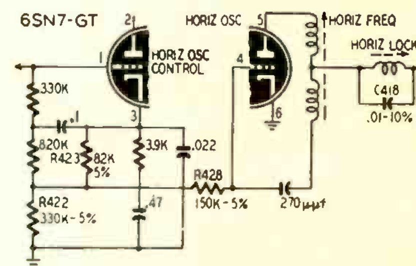


bles can be caused by excessive leakage in the .01-μf coupling capacitor connected to pin 1 of the 6SL7 sync separator and amplifier tube. This capacitor is shown in the diagram. Replace this capacitor with a high-quality, .01-μf, 600-volt unit.—*William George*

ADMIRAL SERIES 19 CHASSIS

In some sets, it may be difficult to adjust the horizontal lock-in range and frequency properly.

This difficulty is caused by critical components in the horizontal oscillator circuit. The coded components in the diagram should be checked for correct values.



Replace components which are not within the specified tolerances. These tolerances are now being specified in production, and the following new parts numbers have been added: 64A2-16, 60B7-334, 60B7-823, and 60B7-154, for C418, R422, R423, and R428, respectively.—*Admiral Radio & Television Service Bulletin*

STROMBERG-CARLSON 116

In strong-signal areas, this set may produce milky, low-contrast pictures with sound bars and buzz in the audio.

This trouble is caused by overloading and can be eliminated by using an attenuator pad in series with the antenna lead-in. Resistor values for the pads will be found on the installation instruction sheets fastened to the rear panel of each set.—*George R. Anglado*

MEISSNER 8C FM TUNER

Complaints of excessive warmup drift in the Meissner 8C tuner are fairly common. This trouble is caused by overcompensation in the tuning of the ratio detector transformer.

The trouble can be cleared up by replacing the 70-μμf, type N750 ceramic capacitor in the top of the ratio detector coil with a 68-μμf, 5% silver mica capacitor.—*Arthur R. Backstrom*

WESTINGHOUSE H-600T16

Sound circuits dead. No video signal visible on the picture tube. Bright vertical line on the left side of the raster.

This trouble is likely to be caused by a defective 6Y6-G audio output tube. The plate-to-cathode resistance of this tube is in series with the B plus line supplying the screens of the first sound i.f., first and second video i.f., and r.f. amplifier stages, along with other points in the receiver circuit.

Replace the 6Y6-G and check the operation of the circuit by measuring the voltage between cathode and ground.—*Michael L. Tortariello*

WESTINGHOUSE H-196 AND H-207

The manufacturer's service notes state that a fixed bias should be applied to the a.g.c. line when using a v.t.v.m. and signal generator to align the video i.f. coils and traps. I find that more uniform results can be obtained by removing the fixed bias and using a sweep generator and scope.

Adjust the sensitivity control for 0.5 volt on the video i.f. a.g.c. line with no signal input to the receiver. Couple the sweep generator to the converter grid and adjust the sweep output for 1 volt on the a.g.c. line. At this setting, the sweep amplitude is optimum for best visual alignment.—*Wayne Miller*

HUM IN G-E 16K1, 16K2

Complaints of tunable hum (hum modulation) on the broadcast band of the 16K1 and 16K2 may be cleared up by connecting a .002-µf, 600-volt capacitor from ground to the black lead on the primary of the power transformer.

If the complaint is residual hum on broadcast, phono, and TV, connect a 20-µf, 450-volt capacitor across the 30-µf input filter capacitor in the radio chassis. Rewire the cabling between the radio and TV chassis as follows:

1. Remove the BLUE and GREEN audio wires which connect through pins 3 and 2 of plug P4 and socket J4.
2. Connect these leads together through a new 2-pin connector (parts RJC-012 and RJC-013) and dress the leads as shown in the illustration.
3. Connect a 22-µµf capacitor from the high side of the volume control to ground at the tone control switch.

All late production models incorporate these changes.

—*G-E Radio Service Bulletin*

9T246 CONVERSION PROBLEM

After conversion to a larger tube, the left side of the picture was darker than the right. Backing off the brightness control made the left side totally black while the right half was still bright enough to watch.

During the conversion process, the picture-tube screen grid had been removed from the B plus line and connected to the boosted B plus circuit as recommended.

The trouble cleared up when a 0 1 µf capacitor was connected from the screen grid to B minus.—*J. V. Cavaseno*

END

HELP-FREDDIE-WALK FUND

THE FUND REACHES $10,702.59

Little Freddie Thomason, armless and legless son of Herschel Thomason, radio technician of Magnolia, Arkansas, received the following letter from G. Carroll Utermahlen, of Baltimore, Maryland, who also enclosed a donation of $1.00:

"Dear Little Freddie: I'm late with the enclosure but trust you will forgive me. Have been having the usual run of trouble here and have been very short of this green stuff. Yet . . . I slipped up before and am making up for it now . . . so . . . in spite of the delay, here she be.

"Once again I am in a position where I can run off a mimeographed memo to my pals, regarding my little chum Freddie. If the boys don't respond to the thing, I'm afraid I'm going to have to resort to BUCKSHOT . . . anyway . . . God bless you, little fellow, and I'll do my best to gather in some green stuff for you. 73 to you and the folks!"

So far we've had no reports of buckshot being used, but the enthusiasm expressed above is echoed by hundreds of loyal Freddie fans who, whenever they have a dollar to spare, send it along to the Help-Freddie-Walk fund with a message of encouragement.

We all realize that treatments, adjustments, etc., in connection with the mechanical appliances upon which Freddie will always be dependent, will cost thousands of dollars, and we are all just as aware of the fact that money is rather hard to come by these days; but we urge each and every reader to send in his contribution, no matter how small, whenever possible. No donation is *too* small to receive our sincere thanks and acknowledgment, as well as the appreciation of Freddie and his parents. *Make all checks, money orders, etc., payable to Herschel Thomason.* Address all letters to:

HELP-FREDDIE-WALK FUND
RADIO-ELECTRONICS
25 West Broadway
New York 7, N. Y.

FAMILY CIRCLE CONTRIBUTIONS

Balance as of April 16, 1953	$590.50
Laurie A. Bishop, Norwood, R.I.	2.00
Ferne Steele, Los Angeles, California	10.00
FAMILY CIRCLE Contributions as of May 19, 1953	$602.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of April 16, 1953	$10,073.59
Lomer Biron, Quebec, Canada	.50
Walter L. Schott Co., Los Angeles, Calif.	25.00
G. Carroll Utermahlen, Baltimore, Md.	1.00
RADIO-ELECTRONICS Contributions as of May 19, 1953	$10,100.09
FAMILY CIRCLE Contributions	602.50
TOTAL Contributions as of May 19, 1953	$10,702.59

TV DX IN JULY

If you are reading this around the normal publication date, you still have some of the best TV of the year ahead of you. The last ten days of June, with some of the best TV dx of the year, have come to be well known among TV dx enthusiasts and hams who work on the v.h.f. bands as a period during which sporadic-E dx is almost continuous. This fortunate state of affairs can be expected to carry over into July as well.

The experienced dx observer will watch the closing days of June carefully, as he knows that there will be July recurrences 27 to 28 days later. Sporadic-E skip being associated in a general way with solar phenomena, marked disturbances follow the 27-day rotation cycle of the sun. This rhythm is usually discernible through at least three cycles, beginning in May (or, in some localities, April). Thus the observer who keeps records will have ample evidence of the dates in July when he can expect the most interesting conditions.

Aurora borealis, often considered a wintertime proposition, puts in at least one appearance normally in July.

Tropospheric propagation will be generally good during July, though the peak season for this sort of thing will come in the early fall. High-band signals should be strong during the early morning and late evening hours, and reception should be good in the period around sundown, particularly in fair, calm weather.

As this is our first summer of commercial u.h.f. TV operation we have much to learn about this new field. Reports of any unusual u.h.f. reception are solicited. We're still waiting for that first u.h.f. report! END

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

JULY 1919 ELECTRICAL EXPERIMENTER

Talking from 'Plane to Earth
"Hello Europe"—Via Radio, by Charles M. Ripley
Electrical Oscillators, by Nikola Tesla
New 1 K.W. Panel Radio Transmitter, by Lester F. Ryan
How European Radio "Sigs" are Photographed Here
Musical Radio-Telegraph Sets, by Jacques Boyer
Operate Your Audions on A.C., by Elliott A. White

SERVICE TECHNICIANS

What was your most unusual service case? Not necessarily the most difficult one, but the one you will remember longest, either because of the problem itself or because of other conditions surrounding the job. If the experience was interesting to you, it probably will be to other readers of RADIO-ELECTRONICS. We will pay $10 for each "My Most Unusual Service Job" item we consider outstanding enough to publish in this magazine. If the item is striking enough or carries sufficient technical information to be worth *more* than $10 in our opinion, it will be paid for at our regular space rates. Address your stories to

Unusual Service Job
RADIO-ELECTRONICS 25 West Broadway, New York 7, N. Y.

Don G. Mitchell, who has been president of SYLVANIA ELECTRIC PRODUCTS since 1946, was elected chairman of the Board of Directors. H. Ward Zimmer, former executive vice-president, succeeds him as president. Max F. Balcom retired as chairman of the Board, but remains as a director in an advisory and consultant capacity. Other top-level Sylvania personnel appointments include W. Benton Harrison, former treasurer, to vice-president in charge of finance; Walter R. Seibert, formerly controller, and Leon C. Guest, Jr., formerly assistant controller, who were named treasurer and controller, respectively.


D. G. Mitchell


H. W. Zimmer

Dr. John Ruze, specialist in electronic research, joined GABRIEL CO. as director of the Gabriel Laboratories in Needham Heights, Mass. Dr. Ruze has done extensive research in the design and development of antenna systems. Gabriel is the parent company of Ward Products and Workshop Associates. Both subsidiaries are manufacturers of antennas and antenna accessories.


Dr. J. Ruze

Walter J. Brock was appointed Midwest sales manager for CBS-HYTRON, Danvers, Mass. He was formerly sales representative at CBS-Hytron's Chicago sales office.


W. J. Brock

Charles E. Balz was promoted to sales manager of BURGESS BATTERY CO., United States Battery Division, Freeport, Ill. He was assistant sales manager for the past two years, and before that was advertising and promotion manager.

Grady L. Roark was appointed manager of marketing for the GENERAL ELECTRIC TUBE DEPARTMENT, with headquarters in Schenectady, N. Y. He had been manager of equipment tube sales for the department. In his new position he succeeds Eugene F. Peterson, who was named manager of marketing for the entire General Electric Radio and Television Department.


G. L. Roark

SUBSCRIBERS

If you're moving, please don't forget to send us your address as it appears on the copy of the magazine, including the numbers shown beside your name, as well as your new address.

If we receive this information before the 20th of the month, you will continue getting the magazine without interruption.

You cooperation will be most helpful and greatly appreciated.

Obituaries

John J. Mucher, chairman of the Board and one of the founders of CLAROSTAT MANUFACTURING CO., Dover, N. H., passed away at his home in Dover.

Edwin I. Guthman, president and founder of EDWIN I. GUTHMAN & CO., Chicago, radio and TV components manufacturer, died in Chicago. He had been chairman of the Coil Section of RTMA.

Personnel Notes

. . . **Jerry Kirshbaum**, vice-president of Precision Apparatus Corp., was elected president of the SALES MANAGERS CLUB — Eastern Group. **Robert D. Ferree**, distributor sales manager of International Resistance Corp., is the new vice-president, and **Walter Jablon**, vice-president of David Bogen Co., was re-elected secretary-treasurer. **B. L. Cahn**, vice-president of Insuline Corp. of America, serves as director to the Executive Board of the Show Corporation for a two-year term, and **Vinton K. Ulrich**, manager of the National Union Renewal Sales Division, continues another year as director.

. . . **Jerome E. Respess, J. Ronald Regnier, Henry Sears, Charles E. Saltzman**, and **Henry L. Shepherd**, executives and directors of LAPOINTE ELECTRONICS, Rockville, Conn., were named to the newly formed Executive Committee of the company.

. . . **Sarkes Tarzian**, president of the Bloomington, Ind., company bearing his name, was elected president of the Bloomington Chamber of Commerce.

. . . **Bruce Holmstrom** was appointed advertising manager of TELEX, INC., St. Paul, Minn., headset manufacturer.

. . . **David B. Tolins, Jr.**, Joined JFD MANUFACTURING CO., Brooklyn, N. Y., in the new position of publicity director. He was formerly with Rocke International Corp.

. . . **Robin S. Kersh, C. Swan Weber, Franklin L. Snyder, Bruce D. Henderson**, and **William C. Rowland**, WESTINGHOUSE ELECTRIC CORP. executives, were elected vice-presidents of the corporation.

. . . **V. E. (Vic) Wollang** was appointed manager of distributor and export sales of OXFORD ELECTRIC CORP., Chicago. He had been doing sales co-ordination work with the company.

. . . **Peter L. Jensen**, president of JENSEN INDUSTRIES, Chicago, was honored with the presentation of a television set by officials of the Electronic Parts and Equipment Manufacturers. Mr. Jensen is celebrating his 50th anniversary in the sound industry.

. . . **D. W. Gunn** was appointed to the new post of assistant general sales manager of Radio Tube and TV Picture Tube Sales of SYLVANIA ELECTRIC PRODUCTS. He was formerly equipment sales manager and will continue his duties as manager of sales to Sylvania equipment accounts.

. . . **Clyde Matthews** joined the LINCOLN SCHOOL OF RADIO AND TELEVISION, New York City, as director of the Public Relations Department. He headed his own public relations firm formerly. END

JERROLD COMMUNITY-TV

Dear Editor:

I read with a great deal of interest the letter on pages 154 and 155 of your May issue regarding community-TV troubles.

The problem of system radiation—as your reader from West Virginia states—is one of the most serious problems affecting community-antenna systems from several standpoints.

1. If a community-antenna system radiates, it interferes with the television reception enjoyed by people in the community who have put up their own antennas. Therefore, if only for the sake of good public relations, it is essential that such interference be eliminated.
2. Such interference violates FCC regulations. Although up to now the FCC has been very co-operative in this regard in working with community antenna systems, there is no doubt that in the future—if many of these community-antenna systems do not correct their radiation problems—it will be necessary for the FCC to step in and take stringent action.
3. Radiation can be costly to the community-system operators. Many people deliberately place their receiving antennas within a few feet of the cable, and effectively "steal" signals from the system without paying either for connection or for monthly service.

It is necessary, therefore, in installing a community-antenna system to take all precautions to make certain that the system does not radiate.

There are three main sources of such radiation, namely, the amplifying and distribution equipment, the coaxial cables, and the television receivers. To do a thorough job and eliminate all radiation it is necessary to tackle the problem in respect to all three.

As for the equipment, there are several very important factors. First, with regard to my own company's apparatus, considerable engineering effort has been spent to develop the Jerrold amplifiers to a point where our equipment itself is "cold." In many of our earlier amplifiers we had a severe radiation problem, but the amplifiers being produced today do not radiate. A dipole placed within three feet of one of our community-antenna system amplifiers, turned up to rated output, will pick up less than 5 microvolts of signal.

However, when this equipment is installed in a weatherproof box on a pole it can still cause radiation problems unless great care is taken to prevent the r.f. signals from getting on the outer braid of the coaxial cable and also on the a.c. power line. To prevent the former, Jerrold has developed a feed-through coaxial fitting which grounds the outer sheath of the coax at the weatherproof box. To prevent radiation into the power line we have developed a power-line filter that is installed in every weatherproof box. This prevents r.f. signals from getting from the box to the outside through the power circuits.

When properly installed with feed-through fittings and power-line filters there is negligible (less than 2 microvolts at a distance of 3 feet) radiation from one of our weatherproof boxes, and, thus, from our equipment.

Radiation from the coaxial cables has been eliminated now by the use of the new double-shielded cable developed especially for us. This cable is Jerrold radiation-proof cable and is known as JRP-59 and JRP-11. The cable is made double-shielded and double-jacketed. To prevent radiation, though, even with this cable, a number of precautions must be taken. First, it is essential that all cables be properly terminated. Any improper termination can cause severe standing waves and radiation. Also, it is essential in making any connections to either the main or feeder cables to take great care that all fittings are tight, and that exposed fittings are thoroughly weatherproofed in order to prevent oxidation. Our field engineers have demonstrated on numerous occasions that a system completely double-shielded with no radiation can have excessive radiation that can be picked up as much as two or three hundred yards away from cables simply by loosening a cable fitting or two.

To reduce radiation still further, and also to comply with specifications of the telephone and power companies for grounding the system, it is essential that the messenger cable and the coaxial cable be grounded at regular intervals. Specifications call for grounding at least one out of every ten poles, but we have found that grounding more often—usually about one in every five poles—helps considerably.

The third source of radiation, the receivers themselves, is a very difficult one to handle. Most receivers have an open strip of 300-ohm lead between the antenna terminals on the back of the set and the tuner in the receiver. In installing a community-antenna system Jerrold specifications call for the use of coaxial cable right up to the antenna terminals of the receiver, in order to minimize any radiation from the system. However, on strong signals the short open lead between the terminals and tuner can radiate and possibly affect sets from 50 to 100 feet away in neighbors' homes. To minimize this, Jerrold has brought out a new matching transformer for 300 to 72 ohms.

To eliminate set radiation one of two methods is recommended. Either run the coaxial lead from the community-antenna system *directly to the tuner* and insert the matching transformer there, or install the matching transformer on the back of the receiver and put shielded loom over the 300-ohm lead in the receiver.

We will be happy to work with any community-antenna operators to solve their problems, in the over-all interest of making sure that community antennas serve a useful and not a nuisance function in their communities.

JERROLD ELECTRONICS CORPORATION
Milton J. Shapp, President
Philadelphia, Pa.

ELECTRONIC LITERATURE

RADIO-TV SERVICING

RCA Test Equipment Division has prepared a 34-page booklet, *This Business of Radio and TV Servicing*, to help the service technician promote good management by suggesting certain business practices which apply particularly to the servicing field.

Among the subjects discussed are planning and using a Budget (with a section on control over salaries and wages); daily time report; supervision; training; customer relations; test equipment; materials; stock control; reducing other operating costs and expenses; and business forms. The book is profusely illustrated with pictures and charts, and interspersed with pages describing RCA test equipment.

Free on request to Commercial Engineering Section, RCA Tube Department, Harrison, N. J.

FILTER CATALOG

Cornell-Dubilier has completed a 12-page catalog describing more than 135 *Quietone* filters. Bulletin NB-148 lists filters for attenuating r.f. in industrial, marine, aircraft, automotive, military, and household equipment.

Descriptions include electric and physical characteristics, outline drawings, circuit diagrams, photographs, and charts.

Free on request from Cornell-Dubilier Electric Corp., South Plainfield, N. J.

STAINLESS WIRE

Allegheny Ludlum Steel Corp. has published a 20-page booklet of technical data on the application of stainless-steel wire. Tables of physical properties, corrosion resistance, and analysis are included. A discussion of the principle uses of stainless wire covers cold heading, weaving, heat-resisting belts, rope, spring wire, slide forming, welding, and winding.

Copies available from Advertising Department, Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.

PARTS CATALOG

An 8-page, 2-color catalog of special TV and radio parts is available from Heppner. Ion traps, centering devices, electrodynamic speakers, ferrite-rod antennas, flyback transformers, and focus magnets are illustrated and described.

Request No. 20 from Heppner Mfg. Co., Round Lake, Ill.

MOBILE PRODUCTS

All mobile radiotelephone equipment and accessories made by Kaar are described in a new 8-page brochure. The equipment is for use in the 152–174-mc band, the 25–50-mc band, and the 1600–6000-kc band.

Free on request to Kaar Engineering Corp., Middlefield Road, Palo Alto, Cal.

RECORDER USES

G-E's *Photoelectric Recorder Applications* is a 12-page illustrated bulletin which describes applications of the recorder with seismology, psychology, textile, metals, fatigue, and research testing equipment.

Request Bulletin GEA-5536 from General Electric, Schenectady, N. Y.

END

SYNCHROS, SELF-SYNCHRONOUS DEVICES AND ELECTRICAL SERVO-MECHANISMS, by Leonard R. Crow. Published by The Scientific Book Publishing Co., Vincennes, Ind. 5¾ x 8½ inches, 222 pages. Price $4.20.

The purpose of this book is to present to the reader a comprehensive understanding of the theory and functional applications of synchros and other self-synchronous electrical devices. The book is illustrated with a large number of basic schematic diagrams and a few photographs of fundamental forms of various types of servomechanisms.

One chapter is devoted entirely to experimental set-ups and procedures with step-by-step listings of the observations which may be obtained and a review which explains the hows and whys of each observation.

The language is straight-forward and free from mathematical formulas, equations, and analyses. This work would make a good text for Armed Forces training courses, trade schools, and for the home student of electricity or electronics. Engineers and technicians will find it an introduction into the field which will make advanced texts easier to read and understand.—*RFS*

THE LIVING BRAIN, by W. Grey Walter. W. W. Norton & Co., Inc., 101 Fifth Avenue, New York, N. Y. 6 x 8½ inches, 311 pages. Price $3.95.

DESIGN FOR A BRAIN, by W. Ross Ashby. John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y. 6 x 9 inches, 260 pages. Price $6.00.

A noted American psychologist-physiologist once remarked to a group

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY PAGE 113

Radio-Electronics does not assume responsibility for any errors appearing in above Index.

of radiomen that it was easier to discuss brain and nerve functions with electronic engineers than with medical men "because the electronics men understand what you're talking about."

The authors of these two books have the distinction of being psychologist-physiologists who have developed electronic devices to further their study of the human brain. Walter is the inventor of *Machina speculatrix* (embodied in the electronic turtles Elmer and Elsie which were described in many popular magazines), and *Machina docilis*, an electronic device which can learn from experience. Ashby is the inventor of the *homeostat* ("The Electronic Brain," RADIO-ELECTRONICS, March, 1949).

The two books are devoted entirely to the human brain, and demonstrate forcibly that the radio-electronic worker is indeed in an excellent position to understand modern works on the brain. Ashby's book in particular uses terms and approaches much more familiar to the vocabulary and methods of electronics than of traditional physiology. Chapter headings include: Dynamic Systems, Stability, Parameters, Step-functions, Ultrastability, Fully Connected Systems, and others only slightly less reminiscent of the field of electronics. Walter's book is less mechanistic, but its heavy reliance on electroencephalography, its schematic diagrams of model nerves and of *M. speculatrix* and *M. docilis*, make an understanding of electronics almost absolutely essential for its full appreciation.

Either or both of these books will be interesting reading for the electronic technician who is interested in the workings of his own communications system.—*FS*

BLUE BOOK OF ELECTRICAL ESTIMATING, by George L. Sherlock. Published by Estimating Handbooks Associates, DeKalb, Ill. 5 x 8½ inches, 120 pages (plus 120 pages for notes). Price $7.75.

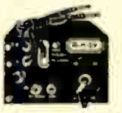
This reference manual is needed by electricians, architects and executives who must estimate electrical costs accurately. It contains information gathered over many years by an expert in this line. It shows how to estimate time and cost of 2,000 different wiring jobs, including installation of conduit, motors, outlets, panels, etc. Carpentry, excavating, drilling and concrete work are covered.

The book outlines each type of job and describes the factors and conditions relating to each. Examples are given. These are followed by charts which show the time required for installing various sizes of conduit, motor, duct, and other equipment. Different columns show the cost per unit if the labor rate is known.

The book is printed in blue ink. Text and charts appear only on right-hand pages. The left-hand pages are ruled and reserved for special notes. A handy and comprehensive index pinpoints the type of job desired.—*IQ*

END

RM29



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SPNO 115 V AC, 15A CTS S'Dunn . . $1.98; 2 for $3.50
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DPDT Clare SK 5010, Octal Base 18-28V 2Amp Cts, Nitrogen Sld. New Stock SPECIAL.............$2.98

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LOTS OF 10
Your selection of 10 at 59c each or smaller quantity at indicated prices.

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3X 20MFD/400VDC. . 79c; 2 for 1.29
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45MFD/450VDC .... 79c; 2 for 1.29
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30-15-10 mf/250vdc .....5 for 1.00
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4AMP	4.25	7.95	12.95	25.25
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10AMP	6.75	12.75	20.00	40.00
12AMP	8.50	16.25	25.50	45.00
20AMP	13.25	25.50	39.00	79.50
24AMP	16.25	32.50	45.00	90.00
30AMP	20.00	38.50		

Full-Wave Selen Rect & Trans. In Kit Form. All 115V/60 cy inputs
up to 14VDC at 12 amps..........$23.98
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0 to 12 VDC/2 Amp. variable DC supply, uncased and completely built—inpt. 115v/60 cy. Usable LAB supply, filament D. C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives ....$10.95 2 for $20.00

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"FEDERALS"—All Purpose Selenium Rectifier Kit. You can make 24 different Rectifiers ½ Wave/FW CT/or Bridge. 8 Plates Rated 18V 12Amp each. All Hardware & Lugs, & instructions. SPECIAL....$19.59

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29PCS CHROME VANADIUM SPEED STEEL. Top Quality for Machinists for all purpose use. Standard Full Length 1/16" to 1/2" by 64th's. With Huot Drill Index $9.69
12 PCS SET 1/16" to 1/2" Less Index $3.49
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½" SPEED ELECTRIC DRILL w/Jacobs Wormgear Chuck & 29 Pcs Drills & Index. "TAB" SPECIAL $39.00

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6 ohm 25W Model LH . .1.49; 2 for 2.49
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20 ohm 50W Model J ...1.98; 2 for 3.50
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100 ohm 50W Model K ...1.98; 2 for 3.50
200 ohm 25W Model D 1.49; 2 for 2.49
250 ohm 25W ....ea. 1.19; 3 for 2.98
300 ohm 225W Model P. . .2.98; 2 for 5.00
350, 500, 5000 ohm Slotted shaft.
25 watt ....79c; 3 for 2.00

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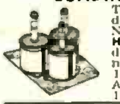
PILOT LIGHT SOCKET 1" Jewel. Hi-Polish Finish. "TAB" Special. . .59c; 10 for $4.50
1" PILOT, 1" LIGHT SOCKET, w/115V 3 Watt Bulb..............79c

CU-24/ART 13 LOADING CONDENSERS



Three 25MMF 10,000V condensers P/o ART13 XMTTR. NEW $2.49
HI-VOLTAGE Ceramic Condensers, 4 mounted on aluminum plate rated as follows 185-200-280-400 MMF P/o ART13 SIG #2C6900-47A. 11 BRAND NEW.....$1.98

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Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—data & tube, ea.......$4.98; 2 for $9.49
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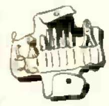
Sharp Cutoff HIQ. Cased & Shielded 60, 90, 150 cycles..........Each $1.75; 2 for $3.00
UTC854, 1024, 1250Cy.Ea.$1.50; 2 for $2.50

TOOL KIT



"My Buddy" 8 pcs. tool kit. 5 interchangeable screw driver blades. 3 ft. steel tape Rule & Cutters. As shown $1.79
8 Screw Drivers. Assorted High Quality. Magnetized. Tool Steel. Hammer-Proof. Unbreakable Plastic Handles. 12" & smaller, incld Phillips Type. "TAB" Special...............$1.25
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Hivoltage Condenser 500MMF 20KV .69

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2MFD 330VAC/1000VDC.55c; 4 for 1.95
5MFD 600VDC.......1.50; 3 for 4.00
10MFD 400VDC.......95c; 2 for 1.50
3MFD 330VAC 1000VDC.49c; 3 for 1.20
2x2MFD 600VDC.......89c; 2 for 1.59
BATHTUB SIDE TERMINALS
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4MFD 50VDC.......29c; 4 for 1.00
.1MFD 2000VDC.......1.05; 5 for 4.50
2x.1MFD 400VDC.......49c; 5 for 2.00
WRITE FOR ADDITIONAL LISTING

MICA CONDENSERS

Fig.	MFD	WVDC	PRICE
A	.033	600	69c; 5 for $2.50
A	.03	600	69c; 5 for 2.39
A	.02	600	69c; 5 for 2.39
A	.015	2500	1.75; 2 for 3.00
B	.01	600	56c; 3 for 1.25
B	.01	1000	49c; 3 for 1.25
B	.01	1200	69c; 3 for 1.49
B	.008	600	39c; 3 for 1.00
A	.005	2500	1.19; 3 for 2.95
A	.004	600	49c; 3 for 1.00
B	.002	1200	58c; 3 for 1.15
A	.002	2500	98c; 3 for 2.25
A	.001	1200	35c; 3 for 1.20
C	.00075	5000	2.98; 2 for 5.00
C	.0007	3000	89c; 3 for 2.39
A	.0004	2500	39c; 6 for 1.95
A	.0001	600	25c; 5 for 1.00
C	.0001	3000	89c; 3 for 2.00
C	.0001	5000	1.49; 4 for 5.00
C	.00005	3000	39c; 4 for 1.00

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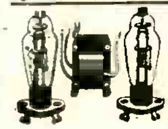

2 Tubes, Sckts, xmfr, 115v 60cyc Inpt, Output 2.5vct/10A/ Hivins $4.98
DIODE PROBE TUBE Unexcelled for No-Loss VHF testing. Ultrasensitive subminiature-envelope. New. w/data VR92 ....25c; 5 for $1.

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DPST BKLT CSD 15A/125V.89c; 3 for $2.50
DPST 20A/250V ....$1.25; 3 for $3.25
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SPDT Momentary Both Sides........ 85c
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2V/20AH Willard PLUS 2V. Vibrator. 2.98
2V 20AH w/vib & acid............. 2.95
6V 6AH Willd NT6/BB214U 2.98
6V 6AH Battery w/acid 3.25
6V 40AH Battery 6.98
6V 40AH Battery w/acid 9.25
We ship acid in bottles R'esp only

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Heinmann Magn. Bkrs. Amps: 3, 7, 9, 12, 15, 20, 30, 35, 40, 80, 180 ....$1.69; 10 for $15.98
Sq. D & CH Toggle Sw Brkrs. Amps: 5, 10, 15, 20, 25, 98c; 10 for $8.98
Klixon Thermal Push Button Bkrs Amps: 5, 10, 15, 20, 25, 30
89c ....10 for $7.98

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WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS. SELL US YOUR TUBES & EQUIPMENT.

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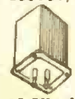
1000VCT/45MA, 795vct/80ma, 360vct/55ma, 3x5V/3A, 6.3vct/1A, 6.3vct/.3A csd Hvins can be used 2x rating Raytheon Hypersil Core........ 4.98
950VCT/100MA, 5V/5A, 5V/2.5A, 45V/1A, 10V/1.5A 5.49
900V/35MA, 2x2.5V/2A, xcint 1800-V'dblr two 2x2 fil. Windgs hsld.... 2.25
840VCT/110MA, 530vct/21ma, 2x5V/3A, 6.3vct/1A, 6.3vct/.3A........ 3.45
780VCT/250MA, 5V/6A, 12.6V/5.5A 7.95
770VCT/200MA, 5V/6A, 12.6V/5.5A 6.95
720V/85MA, 5V/3.5A, 6.3V/3.5A.. 2.98
700VCT/120MA, 2x6.3V/3A, 6.3V 1Amp..................$3.98; 2 for $7.25
700VCT/100MA, 2X6.3V/1.5A, 5V/2A, 115V Isolation-wndg 120MA.. 3.49
680VCT/200MA, 5V/3.5A, 6.3V/4A, 78V/1A.............$4.39; 3 for $12.00
500VCT/60MA, 6.3V/4A Hsld 2.98

FILTER CHOKES



12Hy/80ma/H'Sld/3KVins 2.25
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20 Hy/300ma or 15HY/400ma/12KVins 8.95
13.5Hy 1 amp 17 Kvins Raytheon. .39.95
6 Hy/175ma, 250 ohm. . .1.49; 2 for 2.49
12 Hy/300ma, Hmsld 5KVins........ 4.95
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3 Hy/40ma UTC Hi "Q" .95c; 2 for $1.39

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24V/1.25A CSD @ $1.98. Two for.. 3.49
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110v to 220V 50 Watt........... $2.95
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YOU PICK THEM **$1.00** WHILE THEY LAST
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50 PWR Magnifier & Condsr 2 for $1.00
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Controls, 50 ohm to 2 Meg. . 5 for $1.00
Resistors, ½ & 1W, to 2 Megs 50 for $1.00
Vitreous W W Resistors ......8 for $1.00
Sockets, Asstd. 8, 7, 5, 4P 12 for $1.00
Iron Core Slug & Screw . . 50 for $1.00
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TELEVISION ANTENNA

VEE CONICAL Broad response, all channel, powerful for fringe areas, Hvy const. . $8.95
FOLDED DIPOLE Hi & low antennas, all channel, sturdy const. $4.95
V CONICAL ANTENNA All Channel, Sturdy Inclds 8 elements & 100 ft. Twinex. $5.25
DOUBLE-V Ant. All Channel, Sturdy Cons. w Mtg Clamps & 100 ft. Twinex. . . . $4.49
WINDOW CONICAL ANT. All Channel, Hvy Const. Mounts outside window........$3.—
DELTA BEAM Adjustable Indoor Antenna. No More Snow, Interference, Ghosts, Lines. Powerful, for Fringe Areas. Uses all the Best Principles of Specialized Antennas. $4.75
5 FOOT Interlocking Mast Sections. Hvy Duty, rustproof ....2 for $1.49, 10 for $7

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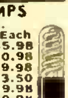
300 Ohm Twinex, Heavy duty 65 mil all copper TV lead in, per foot 2c; 100 feet $1.39; SPECIAL—1000 foot reel ....$11.
RG59U 73 ohm TV Coax Cable MFGRD to rigid UHF specs. per ft. 5c; 100 feet $5.00; SPECIAL 500 feet.........$22.00

TAB "SUN-FLASH" LAMPS



"Tab" No.	Replaces	W-Sec. Max.	Each
U5W	GE FT105	100	$5.98
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
53GT	GE FT 403	500	13.50
VA	SYLV. 4330	200	9.98
353GTQ	FT 503	5000	49.98
V4X4	X400	200	10.98
DX	SPRGFA100	150	9.00

PHOTOFLASH CONDENSERS

100MFD/500WVDC $1.98
200MFD/450WVDC 2.89
300MFD/450WVDC 4.39
16MFD/600VAC/2800VDC Intermit't. 6.95
27MFD/1.2KVDC/2KVDC Int 54W-Sec. 8.95

100 WATT SEC PHOTOFLASH KIT

Includes DX Flash Lamp Rated 150 Watt Sec. Flash Lamp Holder & 8" Reflector & Cable, Power Transformer & CD Flash Capacitors. (5) 200 Mfd Each W/Output of 100 Watt Sec. All Resistors, Capacitors, Rectifiers & Sockets $29.98
Extra Flash Lamp Holders W/8" Reflector & Cord $3.98; with Lamp DX.......$12.98

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"Weller" 115VAC/100 Watt $8.69
"Wen" 115VAC/250 W $9.49, 3 for 25.50
"Primax" 115VAC Kordless Tip 7.69
Phillips "Versa-Tool" 115VAC/250W & 4 Tips "TAB" Special ..10.83
ESICO IRONS 120VAC/DC
55 Watt/⅜ Tip/11½ Lng/.38 lbs...1.25
60 Watt/¼ Tip/12" Lng/.38 lbs... 1.91
100 Watt/⅜ Tip/12" Lng/.5 lbs.... 2.55
130 Watt/½ Tip 12" Lng/.75 lbs.... 3.17
ESICO INDUSTRIAL IRONS 120 VAC/DC
Similar to American Beauty types as shown
61A60 60W/¼ Tip/7" Lng/2.5 oz.. 3.20
#38/Am. Beauty 3138/100W⅜ Tip 5.29
#58/Am. Beauty 3158/200W/⅝ Tip 6.30
#78/Am. Beauty 3178/300W/⅞ Tip 8.18
#98/Am. Beauty3198/550W/1⅛Tip 10.08
Kester Solder one lb. 062 Roll Regular 1.29
With any soldering iron Special 90c
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*From This Special List We Ship $10.00 and Up Tube Orders At Our Expense (Postpaid) Within Continental Limits of U.S.A.
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Tube	Price	Tube	Price	Tube	Price	Tube	Price
OA2	.95	6BN7	1.69	12BH7	1.29	CK539DX	2.19
OA3/VR75	1.04	6BQ6GT	1.20	12BY7	1.35	CK541DX	1.99
OB2	1.37	6BQ7	1.65	12BZ7	1.25	CK543DX	.99
OB3/VR90	1.09	6C4	.50	12SA7GT	.69	CK544DX	.99
OC3/VR105	1.15	6CB6	.69	12SC7	.80	CK546DX	1.[illegible]
OD3/VR150	.90	6CD6G	1.69	12SF5GT	.72	CK547DX	1.98
1B3/8016	.81	6D4	2.70	12SF7GT	.49	CK571AX	2.49
1X2A	1.29	6H6	.60	12SG7	.83	CK573AX	3.4[illegible]
2X2	.49	6J4	6.66	12SH7	.63	CK1005	.85
2X2A	1.53	6J5GT	.47	12SJ7GT	.59	CK1027	2.9[illegible]
5R4GY	1.55	6J6	.63	12SK7	.72	CK1089	2.9[illegible]
5R4GYW	1.75	6K4A	6.45	12SL7GT	.65	CK5672	1.29
5U4G	.69	6K6GT	.59	12SN7GT	.75	CK5676	1.29
5Y3GT	.43	6L6	2.09	12SQ7GT	.63	CK5678	1.89
6AG5	.79	6L6G	1.35	19T8	1.09	5687	5.49
6AG7	1.39	6L6GA	1.35	19V8	1.82	CK5702	3.4[illegible]
6AH5G	1.49	6L6GAY	2.29	25BQ6GT	1.19	CK5703	1.29
6AH6	1.22	6SA7GT	.63	25L6GT	.89	Xtal Diodes	
6AJ5	1.40	6SC7	.90	25Z5	.79	1N21A	1.55
6AK5	.74	6SD7GT	.80	25Z6GT	.99	1N21B	2.89
6AK6	1.05	6SF5	.77	28D7	1.95	1N21C	21.50
6AL5	.54	6SF7	.73	35Z5GT	.59	1N22	1.25
6AL7GT	1.29	6SG7	.72	50L6GT	.69	1N23	1.35
6AN5	2.90	6SH7	.61	80	.69	1N23A	2.20
6AQ5	.55	6SJ7	.70	81	1.69	1N23B	2.25
6AQ6	.81	6SK7GT	.69	82	1.19	1N25	4.98
6AQ7GT	1.29	6SL7GT	.69	82V	1.39	1N26	8.75
6AR6	2.98	6SN7GT	.70	83	1.45	1N27	1.55
6AS5	.79	6SQ7GT	.63	83V	1.79	1N34	.64
6AS6	2.43	6SR7	.65	84/6Z4	.99	1N34A	.90
6AS7G	4.65	6SS7	.75	117L/M7GT	1.59	1N35	1.65
6AT6	.63	6ST7	.98	117N7GT	2.49	1N38	1.43
6AU5GT	1.10	6V6	1.39	117P7GT	1.39	1N38A	1.15
6AU6	.59	6V6GT	.57	117Z6GT	1.19	1N41	8.95
6AV5GT	1.29	6W4GT	.57	117Z7GT	1.49	1N42	16.95
6AV6	.49	6X4	.59	CK501X	1.26	1N45	1.45
6AW6	1.89	12AH7GT	1.45	CK501AX	2.20	1N46	.69
6B4G	1.23	12AK5	1.98	CK502AX	1.49	1N47	4.00
6BA6	.63	12AL5	.75	CK503AX	1.49	1N48	.55
6BA7	1.27	12AT6	.89	CK505AX	1.79	1N51	.45
6BC5	.63	12AT7	.81	CK506AX	1.49	1N52	1.39
6BC7	1.23	12AU6	.72	CK509AX	1.79	1N54	.89
6BD5GT	1.65	12AU7	.63	CK512AX	1.45	1N54A	1.15
6BD6	.83	12AV6	.49	CK522AX	1.29	1N57	.89
6BE6	.59	12AV7	.98	CK525AX	1.29	1N58	1.19
6BF5	.98	12AW6	1.79	CK526AX	1.49	1N58A	1.15
6BF6	.65	12AX4GT	1.20	CK528AX	1.49	1N60	[illegible]
6BF7	2.55	12AX7	.79	CK529AX	1.79	1N61	2.07
6BG6G	1.39	12AY7	2.79	CK531DX	1.89	1N63/K63	2.49
6BG7	1.98	12AZ7	1.49	CK532DX	1.89	1N64	.69
6BH6	.63	12BA6	.59	CK533AX	1.29	1N69	.98
6BJ6	.69	12BA7	.79	CK534AX	.99	1N86	1.15
6BK7	2.15	12BD6	1.23	CK536AX	.99	1N87	1.15
6BL7GT	1.45	12BE6	.59	CK537AX	3.04	1N88	1.15
6BN6	1.7[illegible]	12BF6	.85	CK538DX	.98		

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