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OCTOBER 1952

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Extra long-playing "Personal" type RCA radio batteries

These RCA long-life batteries have completely revolutionized the design and performance of "personal" type portable radios. They've opened up a brand-new replacement market for you that *never before existed.*

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New "personal" type portable radios designed to use one VS216 and two VS236 batteries can play up to *10 times longer without a battery change* than previous models using one 67½-volt "B" battery and one 1½-volt "A" battery of the ordinary type. This new battery complement offers savings in battery operating cost of as much as 25%!

Secret of the longer useful life of the new RCA VS216 "B" Battery is its use of "crown-type," alkaline dry cells. These cells use their active ingredients more effectively than do ordinary cells—resulting in greatly increased playing time.

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RADIO BATTERIES **HARRISON, N. J.**

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RADIO-ELECTRONICS

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

ON THE COVER (See page 50)
The new sound trailer which Electro-Voice uses to bring music to areas which are not served by dealer's demonstration rooms.
Color original courtesy of Electro-Voice, Inc.

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MEMBER Audit Bureau of Circulations

Vol. XXIII, No. 13

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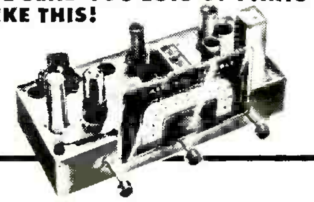

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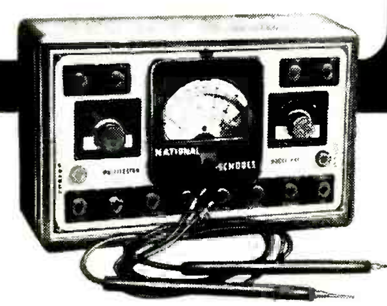

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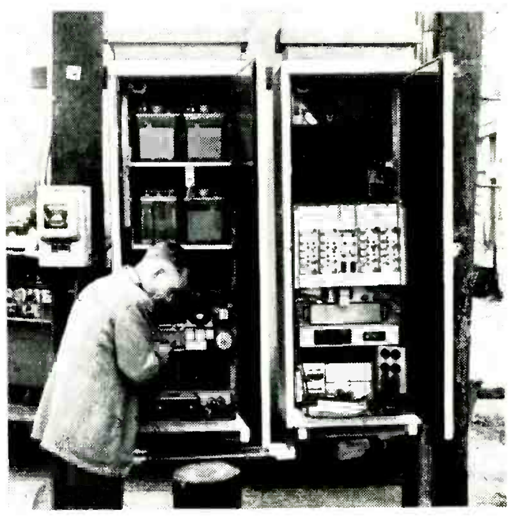
MUCH of your Long Distance telephone system works through cable but open-wire lines are still the most economical in many places. Thousands of these circuits are so short that little would be saved by using elaborate carrier telephone systems which are better suited for long-haul routes. But a new carrier system . . . the Type O designed especially for short hauls . . . is changing the picture. It is economical on lines as short as 15 miles. With Type O thousands of lines will carry as many as 16 conversations apiece.

Type O is a happy combination of many elements, some new, some used in new ways. As a result, terminal equipment takes up one-eighth as much space as before. Little service work is required on location; entire apparatus units can be removed and replaced as easily as vacuum tubes.

Moreover, the new carrier system saves copper by multiplying the usefulness of existing lines. For telephone users it means more service . . . while the cost stays low.



Repeater equipment is mounted at base of pole in cabinet at right, in easy-to-service position. Left-hand cabinet houses emergency power supply. System employs twin-channel technique, transmitting two channels on a single carrier by using upper and lower sidebands. A single oscillator serves two channels.

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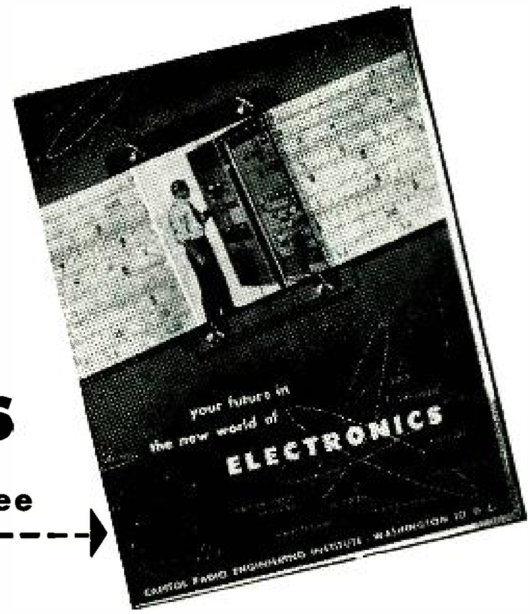

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Growing civilian markets include radio-equipped police cars, fire-equipment, taxis, planes, ships—in increasing numbers. There are industrial radio network installations, medical applications, and countless others. There are 109 TV stations now on the air and 2000 more expected now that the FCC freeze is off. Already it is estimated there are over 18,000,000 TV sets and over 100,000,000 radios in operation. How these figures will increase in the next few years, the most daring experts are reluctant to predict. This much is certain: Limitless numbers of positions must be filled—in development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting, and servicing. To fill these posts, trained men are needed—men who somewhere along the line are alert enough to improve their knowledge and skills. "Your Future in the New World of Electronics" shows how CREI Home Study leads to greater earnings, by helping get you ready for the openings described above.

CREI promises no short cuts. In an accredited technical school such as this, *you must study* to transform your ambition and energy into knowledge that pays off. Since its founding in 1927, CREI has provided thousands of professional radio men with technical educations. During World War II CREI trained thousands more for the Armed Services. Leading firms choose CREI courses for group training in electronics at company expense; among them are United Air Lines, Canadian Broadcasting Corporation, Trans Canada Airlines, Bendix Products Division, All American Cables and Radio, Inc., RCA Victor Division, Mochlett Laboratories, Canadian Marconi and Heppner Mfg. CREI's practical courses are prepared by recognized experts. You get up-to-date material; your work is under the personal supervision of a CREI staff instructor, who knows and teaches you what industry needs. Training is accomplished on your own time, during hours chosen by you. As a graduate, you will find your CREI diploma the key to success in Radio, TV and Electronics. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply. CREI alumni hold top positions in America's leading firms.

Now is the time to decide—to act. When opportunity knocks, knowledge must be "at home." You supply the willingness to learn. We supply the technical training. This combination of ambition and knowledge is unbeatable in the new Age of Electronics. Fill out the coupon and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics."

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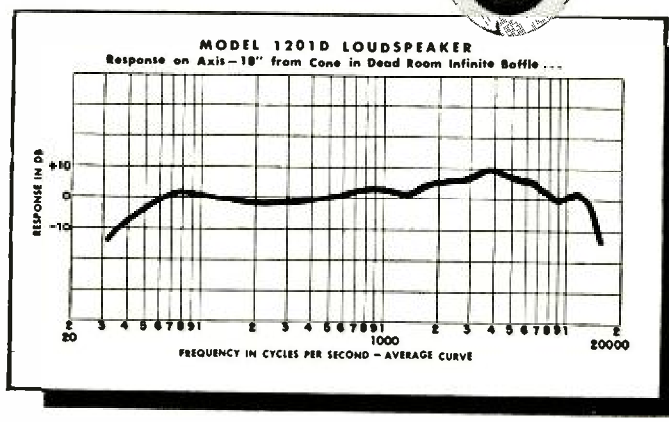

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See for yourself how readily you may prepare at home, or in our modern Chicago laboratories, for a better job or business of your own in one of America's fastest-growing fields—TELEVISION-RADIO-ELECTRONICS.

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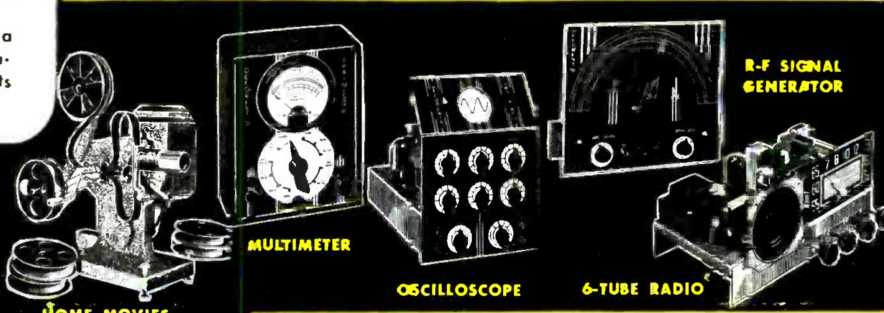

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HUGE COMPUTER "WORRIES" about giving correct answers. Navy's "Raydac" (Raytheon Digital Automatic Computer), which analyzes performance of guided missiles, has special circuits to bother it if anything goes wrong.

Once a missile is launched, miniature transmitters inside send detailed data concerning its operation so rapidly and in such volume that it is necessary to store this information on high-speed tape recorders. Four magnetic tapes

comprise the Raydac's external memory, store 2,800,000 decimal digits of information for use in computations. The machine's internal memory stores information in the form of ultrasonic pulses in mercury delay-line columns. The pulses circulate within the delay lines 200,000 times per minute, until they are called out to be used in a mathematical calculation. A typical numerical problem proceeds at approximately 1,600 operations per second.

The computer is self-sequenced, i.e. the conclusion of one operation initiates the next.

A check pulse indicating correct operation must be delivered to the sequencing circuits before computation may proceed. When any error occurs, the "worry" circuits halt the computation, and indicate the location of the trouble. However, all work done up to that point is preserved, so that the machine can continue where it left off.

FIRST-CLASS OPERATORS would be dropped by 10-kw and smaller broadcast stations under a change in FCC rules proposed by the National Association of Radio and Television Broadcasters. Claiming that routine station operation can be performed by lower-grade licensees, industry spokesmen state that the reduction in operating costs would enable these stations (which represent 95% of the country's 3,000 AM and FM broadcasters) to improve their program services. A first-class operator would still have to be called in for certain operating adjustments.

MICROWAVE RADIATION accompanies flares on the sun and sudden blackouts of shortwave radio signals, it now appears. Dr. John P. Hagen and Nannielou Hepburn of the Naval Research Laboratory report that five bursts of radiation at a frequency of 35,000 megacycles were recorded from May 1 to Oct. 1 last year. Four of the bursts coincided with observed flares and sudden ionic disturbances.

This is the highest frequency at which radio astronomers have recorded tremendous increases in solar radiation.

These bursts usually coincide with those on lower frequencies, but end much sooner and have much smaller amplitude.

Previous work with a highly directive beam had shown that the intensity of the sun's radiation at 35,000 mc was much more constant than at lower frequencies. With improved equipment capable of detecting sudden changes in the intensity of the radiation anywhere on the sun's surface none of the bursts lasted more than five minutes.

THE AUDIO FAIR, 1952, slated to open in New York City October 29 at the Hotel New Yorker, will run for four days instead of three as in previous years, closing November 1. Decision to extend the Fair's length was motivated by last year's capacity attendance, together with the belief that this year's attendance will be considerably greater. Theme of the 1952 Fair will be *Audio Today and Tomorrow.* Old-time gooseneck speakers, quarter-pound magnetic pickups, and cylinder-type records will highlight demonstrations of the latest speakers, amplifiers virtually without distortion, binaural tape recordings, and modern LP recordings and pickups which approach the ultimate in sound reproduction.

In addition to American and Canadian manufacturers, participants in the 1952 Fair will include a sizeable group of European companies, and will represent the greatest number of manufacturers of high-fidelity sound equipment ever to participate in a single exhibit. Held annually in conjunction with the convention of the Audio Engineering Society, the Audio Fair has achieved worldwide prominence as a scientific forum. Admission is free to all persons with an interest in the reproduction of sound, hobbyists and professionals alike.

GERMAN RADIO-TV EXHIBIT which was to take place in Düsseldorf from August 22nd to 31st, will now be held from February 27th to March 8th, 1953. The Exhibition has been postponed to this date to coincide with the start of regular television programs throughout Western Germany. Transmission is on the 625-line, 50-frame CCIR standard used by all central European countries except France. The standard picture size is expected to be 12 inches, but there will be some 16-inch and projection models. Many of the

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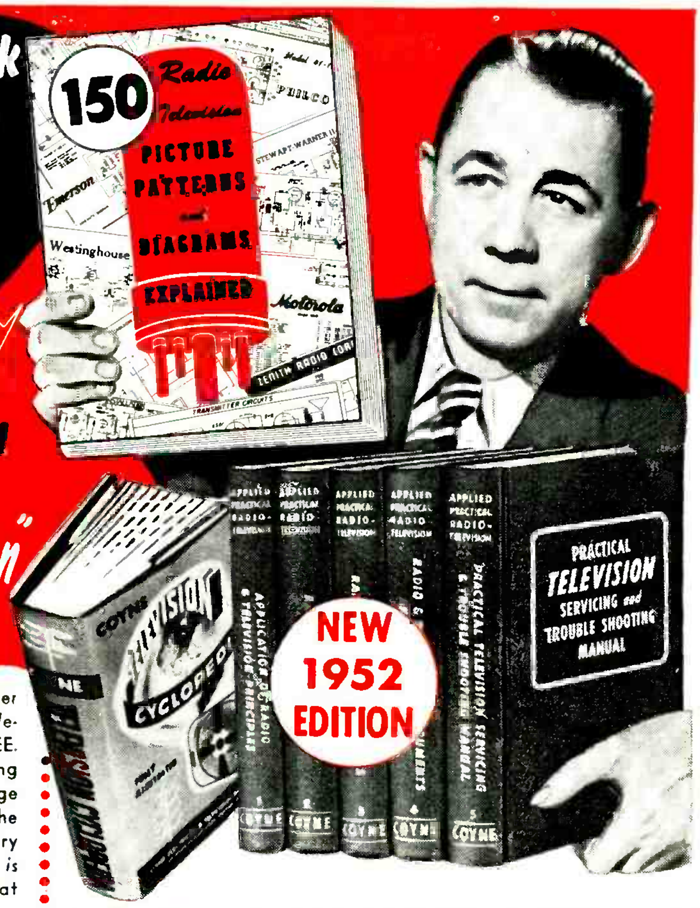

Now! Coyne offers you the most liberal "get-acquainted" offer ever made! Think of it—you get this big, brand new book, *"150 Radio-Television Picture Patterns and Diagrams Explained,"* ABSOLUTELY FREE. Up-to-minute . . . practical . . . valuable. Gives you complete wiring circuits and diagrams on the leading Radio and Television Sets. Large 8½ x 11" pages. Full instructions show you how to read and use the diagrams. One of the most valuable "tools" that belongs in every Radio and Television serviceman's repair kit. *This valuable book is Coyne's FREE GIFT to you!* It's yours for just asking to see the great new Coyne 6-book set, "Applied Practical Radio-Television"!

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You'll get into the big money faster in TELEVISION-RADIO if you know where to find the right answers to today's servicing problems—and find them quickly. Coyne's great new 1952 Edition 6-volume set gives you all the answers you want—as fast as you want them! Over 5,000 practical facts and data are fully covered in easy-to-understand fashion in volumes 1 through 5. Every step is completely explained—from principles of radio and television to installing, servicing, trouble-shooting and aligning. So up-to-date, you also get full facts on COLOR TV and UHF, adapters and converters. Hundreds of photos, illustrations, charts and diagrams help you understand quicker. And then, for speedy on-the-job use you also get the famous 762 page Coyne TELEVISION SERVICING CYCLOPEDIA—covering all of *today's* television problems from A to Z, in easy-to-find alphabetical order. This complete 6 volume TV-RADIO LIBRARY is yours to use FREE for 7 days. And you get the valuable Picture Pattern-Diagram Book ABSOLUTELY FREE for doing so!

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Vol. 4. RADIO-TELEVISION INSTRUMENTS & TESTING METHODS: 343 pages, covers all types of testing instruments, their use in service work.

Vol. 5. TELEVISION SERVICING & TROUBLE SHOOTING MANUAL: 400 pages, practical servicing all types of TV sets, UHF, Boosters, color TV printed in 4 colors, etc.

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television receivers will also be equipped for FM reception in the 88-108-mc band. Advance announcements by manufacturers indicate a large showing of tape and wire recorders.

FREE LOOK AT PROGRAM gives the customers of coin-operated TV sets a chance to save their money. The new *Preview* receiver operates without charge for a few minutes at the beginning of a program; then turns itself off and lights a sign inviting the user to deposit a coin to see the rest. Large blocks of motels have contracted for installation of this new TV entertainment device.

Transvision, Inc., New Rochelle, N. Y., developed the extra-rugged chassis needed for trouble-free operation at the hands of itinerant operators; and has been appointed exclusive manufacturer to supply the set for the Preview Corporation.

AN "ELECTRONIC COP", a simple radar-like device that sends out a beam of tiny radio waves and picks up their echoes from moving objects, is being

used to detect automobiles, as well as pedestrians, approaching the main entrance of the General Electric Research Laboratory at Schenectady, N. Y.

The system sends out radio waves only five inches in length which behave much like light waves. They are focused into a beam by an 18-inch parabolic aluminum reflector placed behind one of the windows of the gatehouse.

Some of these waves may be echoed back to the transmitter by an object in the beam. If the object is stationary nothing happens, but if it is moving the returning waves successively go in and out of phase with those being sent out, causing the alarm to operate.

The device has proved especially useful at night and over week ends, when there is little traffic, since security guards are relieved of the need for constantly watching the road. Approach of a car rings a bell, warning a guard whose attention may have been temporarily diverted, as by a telephone call.

A person walking is detected at about 100 feet; an automobile produces an effect while several hundred feet away. The flat end of a metal-body trailer truck is effective at a considerably greater distance.

TITANIUM-DIOXIDE RECTIFIERS, developed by R. G. Breckenridge and W. R. Hosler, are now under study at the National Bureau of Standards. The new elements resemble copper oxide rectifiers physically, but show markedly different electrical characteristics. Conduction is reversed, and performance actually improves with increasing temperature, up to about 150 degrees C.

TELEVISION IN URUGUAY will be delayed until financial problems have been cleared. Although a loan by the Banco de la Republica has been authorized to establish a station in Montevideo, the capital city, foreign exchange difficulties, involving half a million dollars needed to purchase equipment abroad, are responsible for the postponement. When funds are finally made available, it is expected that equipment deliveries will take six months, and the installation and preliminary testing three additional months.

CLOSED-CIRCUIT TV for railroads is proving ideal for yard watching operations and equipment checks. An RCA Vidicon installation for the Baltimore and Ohio R.R. flashes incoming freight-car numbers to the control tower, while another unit inspects passing cars for damaged riding gear. The New Haven Road will check cars for hotboxes with 14 Du Mont units.

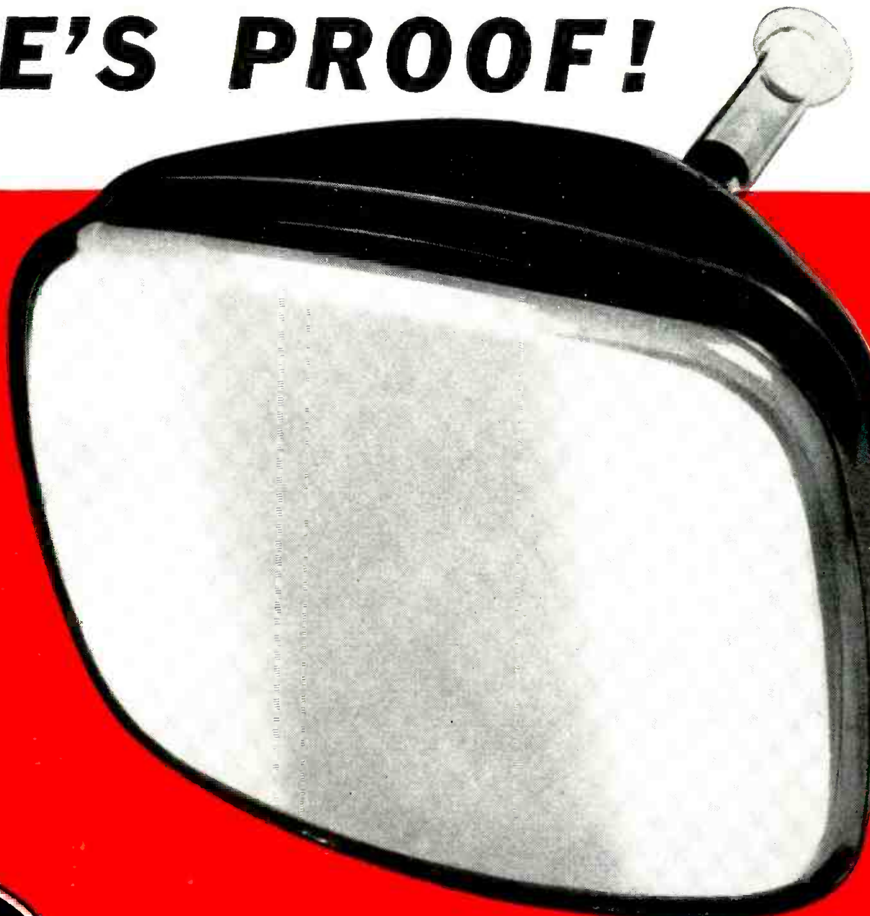
Prices of industrial TV systems now range from $4,200 for Diamond Power Specialty Corp.'s Utiliscope, used by power companies for checking furnace and chimney operation, to $25,000 for CBS-Remington Vericolor. Large department stores use Vericolor units at eye-catching points, for showing fashions, furnishings, and bargain specials. RCA's railroad unit costs $5,500.

FCC MAY ADD 540 KC to present broadcast band. A proposed amendment to present regulations would open the extra channel for Class II (experimental) operation. The National Association of Radio and Television Broadcasters is backing the Commission's proposal.

U. S. TV SERVES CANADIAN firefighters. Burnaby, B. C., firemen got their first news of a recent $500,000 three-alarm warehouse blaze five miles from the firehouse on their television receiver. The set was tuned to a station in Seattle, Washington, 150 miles away.

EARL C. RAYNER, founder of one of the earliest radio publications of the broadcast period, died on August 17 at the age of 63. He founded the magazine *Radio Digest*, which in the early '20's catered to the broadcast listener and experimenter. Old-timers will remember the magazine as the one that introduced the Solodyne circuit to American experimenters. END

HERE'S PROOF!



Glass used in second hand tubes is 20% DIMMER than NEW GLASS used in

RAYTHEON PICTURE TUBES

THE unretouched picture above demonstrates why you risk your reputation as a competent service dealer every time you sell your customers a second hand tube.

A standard Raytheon Tube was put on life test equipment and adjusted so that the raster did not cover the entire face of the tube. The tube was given the equivalent of 1000 hours of operation in a consumer set. The tube neck was then cut, the gun removed, the tube renecked and the screen washed out. The bulb was rewashed and rescreened and as you can see, the portion of the bulb that was scanned *is about 20% darker than the unscanned area.* In short, scanning darkens glass and any used bulb that is rescreened will be 20% darker than a new bulb. The only way you can get new tube-brightness out of a second hand tube, is to increase the beam current. And since beam current comes from the cathode, increasing the beam current shortens tube life. For this reason, when you replace with second hand tubes your customer loses, and in the long run so do you!

It's good business to always replace with *new* tubes. And, of course, if you want the finest new tubes that money can buy . . .

. . . use **RAYTHEON TELEVISION PICTURE TUBES**

They're Right for *Sight* . . . and Right for *You* . . . and *Always New!*

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Receiving Tube Division

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

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[illegible]

BAROMETER of the PARTS INDUSTRY

During August, 42 of the leading 400 manufacturers of Radio-Television-Electronic parts and equipment made changes in their lines. Actually there was an increase in "change activity" as compared to July.

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

	No. of Manufacturers	
	July	August
Increased prices	4	5
Decreased prices	17	14

	No. of Products	
	July	August
Increased prices	7	9
Decreased prices	88	515

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

Product Group	Increased Prices		Decreased Prices		New Products		Discontinued Items	
	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.	1	1*	3	37*	5	32**	2	26*
Capacitors	0	0	1	300*	1	49*	1	3*
Controls & Resistors	0	0	0	0	0	0**	1	32**
Sound & Audio Prod.	0	0	2	16*	8	49**	3	18*
Test Equipment	2	3*	1	1*	4	10**	1	1**
Transformers	0	0	1	11*	4	62**	2	8*
Tubes	1	3**	5	49*	5	58*	3	42*
Wire & Cable	1	2	1	101	0	0	0	0

* Increase over July
** Decrease from July

* Increase over July
** Decrease from July

Comment: As previously noted, product activity in the Electronic Industry continues to center upon the introduction of new items. At the same time manufacturers are withdrawing products at almost the same pace. Price increases and decreases are quite spotty with no apparent trend at this time.

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

The RCA Victor Tube Department launched a point-of-sale promotion campaign to promote the use of RCA replacement crystal cartridges and styli. The campaign is built around a new crystal cartridge package, a bonus offer of a styli utility cabinet and a *universal* stylus wrench with each model inventory of styli ordered by a dealer.

New RCA stylus-replacement bonus kit.

Sprague Products Co., North Adams, Mass., is issuing a new window display poster, "Why Doesn't My Set Stay Fixed?" which gives a clear answer to this frequently asked customer query. The poster is signed by Harry Kalker, president of Sprague Products. It is available, free, from distributors, or for ten cents, to cover handling, from the company.

The Walter L. Schott Co., Los Angeles, will celebrate the production of its 1,500,000th TV antenna by awarding four free vacation certificates. Two all-expense vacations will be given to the distributor who sells the lucky antenna and two to the service technician who buys it. The winners may select any vacation spot in America for a full week. Transportation will be supplied aboard a TWA Super Constellation.

Walter L. Schott (left) with antenna featured in new Walsco prize contest.

Merit Coil & Transformer Corp., Chicago, held a series of combined jobber and TV service technician's conferences in St. Louis and Omaha. They were addressed by Chet Jur, chief TV technical engineer. The St. Louis meeting was sponsored by Radonics, Van Sickle Radio Co., Hollander & Co., and Tom Brown Interstate Supply Co. The Omaha meeting was held under the auspices of the J-B Distributing Co., Omaha Appliance Co., and World Radio Laboratories.

RCA's Television Dynamic Demonstrator was shown recently by John

John Meagher (left) of RCA shows his TV-receiver demonstrator panel.

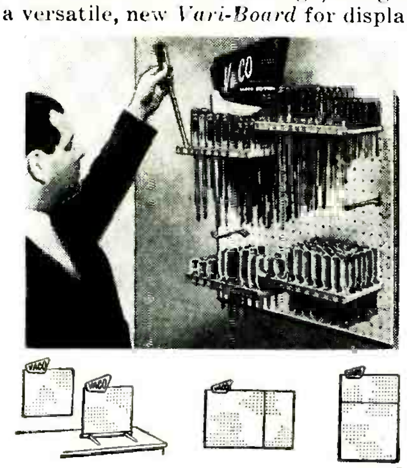
Meagher of the company's Television Service Clinic at an Electronic Fair, the second annual show of this type sponsored by the Lew Bonn Co., Minneapolis distributors.

Jensen Industries, Chicago, is running a contest for service technicians from September 1 to the end of the year. Cash prizes will be awarded to those

Karl W. Jensen, of Jensen Industries, Inc., announces phono-needle contest.

who send in the most empty Jensen needle packages during this time. $1,000 is the top award in this *Win a Grand* contest.

Vaco Products Co., Chicago, designed a versatile, new *Vari-Board* for display-



Flexible "Vari-Board" displays *Vaco* line of hand tools for electronics industry.

NOTE the wide ranges of this compact pocket-size instrument. Note controls—flush with panel. Then study the inside view. Nowhere will you find, in design and manufacturing quality, the equal of 666-R.

Model 666-R

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3. Unit Construction—Resistors, shunts, rectifier, batteries, are housed in a molded base integral with the switch. Direct connections without cabling. No chance for shorts.

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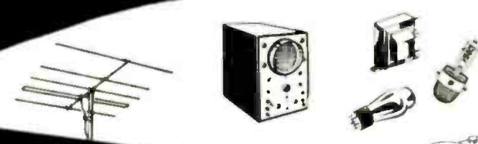

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*City*__________ *Zone*____ *State*______ ing its screwdrivers. The punched-out Masonite construction permits a variety of uses. A specific model has been designed for sales in the electronic field.

M. A. Miller Manufacturing Co., of Chicago, is repackaging its No. 550 and No. 560 needles and is also featuring a new item, the No. 35 straight-shaft needle which is tipped with osmium alloy.

General Electric, Syracuse, N. Y., is planning an intensive nationwide educational program designed to familiarize technicians with its new Stratopower TV chassis.

Insuline Corporation of America, Long Island City, N. Y., released a new eight page brochure describing its facilities for the production of electronic parts and equipment.

The Battery Committee of the National Electronic Distributors Association prepared a new "Sales Booster" in the form of a battery index which is designed to eliminate confusion in the handling of dry batteries and at the same time increase sales. Copies are available from the NEDA office at 221 N. LaSalle St., Chicago.

Production and Sales

The RTMA announced that June TV picture-tube and radio receiving-tube sales were above those for May, with totals of 376,943 and 24,365,462, respectively. For the first six months of 1952, a total of 2,393,980 TV picture tubes and 160,183,526 receiving tubes were sold. Both of these figures are off from the 1951 period.

The RTMA reported that 2,118,510 TV sets were shipped to dealers during the first six months of 1952.

New Plants and Expansions

Sylvania Electric Products announces that its Electronics Division is now located in new headquarters in Woburn, Mass. The new plant will house the administrative, sales, engineering, and manufacturing staffs of the division, which manufactures electronic products to be used in such fields as radar, navigation, communications, and flight.

Ampex Electric Corp., Redwood City, Calif., opened expanded Midwestern district sales facilities in Chicago under the direction of Russell J. Tinkham. The new location includes sales offices, showrooms, and warehouse facilities.

Skottie Electronics, a new corporation which will manufacture disc plate, tubular ceramic capacitors and other electronic items, was formed in Peckville, Pa. Officers are Joseph P. Sewack, president; Paul Machiesky, secretary; James Mitchell, treasurer and Karl E. Bretz, executive vice president in charge of sales. Mitchell was an executive with Electrical Reactance Corp. and Bretz with the Hi-Q Division of Aerovox.

The Philco Corp. Government and Industrial Division established headquarters at a new address, 4700 Wissahickon Ave., Philadelphia.

Allen B. Du Mont Laboratories announced the formation of Du Mont Television & Electronics, Ltd., Montreal, a Canadian subsidiary which will make

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"I have had a half dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as a Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."
Dale E. Young, 122 Robbins St., Owosso, Mich.

GETS CIVIL SERVICE JOB

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with my landing this desirable position." **CHARLES E. LOOMIS,**
4516 Genessee Ave., Dayton 6, Ohio.

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS

"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations, in the southern states, and am now employed as Transmitting Engineer on WMMT."
ELMER POWELL, Box 274, Sparta, Tenn.

GETS PUBLIC UTILITIES JOB

"I have secured the position of Radio Technician with the Toledo Edison Company. I want to thank you once more. The help you gave me was much more than would ordinarily be expected—both in obtaining my license and in finding employment."
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Telegram from Chief Engineer, Broadcast Station, Pennsylvania: "Immediate opening for engineer. Automobile and First Phone a must. If graduate available, please forward name and address."

Letter from Chief Engineer, Broadcast Station, Montana: "Immediate opening for Engineer-Announcer. Basic salary $62.50 . . . real future for right man."

Letter from Chief Engineer, Broadcast Station, Tennessee: "Have opening for operators. If you have men, please have them contact us."

These are just a few examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs; it might have been you!

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Clifford E. Vogt, Box 1016, Dania, Fla.	1st Phone	20
Francis X. Foerch, 38 Beucler Pl., Bergenfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis, 317 N. Roosevelt, Lebanon, Ill.	1st Phone	28
Francis X. Foerch, 38 Beucler Pl., Bergenfield, N. J.	1st Phone	38

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"I was very pleased to receive my diploma for Nilson's Master Course, after which I took the exam for First Class Radiotelephone and the Radar exam. I am happy to say I received my First Class license, number P1-2-4361 with the Ship Radar endorsement. I experienced no difficulty at all in taking these exams, thanks to Nilson's Master Course."

RICHARD E. STREBEL, Box 589, New Providence, N. J.

"I took the license examination for 2nd 'Phone and 2nd Telegraph, in Knoxville, Tenn. I am happy to advise that I passed both in fine shape. I received my licenses this morning. Your course proved invaluable in preparing for the examination."

E. F. JONES, Jr., Gallatin, Tenn.

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1. 200 EMPLOYMENT APPLICATIONS
200 employment applications, with our letter of recommendation attached, addressed to employers of your choice, in areas you select, in broadcasting, mobile communication, manufacturing, airlines, CAA, State Highway Communication, Police Radio, and other fields of radio employment.

2. CHIEF ENGINEERS BULLETIN
Mailed every month to the chief engineers of every AM, FM, and TV broadcast station in the United States and territories. If you want a broadcast technician's or engineer's job this is an amazingly effective way to get your choice of broadcast jobs almost anywhere in the U.S.A.

3. "JOB WANTED" LIST
Mailed to all employers who telegraph, telephone, and write asking for our graduates. We regularly receive requests for our students from almost every state in the Union. No greater tribute can be paid to the high caliber of our training, coaching and Job-Finding Service!

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"I am now working as a lab technician in the engineering department of Stromberg-Carlson Company. My CIRE course and 2nd 'phone helped a great deal in obtaining this position."

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Ex-Navy Man Gets RCA Job

"Since my discharge from the Navy I have been employed by RCA Service Company. Believe it or not, I owe all of my good fortune to your course of instruction, and I can truthfully recommend it to anyone."

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licensing agreements with Canadian manufacturing organizations for the manufacture of Du Mont products in Canada. Dr. Thomas T. Goldsmith, Jr. is president, Ernest A. Marx, vice-president, and Bert L. Graham, secretary-treasurer.

Business Briefs

. . . Raytheon Manufacturing Co., Waltham, Mass., voted to change the name of its television manufacturing subsidiary, Belmont Radio Corp., Chicago, to Raytheon Television & Radio Corp.

. . . Bulova Watch Co., Inc., New York City, took another step into the electronics field with the introduction of a new clock radio. The company had previously announced a licensing agreement with Western Electric for the development and production of transistors.

. . . The 1952 Radio Fall Meeting which will be held in the Hotel Syracuse, Syracuse, N. Y., October 20 to 22, under the sponsorship of the RTMA Engineering Department, will feature three technical sessions on television, including u.h.f. and color TV.

. . . Webster-Chicago Corp. and Radio Electric Service Co., its Pennsylvania distributor, appointed the Witte Radio & Television Co., Philadelphia, as official service station for "Webcor" products.

. . . Motorola, Inc., Chicago, was awarded a $28,000,000 contract for two-way communications equipment by the U.S. Signal Corps.

. . . RCA sold the experimental u.h.f. TV station KC2XAK at Bridgeport, Conn., to the Empire Coil Company of New Rochelle, N. Y., for installation in Portland, Oregon. The station broadcasted programs from WNBT, New York City, on a regular schedule from December 29, 1949, to August 23, 1952.

. . . NEDA announced that four new members had been admitted to the Association: Joseph F. d'Aquin, Crescent Radio & Supply, Inc., New Orleans; Howard Bristol, Bristol Distributing Co., Fargo, N. D.; Harold Bruce, Harold Bruce Co., Springfield, Ill.; and V. R. Lampley, Lampley Radio Co., Benton, Ill.

. . . The RTMA announced a new statistical service covering the movement of radio and TV receivers at the retail level, including dealers' sales and inventories. The new plan was proposed by retired president Glen McDaniel and was developed by the RTMA Industry Statistics Committee, under chairman Frank W. Mansfield, Sylvania Electric Products, and RTMA statistical director William F. E. Long.

. . . There were 18,354,300 TV sets in use in the U.S. as of August 1, according to NBC.

. . . Standard Coil Products, Chicago, set a list price of $13.75 per set on u.h.f. tuning strips for its turret tuners. Each set will tune in one u.h.f. channel.

. . . Both Du Mont and Admiral have announced that they plan to bring out only one new line of receivers a year, beginning in 1953. All service technicians will rise and say Amen. END

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proudly introduces

the world's first Broad Band Yagi

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A great new type of antenna that combines:

- **Broad Band coverage** *with the*
- **high gain and directivity of the Yagi**

Spectacular high gain! Razor-sharp directivity! In fact, all the brilliant performance that only a Yagi can deliver, is now yours with the FUTURAMIC — not on just one channel, but CLEAR ACROSS THE BAND!

For the first time in television history, here is an antenna that not only solves <u>today's</u> installation problems — but also provides for the <u>new</u> VHF channels of the <u>future</u>. This is the antenna you have been waiting for — the 10 Element FUTURAMIC is a true Broad Band Yagi!

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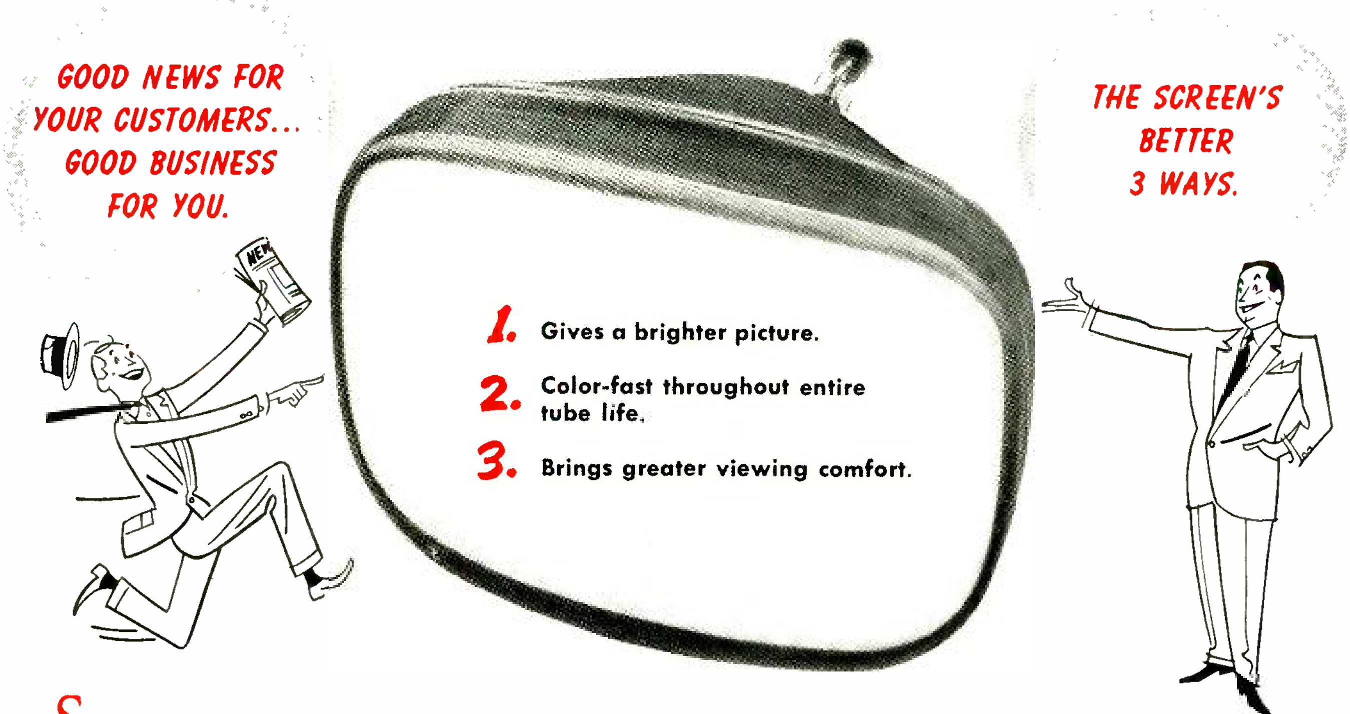

Sylvania's years of research in fluorescent phosphors and lighting techniques have resulted in a vastly improved *picture-tube screen.*

FULL YEAR GUARANTEE ON ALL SYLVANIA PICTURE TUBES

Sylvania now guarantees all its Picture Tubes for one entire year from date of installation. This is your positive assurance of trouble-free performance.

This screen gives an increased light output over former screens . . . particularly when the tubes are operated at voltages below 14 kilocycles.

The face of this Sylvania screen is a restful blue-gray color for maximum viewing comfort. And, it is absolutely free from any discoloration . . . throughout the entire life of the tube.

So remember, you'll win more satisfied customers . . . good business and good will . . . when you install picture tubes trademarked *Sylvania.* For prices and complete information mail the coupon NOW!

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President of Radio-Television Training Association,
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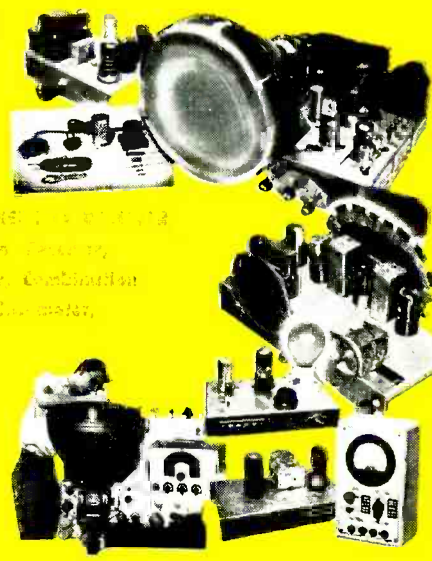

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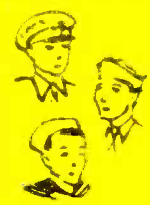

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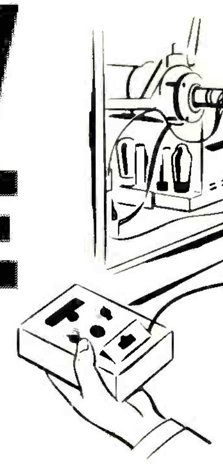

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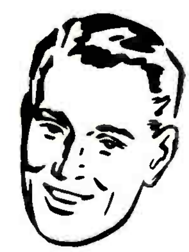

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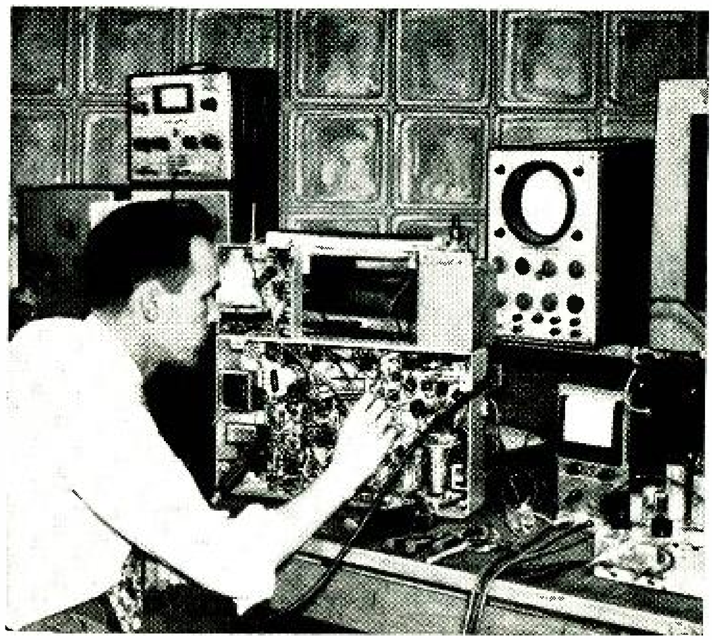

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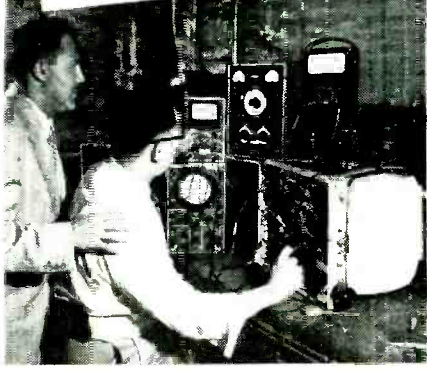
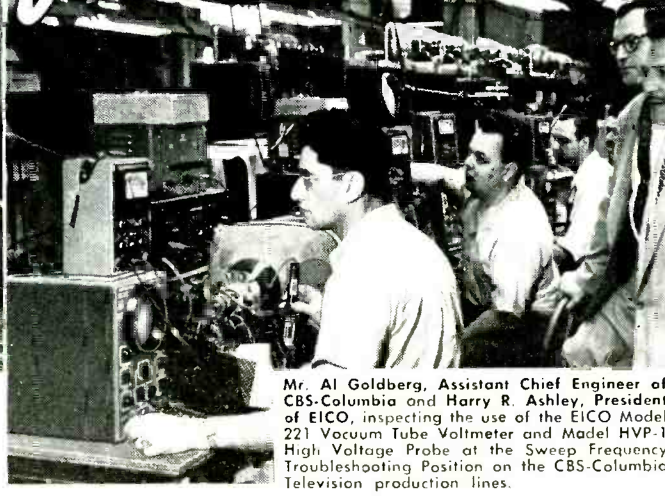


In the CBS-Columbia design laboratories, Al Goldberg takes some important readings with the EICO Model 221 Vacuum Tube Voltmeter and Model 555 Multimeter as Harry R. Ashley looks on.



Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Television production lines.

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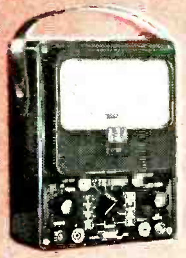

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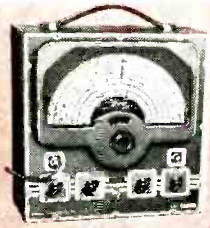

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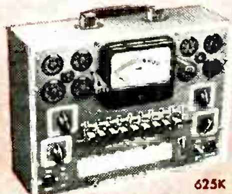

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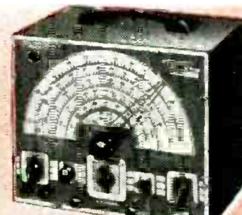

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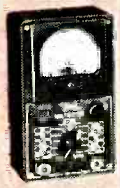

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Our Electronic Universe

... The heavens are the major producer of all electrons ...

By HUGO GERNSBACK

EXACTLY 30 years ago the writer authored an article entitled "The Celestial Audion" (*Radio News*, July, 1922). This article showed the surprising close parallelism of the vacuum tube with the solar system. Just as the filament or cathode of the vacuum tube constantly emits electrons which bombard the "empty" space and the elements in the tube, so the sun, too, emits electrons on a gigantic scale which bombard the earth, moon, and other planets, through space.

When, due to sunspots or other atomic activity, the flow of solar electrons is increased, we, on earth, know it about 26 hours later, for it takes this particular electronic flow—traveling at the rate of 994 miles a second—that length of time to bridge the 93 million miles separating us from the sun. Magnetic storms on earth, which disrupt wire and radio communication, the flaming up of the *aurora borealis*—the northern lights—are only a few of the phenomena noted by us when solar electronic activity increases.

Even without a sudden increase of solar electron radiation, we are under continuous electronic bombardment from the sun. Nor is this solar energy which the earth intercepts trifling. Scientists today are certain that most of the magnetic field of the earth is created chiefly by solar electronic emission.

That the sun is indeed a gigantic radio transmitter was confirmed again in September 1951 and February, 1952. A French scientific expedition on the African River Niger made a number of significant radio observations during solar eclipses. It was noted that with a specially constructed wave guide a considerable amount of radio energy was intercepted on centimeter wavelengths. Nor did the radio energy originate from the center or the edge of the solar disc. It appears that the radiation comes from *outside* the solar surface. As the scientists put it: "*the radioelectronic sun's diameter is 70% larger than the optical sun.*" It thus appears that the sun's corona is also a radio emitter.

But our sun is not the only celestial radioelectronic transmitter. There are hundreds of millions of other stars in the universe and practically all of them send us similar radio energy. Naturally, due to the enormous intervening distances, the intercepted energy received on earth is trifling. Nevertheless, our new radio telescopes, now springing up all over the globe, collect these celestial radio waves and measure their frequency and energy accurately.

Not all of the myriad suns in the universe are alike. All vary in age, size, and composition. Thus our sun is a moderate-size star, fairly young—about four billion years old, and will probably last 50 billion years more according to cosmologists.

Other stars *much* larger than the sun have a different life cycle. These, called super-giants, are colossal in size, but when their hydrogen supply becomes exhausted, the star shrinks, or begins to collapse rapidly. Now it starts to radiate a different type of electronic energy—hard, powerful X-rays. Finally the super-giant in its death throes explodes with a force that would make the detonation of a million man-made atomic bombs, set off together, seem like a harmless firecracker. The exploding star has now become a *supernova*, such as we see flaring up in our skies periodically. Nevertheless, even after such a massive world-explosion, the supernova lives on a while. According to Prof. Fred Hoyle of Cambridge University, about 10% of the original star remains after the explosion. At this point the supernova emits the most powerful rays known to man, namely: cosmic radiation.

Inasmuch as there are many millions of different types of *novae* throughout the whole universe, continuously radiating cosmic rays, our earth intercepts unending streams of this still little understood electronic super-radiation.

Most cosmologists today are agreed that the universe has neither beginning nor end, startling as the idea is to most of us. Space and universe are one entity—you cannot well conceive one without the other. Even a truly empty space cannot be conceived as not having existed at one time.

More surprising still is the theory recently advanced by scientists. It is called *continuous creation*. This in its simplest terms means that the universe can never run down—it will live on forever. It has been shown mathematically that the fuel on which all suns feed is hydrogen—the most abundant material throughout the universe, which means throughout infinite space. (Let us not forget too, that hydrogen is composed of one negative electron, and one positive proton.) Far more startling is that in order to keep all the billions of stars, big and little, supplied with fuel, it is only necessary to continuously create *one single* hydrogen atom in a space as large as a medium skyscraper, *once a year*. But we must consider the immensity of universal space to realize how these lone atoms will nevertheless in the aggregate add up sufficiently to run the universe composed of millions of galaxies and billions of stars.

But cosmologists are silent when it comes to explaining *how* the hydrogen atoms are created continuously. They are no more concerned with this than to explain *what* gravitation is or how *it* is created. They merely say, as does Hoyle: "Where does the created material come from? It does not come from anywhere. It simply appears—it is created."

What practical benefit do we derive from the electronic universe? For one thing we learn many new electronic facts and we greatly enrich our present knowledge. We learn that electric radiation can be produced *directly* from the atom—achieved only as a laboratory curiosity today—but a commercial possibility tomorrow.

It will also be possible in the future to tap the sun for its electrical energy. This may be difficult to accomplish on earth for some time, due to our atmosphere which now hinders reception. But on the moon this obstacle vanishes. As it will not be very long now before we reach the moon, solar-electric generation stations are certain to be built for power purposes, to smelt lunar metals, for lighting and heating and many other purposes.

But it is in the cosmic radiation where our greatest hope in the future centers. These unbelievably powerful rays have such vast energy that they not only pass easily through our atmosphere but penetrate far into the earth without difficulty. Cosmic rays have been detected in mines over a mile below the earth's surface. As it takes around three billion volts for these rays to penetrate to the bottom of our atmosphere, an idea can be gained of this gigantic radiation. It seems certain that some day this stupendous energy will be harnessed for man's use. When that happens it may well revolutionize our lives.

This sketchy account of our electronic universe does not even begin to scratch the outer film of the subject. Let us ponder that our infinitesimal knowledge of this fascinating study is less than one hundred years old, and that the *local* electronic universe—our own galaxy—according to the latest researches, has been functioning uninterruptedly for over five billion years!

CONVERTERS for U.H.F. TV

Commercial units for receiving the new u.h.f. channels on your present TV set. Continuous-tuning models give complete coverage.

Fig. 2—Kingston continuous-tuning u.h.f converter.

By FRED KING*

WHEN TV channels 14 through 83 were proposed for the 470–890-mc portion of the u.h.f. spectrum manufacturers had to assure prospective buyers that their sets would not become obsolete but could be adapted to the new channels.

Converters had to be designed which could be used with the millions of sets already in existence and which could be attached simply, without making changes in the internal wiring. Later—when the new stations actually got onto the air—newer designs would be needed with the u.h.f. section as an integral part of the chassis.

Very few persons had experience in this band (too low for microwave techniques and too high for conventional lumped-constants design). No signal generators or precise measuring equipment were available and few tubes were suitable for these frequencies, where the capacitance of an inductor and the inductance of a capacitor really amount to something.

Most converter designs operate on the double superheterodyne idea with output on one of the v.h.f. channels which then becomes an intermediate frequency. This is popularly designated as the converter i.f. See Fig. 1 for a block diagram of the typical u.h.f. converter.

Early experiments showed that vacuum-tube r.f. stages and mixers resulted in a poor noise figure at u.h.f. They were abandoned in favor of the microwave technique of using a crystal mixer with some sort of preselection between it and the antenna. The improvement was considerable and this system seems to have been adopted generally. The most popular germanium crystals for the mixer position are the G-E G7, the Sylvania 1N72, and the

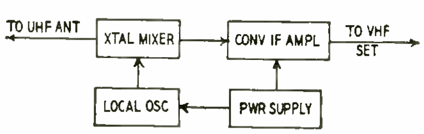


Fig. 1—Block diagram, u.h.f. converter.

* Chief Engineer, Radio Station WELI New Haven, Conn.

Fig. 3—Rear of Kingston converter. Large cylinder is the tuner.

Raytheon CK710 u.h.f. crystal diodes.

Converter i.f. amplifiers

The incoming signal is attenuated about 9 db in the crystal mixer and a carefully designed low-noise intermediate-frequency amplifier is required in the converter to boost the signal level before it is applied to the input of the v.h.f. receiver. Most manufacturers use the famous cascode circuit, the driven-grounded-grid, or the direct-coupled driven-grounded-grid circuits, or some slight modification of these. The 6BZ7, 6BK7 and 6BQ7 low-noise miniature twin triodes were designed especially for these low-noise circuits.[1]

The choice of the v.h.f. channel used as the converter i.f. varies somewhat. A lower noise figure results with the use of the lower channels, while there is less oscillator radiation and fewer images and other spurious responses if the higher channels are used. The popular all-around compromise seems to be channel 5 or 6 (with some means of adjusting the converter to either). This is necessary, as a strong local v.h.f. signal may ride in and interfere with the converted v.h.f. signal on one or the other channel.

The Crosley *Ultra-Tuner* does not have this problem, as it uses 127 mc for the converter i.f. This is possible because their v.h.f. receivers use the Mallory *Inductuner* and can tune the spectrum between channels 6 and 7.

U.h.f. oscillators

The u.h.f. oscillator must be tuned to the low side of the received signal to maintain the proper relation between the sound and picture carriers. The 6AF4 tube is the most popular in this position because of its small lead inductance, tube capacitance, and transit time.

Oscillator drift loomed as a serious problem in early converters. When used to feed v.h.f. sets with separate sound and picture i.f. systems they drifted so badly that the critical FM sound tuning had to be adjusted every few minutes to compensate for it. When used with intercarrier sets this frequent adjustment was unnecessary, as the sound information is taken from the 4.5-mc beat between the two carriers, which are kept within close tolerances with precise equipment at the transmitter. This probably helped to influence some manufacturers to change over to the intercarrier sound design. The oscillator drift was reduced tremendously in newer model converters with new designs of circuit elements and tubes.

Oscillator radiation

One would think that oscillator radiation through the antenna would be less intense with a converter using an r.f. stage and tube mixer. This is not the case at u.h.f.[2] The crystal mixer requires less oscillator injection power to operate efficiently than vacuum-tube mixers and so there is less power to get through to the antenna. Radiation direct from the chassis is another problem and can be controlled by proper shielding and design.[3]

Converter design

The geniuses of design approached their individual problems from different angles, depending to a great extent on the front-end design of their present and past v.h.f. receivers. This makes it possible to group converter design into three general categories as follows:

1. Continuous-tuning type

Manufacturers not using the turret type v.h.f. front end designed converters built in small cabinets with self-contained power supply that resemble the conventional booster. They have the advantage of being able to tune the entire 70 channels from 470 to 890 mc. They have the disadvantage of being an external accessory and are more confusing for the nontechnical public to operate.

Some examples of this type of converter are: RCA, G-E, Crosley, Mallory, Stromberg-Carlson, Sylvania, Bendix, Kingston, Arvin, Philco, Dumont, Sarkes Tarzian, and Sutton.

2. U.h.f. strip type converter

Manufacturers who had consistently used the turret type v.h.f. tuner could go ahead with the design of a converter with the lumped constants and crystals mounted on a replaceable individual segment of the turret. These strips can be inserted in unused positions of the v.h.f. turret.

Advantages of this type are the operation is the same as for v.h.f. and there is no external accessory to be tuned. Also it is simpler and cheaper when only two or three u.h.f. channels are within range. The method has the disadvantage of requiring new strips if the TV set owner moves to a different city with different channel assignments, and distributors will require a considerable stock for the different channels used in any area and for different models of v.h.f. receivers. This type of converter is made by Zenith and by Standard Coil who supplies v.h.f. tuners for more than 60 manufacturers.

3. Two- or three-channel switch type

A few companies have designed small converters for attachment to the back, bottom, or inside of the v.h.f. receiver with lumped constants pretuned to several selected channels and switched by pushbuttons or some mechanical extension. They may or may not obtain operating voltages from the TV set.

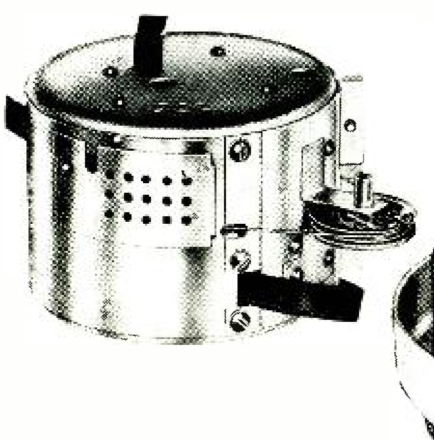


Fig. 4—Continuous u.h.f. tuner assembled in external shield.

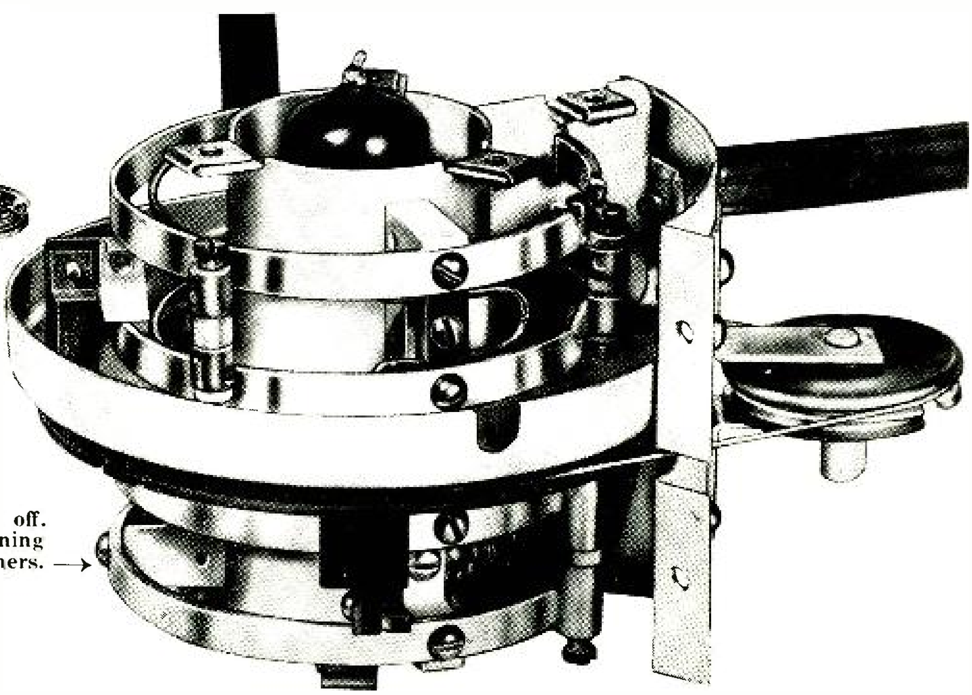


Fig. 5—U.h.f. tuner with shields off. Straps surrounding tube are tuning lines with cylindrical ceramic trimmers. →

This type is simple and cheap when only a few channels are within range. Some recent v.h.f. receivers have provision for this type converter on the chassis. RCA, G-E, Philco, and Sarkes Tarzian have models using this idea.

The Kingston converter

This converter falls into Type 1. The manufacturer is Kingston Products Corp. of Kokomo, Ind. Fig. 2 shows a front view of the complete converter. The three controls are off-on and u.h.f.-v.h.f. antenna change-over switch, channel selector, and fine tuning. The over-all dimensions are 8⅛ inches wide by 5¾ inches high by 4½ inches deep.

The basic tuner uses tuned-line microwave principles and its mechanical design is compact and practical. The tuner is 4 inches in diameter and 3 inches in depth. It is a continuous-tuning type using curved lines with sliding silver shorting bars for tuning. The 70 u.h.f. channels are covered in 340 degrees of rotation and the slide-rule type dial indicates the frequency in megacycles. One stage of i.f. amplification is included with the tuner.

In basic physical layout and construction it is suitable for any selected i.f. and is normally supplied with output on channel 10. If there are spurious responses, or if a strong v.h.f. signal rides in, the i.f. output trimmer—located on the rear of the tuner—may be adjusted for output on channels 8 through 12. In Fig. 3 the white arrow shows the exact location of this trimmer. This rear view also shows the terminal board with the u.h.f. and v.h.f. antenna and output connections.

Fig. 4 shows the u.h.f. tuner removed from the chassis but with all covers and shields in place. Fig. 5 shows the u.h.f. tuner with the shields removed. The preselector lines and sliders with their respective trimmers are at the top. The antenna coupling loop is behind the preselector line. The oscillator lines with slider and trimmer are at the bottom. The cascode i.f. amplifier tube is mounted in the center. An antibacklash drive and speed reduction are simultaneously obtained with a spring-loaded dial cord around a molded bakelite ring to which the preselector and oscillator sliders are attached.

The r.f. circuit of the converter (Fig. 6) consists of a stationary balanced transmission-line type antenna coupling loop, a tunable preselector transmission line, and a crystal mixer. The oscillator and preselector lines are curved parallel strips of silver-plated brass, ¼ inch wide. Tuning with parallel lines of adjustable electrical length allows a large frequency range and simplifies tuning.

Two trimmer capacitors on the preselector lines simplify the tracking problem. One sets the high-frequency end and the other sets the low-frequency end of the range. Tracking the oscillator with the pre-selector circuits is a simple alignment operation.

The u.h.f. local oscillator uses the miniature 6AF4 triode capacitance-coupled to the quarter-wave short-circuited transmission line. It tunes from 275 to 695 mc. A trimmer capacitor across the plate tank circuit sets the frequency to any desired point at the low end of the range. The warmup drift of the oscillator is about 250 kc at the high-frequency end of the band and about minus 250 kc on the low end. The frequency stabilizes after five minutes of operation.

The converter i.f. amplifier uses a 6BK7 twin-triode tube in the familiar cascode low-noise circuit. It is series-coupled to the crystal mixer.

This converter has been tested over a 6-month period at a u.h.f. monitoring station maintained by WELI at New Haven. Reception of the Bridgeport RCA-NBC experimental u.h.f. station KC2XAK has been very satisfactory and no mechanical or electrical failures were encountered. END

References

[1]**Use of Low-Noise Twin Triode in Television Tuners,** Robert M. Cohen. *RCA Review*, Volume XII, No. 1, March, 1951.

[2]**Some Design Considerations of Ultra-High Frequency Converters,** Wen Yuan Pan. *RCA Review*, Volume XI, No. 3, September, 1950.

[3]**Reducing TV Receiver Oscillator Radiation,** E. W. Chapin and Willmar K. Roberts (FCC). *Electronics*, July, 1952.

Mr. King will give us further information on u.h.f. conversion and converters in future articles in this magazine.

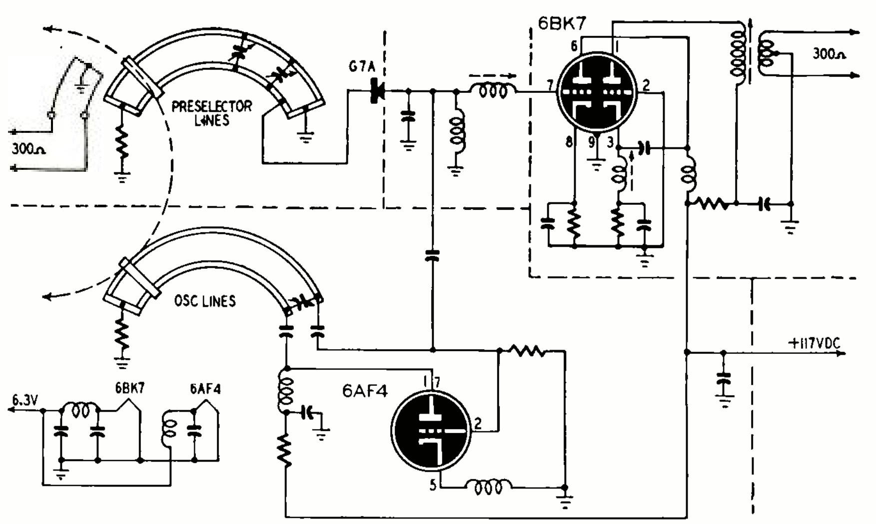


Fig. 6—Signal circuits of the Kingston converter. Output is on channel 10.

TV DX REPORTS

October is an interim month in both weather and propagation conditions. TV reception can be expected to show both the extended range of late summer and the somewhat shortened coverage of early winter, before the month is through. It will not be a good month for the TV dx enthusiast who is looking for reception from 1,000 miles or more away, for sporadic-E skip is rare at this time of year. There may be an opening or two during the month, but signals will be generally poor, and the reception in most cases will be of short duration.

Tropospheric bending, on the other hand, may be as good as at any season. The warmer sections of the country will probably find October superior to September in this respect. The calm warm days and cool nights, variously known as Indian summer and World Series weather, produce stable air-mass stratifications that bend v.h.f. waves back to earth and bring fringe-area signals up to many times their normal levels.

The considerable extension of transmitter coverage that results may not be considered dx to some viewers, but it is great stuff to TV receiver owners who are outside normal primary service areas. For them October will mark the beginning of the end of the favorable conditions they have enjoyed during the spring and summer months.

Trees shedding their foliage will reduce absorption and increase signal levels in locations where the antenna is screened by nearby trees. This effect will be more marked on the higher channels, and it will tend to make up for the gradual dropping off in signal levels that might otherwise be expected at this season.

Aurora borealis is common in October, showing up frequently in our more northern states. It may be observable down to the Mason-Dixon Line, or even farther south on a few rare occasions.

The principal effect on TV reception, when any is found at all, is usually in the form of indefinite streaks. Such interference is more readily detected when the array is aimed in a northerly direction, and is most pronounced on the lower channels.

The ability of the aurora to reflect v.h.f. signals varies widely. Careful observation of aurora-reflected TV signals is needed, and the readers' assistance in this respect is earnestly solicited. Please report all effects—or suspected effects—of aurora borealis on your TV reception, with full details such as date, time, duration, type and orientation of antenna, and how the aurora looks, if visible. END

CONVERTING A SET WITH RF SUPPLY

Package-type flyback unit modernizes many small-screen models

By J. V. CAVASENO

A NUMBER of the early 10- and 12-inch TV sets were built with r.f.-type high-voltage supplies instead of the now-standard flyback system. Many of these sets are still in operation and are giving satisfactory service. Their only objectionable feature is a screen which is too small by today's standards.

When TV conversions became a large-scale business, many service technicians claimed that sets with r.f. supplies were unconvertible. Others passed them up in favor of easier-to-convert models which have flyback power supplies. Now that the easier conversion jobs are pretty well cleaned up, those sets with r.f. power supplies represent a good share of the conversion jobs yet to be done.

Contrary to popular opinion, these sets are just about as simple to convert as those having flyback supplies. Of course, the job takes a little longer because the modifications are more extensive. (Before going further, I must stress that this discussion refers only to those sets which have *electromagnetic* deflection systems. The jobs using electrostatic deflection can be handled best by constructing a big-screen electromagnetic slave unit like that described in the August, 1951, issue of RADIO-ELECTRONICS.) You can tackle those r.f. conversion jobs and make them pay simply by following my method.

Realizing that the major circuit differences are in the horizontal output stages of sets using the two types of power supplies, I decided to junk the old r.f. supplies and start from scratch. Some of the earlier sets operate with B voltages as low as 240, so I determined to construct a universal horizontal output and high-voltage circuit which could be added to almost any set. The circuit would have to supply enough width and brightness for a 17-inch tube.

Flyback circuit

The first set that I tackled was an Andrea VJ12. First I removed the 6Y6-G high-voltage oscillator and 6BG6-G output tube and all other related components from the small high-voltage chassis. I mounted a flyback transformer in the center of the stripped chassis between the two octal sockets. Needing a third socket, I mounted it on 1½-inch long polystyrene rods on one corner of the chassis. I now had sockets for a 1B3-GT high-voltage rectifier, 6W4-GT damper and 6BQ6-GT.

After some experimenting, I found that the circuit in Fig. 1 delivers enough high voltage and width to drive a 20-inch tube. I haven't tried a 24-incher but I believe that this unit will drive one equally well. The flyback transformer can be a Stancor A-8130, RCA 231T1, Ram XO35, Merit HVO-6, G-E 77J1, Du Mont H1A1, Halldorson TV-14, or equivalent. For good focus, use a cosine yoke whose impedance matches the flyback used. I used a 201R10 width coil. No linearity coil was needed.

Oscillator modifications

The 6BG6-G horizontal output tube and the 6AS7-G damper and their components were removed from the horizontal output cage. I redesigned the oscillator circuit as shown in Fig. 2 to produce a flat-topped sine wave which I fed to the grid of the discharge tube which also underwent minor modifications. After changing the values of the grid and plate load resistors, and removing the width control, we supplied the discharge tube with 240 plus. The circuit now gives a sawtooth of the greatest amplitude possible with good linearity. No changes were made in the a.f.c. (6AC7 and 6AL5) circuits.

The VJ12 has a 4-wire cable between the main and high-voltage chassis. I used this to supply the small chassis with heater voltage, 240 volts plus, and ground. Two wires were added to the cable to carry the sawtooth from the discharge tube to the grid of the 6BQ6, and to carry the horizontal sweep signal to the yoke which plugs into the main chassis. Of course, if you are working on a different make or model, you may need more or fewer wires.

Some sets already produce a good sawtooth waveform, so their oscillators do not have to be modified. In this case, the high-voltage and deflection circuit is all that is needed. The circuits in Figs. 1 and 2 can be used to modernize such sets as the Westinghouse H-242, H-251, and similar models, and give plenty of width and brightness. Too much width can be remedied by reducing the B plus supply to the high-voltage, by trying different width coils, or by using larger resistors in the cathode and screen circuits of the 6BQ6-GT.

Before tackling a conversion of a set with r.f. power supply, study its diagram very carefully and compare the circuits of the output stage and horizontal oscillator with those in Figs. 1 and 2. Then follow through along the lines that I have discussed and you will be as pleased with the finished job as I am with the jobs that I have done. END

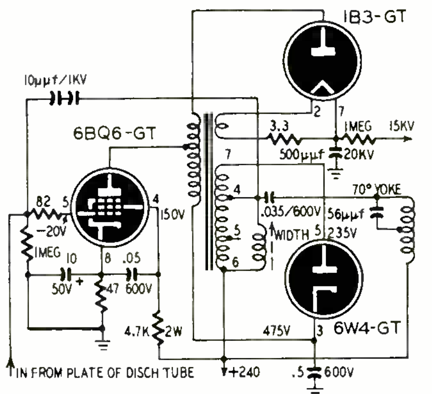


Fig. 1—Horizontal-output and h.v. unit used for conversions to 20-inch tubes.

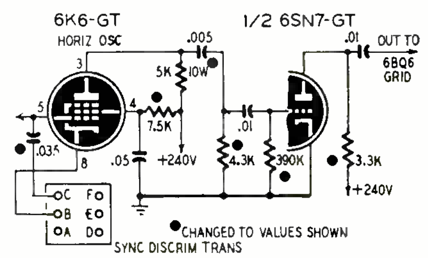


Fig. 2—Changes made in Synchrolock horizontal oscillator-discharge circuit.

THE EIDOPHOR PROJECTOR

Theater TV system makes possible full-color pictures of unlimited size and brightness

By AARON NADELL

Fig. 1—The Eidophor equipment. Light beam comes from the projector hood 2.

BELIEVE it or not, *this* television has a built-in refrigerator! It also shares with the electron microscope the distinction of a continuously acting vacuum pump. Its electron gun does not bombard a phosphor that glows, but a liquid that dimples! Its electron beam is velocity-modulated. The illumination that makes the image visible to the beholder comes, not from the electronic bombardment, but from an arc lamp. This new system of theater television that produces a full-screen size, full-color image without a cathode-ray tube (although it uses an electron gun), is called Eidophor, from the Greek: *eidolon* (image) and *phoros* (bearer or carrier). Eidophor is an image-carrier. (Of course the "phor" part of the word has the same root as in "phosphor"—light-carrier from *phos*, *photos*, meaning light, and *phor* as bearer or carrier.) It constitutes the motion picture theater's latest answer to the competition of video in the home.

Eidophor is the property of 20th Century-Fox Film Corporation. As recently demonstrated in their New York preview theater, the equipment filled a screen 15 feet wide with a color picture so bright and detailed that some visitors thought they were seeing a Technicolor movie and asked when the TV demonstration was going to start.

The system combines some of the most intricate achievements of electronic engineering, electrical engineering, and the optical, mechanical, and chemical sciences.

Original invention is credited to the late Dr. F. Fischer, Professor of Applied Physics at the Swiss Federal Institute of Technology, who applied for a basic patent in 1939. He was assisted by a group of collaborators at the same institution and at Zurich. Rights to the system were acquired by Spyros P. Skouras, president of 20th Century-Fox. It was simplified and reduced to more manageable dimensions, with color added, by Earl I. Sponable, who is 20th Century-Fox's chief of research and past president of the Society of Motion Picture and Television Engineers.

Fig. 1 illustrates the complete equipment as used for the recent New York demonstration. The cabinet numbered 4 houses the refrigerator and vacuum pump. The item numbered 5 is the arc lamp. This particular lamp burns an arc current of 125 amperes. If more screen light or a still larger screen are desirable, there is no apparent reason why a more powerful arc should not be used—large theaters and drive-in theaters burn up to 200 amperes. The shield numbered 3 covers the rotating color wheel: Eidophor uses the CBS field-sequential color system at present. The item numbered 2 is the hood from which the light-beam emerges to illuminate the theater screen; cabinet 1 is the projector proper, the mechanism in which the TV signal is converted to a visible image. There are two other cabinets, which contain conventional TV control and power-supply circuits.

Fig. 2 diagrams the essential details of the projector; and shows their relationship to item 1, the arc lamp, and to item 12, the theater screen. Here the sciences of electronics, optics, mechanics, and chemistry are combined.

The action in general (leaving details till later) is as follows: A beam of electrons, velocity-modulated by a TV signal, bombards a semiconducting surface consisting of an oily liquid. This liquid is optically located in the path of a light-beam, the origin of which is the electric arc. When there is no signal on the electron gun the surface of the liquid remains unruffled and the light that reaches it is reflected back to the arc whence it came. Wherever, and to the extent that, the cathode ray is modulated by signal, the surface of the liquid is ruffled proportionately. The light is deflected by the wavelets or dimples thus formed, and instead of being returned to the arc lamp is shifted slightly to another course which terminates at the theater screen.

The field sequential color system is well known: By reason of synchronized color wheels on camera and projector each successive field is seen by the camera, and shown by the projector, in one of the primary colors only. These successive red, blue, and green fields are merged by the eye into a single full-color image, through the phenomenon of persistence of vision.

The electron beam, item 6 of Fig. 2, may now be examined in some detail. From the diagram it can be seen that both magnetic and electrostatic deflection (two coils and one pair of plates) are used. There are other peculiarities also. For example, an oxide cathode is impossible. The Eidophor liquid is bombarded, not only by a 20-kv electron beam, but also by the heat of an arc lamp (item 1 of the figure)! Despite the remarkable chemical achievement of an *almost* nonvolatile liquid, evaporation takes place; and despite the best efforts of the vacuum pump a low concentration of hydrocarbon vapor exists in the vacuum chamber. It has been found that oxide-coated cathodes are incompatible with this situation. A rod of pure tungsten is used instead.

Another peculiarity: A cathode, normally the negative terminal, is not necessarily negative in Fig. 2; but is negative only to its own anode, the Eidophor

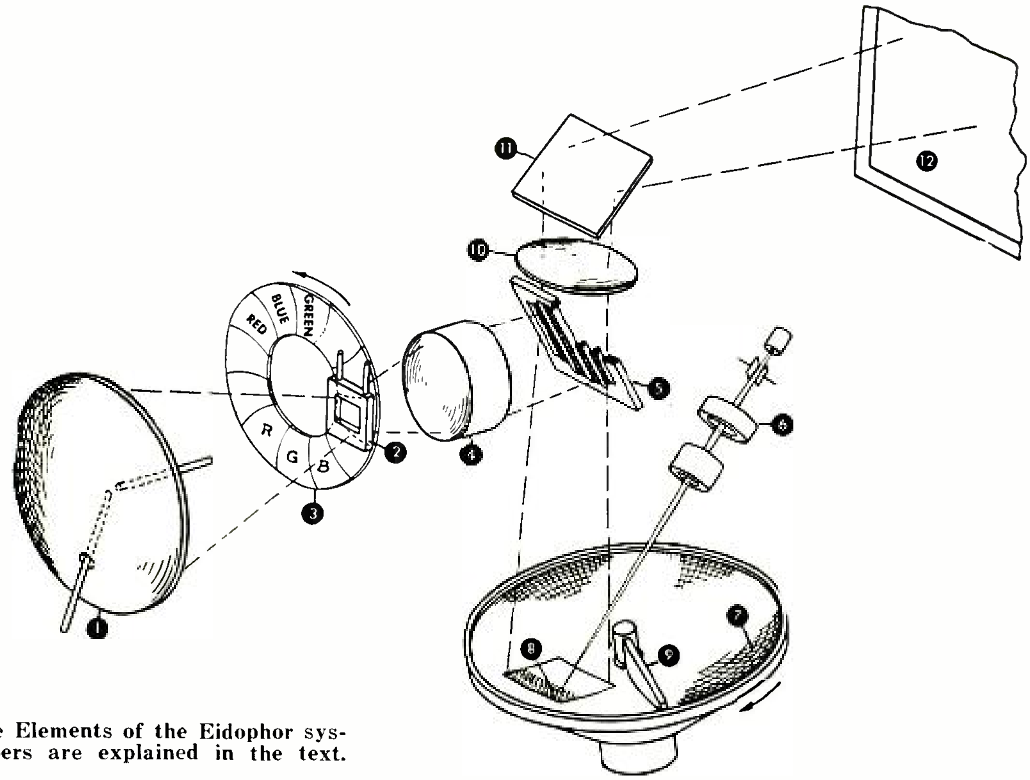


Fig. 2—The Elements of the Eidophor system. Numbers are explained in the text.

liquid. It is an anode to an element not shown in the diagram, a helix of tungsten wire, which surrounds the tungsten rod. This wire is heated by passing a current through it, and radiation of heat from it warns the tungsten rod; but the temperature thus attained is not high enough to produce an electron beam of the required 20 μa. Therefore the helix of tungsten wire is made very strongly negative with respect to the tungsten bar, and the bar in consequence is bombarded by electrons from the cathode. The combination of heat-from-radiation and heat-from-bombardment brings the cathode rod to the required emission; probably secondary emission helps here also, although such is not specifically stated in the information released. The potential difference between helix and cathode bar is not revealed either.

It might seem that the helix itself could be used as cathode for the system, dispensing with the bar, but apparently a point-source of electrons is needed and the helix area is too great. The cathode ray as it impinges upon the Eidophor liquid has a rectangular cross-section, 0.004 × 0.0006 inches. To maintain this size and shape in the beam a mechanical diaphragm of tungsten, having exactly that same opening, is placed in the cathode-ray path at the point of electron crossover in front of the cathode. A 1:1 magnetic lens then projects the image of this diaphragm opening to the surface of the Eidophor liquid (item 8).

Scanning likewise is effected magnetically, but the velocity modulation is produced by the pair of electrostatic vanes shown in the diagram. There is no amplitude modulation: the density of the beam, and the area and shape of its cross-section upon the surface of the liquid, remain constant at all times. The deflecting vanes are energized by a constant-frequency a.c., the amplitude of which varies inversely with signal strength. When the signal is weak the vane a.c. is strong and the beam is swept rapidly, depositing only a weak charge on the liquid as it hurries past. When the signal is strong the vane charge is weak and the beam moves more slowly, leaving a stronger charge.

The action of this bombardment on the Eidophor liquid may now be considered, after which this review of the system will be completed by tracing the action of the Eidophor liquid upon the light-beam.

Actual composition of the liquid has not been revealed. It is said to be essentially a hydrocarbon, to which unspecified ingredients have been added to provide a moderate degree of electrical conductivity. It has a minimum tendency to evaporate under the intense bombardments to which it is subjected. Finally its viscosity, for reasons that will be seen, is extremely critical.

Bombardment of the Eidophor liquid by the cathode ray amounts to depositing electrons onto and into it. It is desirable that these electrons remain essentially where placed for one picture period, and the conductivity of the liquid is adjusted accordingly. Mutual repulsion of the electrons deforms the surface of the liquid. The deformations are minute, their maximum amplitude being only a few thousandths of a millimeter. As the charge leaks off, these deformations subside. Their subsidence depends partly on the rate at which the charges leak off and partly upon the viscosity of the liquid. Hence this property of the liquid is critical; and since viscosity is a function of (among other things) temperature, refrigeration is essential. The refrigeration requirements are not particularly drastic (it is said the mechanism and controls of an ordinary household refrigerator are adequate) but they cannot be disregarded.

Presence of the Eidophor liquid also explains the need for the vacuum pump; evaporation being unavoidable, the vapors formed must be removed or the system will cease to function.

Item 7 in Figure 2 is a spherically curved mirror, upon the surface of which the liquid is coated, and which rotates slowly in the direction shown by the arrow. Rotation of the mirror serves three purposes: It constantly brings under the electron gun a fresh, cooled surface, and thus minimizes the refrigeration load. It removes from the area of bombardment a surface that has accumulated a certain constant charge, and presents a fresh surface from which the residual charge has had time to leak off. It passes the oily surface under a knife-edge (item 9) just before rotating it into the scanning area, thereby mechanically smoothing away any ripple or deformation that may have remained.

The optical arrangements upon which all these equipment items operate should not present much difficulty in description or understanding—although to design such a system is a very different matter! The arc lamp of Fig. 2 and the color wheel (items 1 and 3) are practically self-explanatory. The arc lamp is equipped with the conventional curved mirror that reflects and concentrates the light. Item 2 is a rectangular diaphragm. Just as the electron gun is fitted with a mechanical diaphragm to impart a desired rectangular shape to the cathode ray, so item 2 is a mechanical diaphragm which imparts the desire 4:3 rectangular aspect ratio to the light-beam. Item 4 is a lens. Item 5 is the "schlieren," or slit grating, the heart of the optical system.

The grating bars of item 5 are silvered on the side that faces the arc lamp. Light from the arc is focused upon the entire area of the grating. That light which passes between the bars is lost forever. (This corresponds roughly to the shutter light-loss of a motion-picture projector). The light that strikes the silvered bar surfaces is deflected downward to the Eidophor liquid on the surface of the spherical mirror.

Wherever that liquid is unruffled by the electron bombardment the optical effect is as if there were no liquid there; the light is reflected from the mirror surface back to the schlieren bars, and from them back to the arc. But wherever the liquid is disturbed this light-path is altered, so that a portion of the light does not touch the mirror bars on its return path but passes between them to the projection lens (item 10). By this lens and directing mirror (item 11), the TV image is projected to the screen.

Advantages and Otherwise

Some technical advantages and disadvantages of the Eidophor system of theater television, as contrasted with other large-screen systems now on the market or proposed, include the following:

Unlimited illumination, at least within the capabilities of modern projection arc lamps, which are enormous. In the demonstration system, the arc burned 125 amperes, or perhaps 6 kw. But the electron power in the cathode-ray beam was only 20 kv $\times$ 20 μa, or 0.4 watt. This is an amplification of 15,000. Ten times greater amplification is possibly available, since Dr. Edgar Gretener, who built the demonstration arc and otherwise collaborated in the development of Eidophor, reports in the *Journal of the Society of Motion Picture and Television Engineers* for October, 1950, that he has developed an experimental lamp of similar design burning 63 kw—and producing a light output of 5 million lumens. No other system of direct projection theater-size television (except Skiatron, which is not on the market and may never be) uses the electric arc as its source of illumination. Film-intermediate systems—in which the face of a TV picture tube is photographed onto motion picture film, which is then automatically developed in a few seconds and projected like any other film—do so.

A second advantage of Eidophor is its unlimited projection "throw"—distance from projector to screen. Projection lenses are available for theaters and drive-ins of all sizes. But theater TV systems that utilize direct projection from the face of a picture tube to the theater screen are not now equipped with projection lenses but with the more efficient Schmidt optical systems. Their designers compensate for relatively limited light output by building in the maximum obtainable efficiency in optics. However, owing to the present limited market for theater TV equipment, Schmidt systems are not yet available for throws of all lengths, and the projector unit must in consequence be located in some theaters, outside the projection room, where it is not readily available for attention and servicing. (Film-intermediate systems, of course, have arc lamps and motion-picture projectors and standard projection lenses, and are not limited as to throw.)

A third advantage of Eidophor (in the opinion of this writer) is its image quality. This is truly good; it does approach the quality of a Technicolor motion picture. Although standard 525-line interlaced scanning is used, the scanning lines are seldom visible; the image usually does not appear to have any horizontal "grain" at all. Mr. Sponable, when questioned, attributed this to a high degree of perfection in the interlacing. Faults not known in other TV systems can, however, cause trouble in Eidophor, notably, dust. Since the maximum amplitude of the deformations of the liquid surface, on which the image depends, is not more than a few thousandths millimeter, particles of dust too small to be seen by the naked eye can impair or even ruin the image if permitted to drift into the liquid. Such tiny, invisible particles are not always easy to keep out; particularly when the equipment must be opened in the theater for emergency repairs.

Among the drawbacks of Eidophor, as compared with direct-projection theater TV systems, is its complexity. It requires a vacuum pump and refrigerating apparatus in addition to normal television apparatus items; and it uses oil, which must occasionally be replenished. Eidophor is the most complex and elaborate of all direct-projection systems, not excepting the currently nonexistent Skiatron. It is not, however, particularly more complex than film-intermediate systems; perhaps somewhat less so.

In its present form, Eidophor cannot give a continuous performance, since the arc carbons burn away and must be replaced. The same is true in projecting ordinary motion pictures, but does not matter in that case because the film runs out and must be replaced by a new reel. Theaters, therefore, always have two projectors, changing from one to the other as each reel is exhausted, and carbons are replaced at the same time as the film. Eidophor uses no film, and therefore has no need for two projectors, except to replace the carbons. For this purpose a modification of a military magazine-fed carbon arc is being developed for Eidophor. This is expected to permit continuous operation for from four to five hours.

An order for 500 Eidophor installations for theaters all over the United States is in process of negotiation between 20th Century-Fox and General Electric Company, President Spyros Skouras told his guests at the New York demonstration. END

PICTURE

Of all the circuit checks involved in testing a modern TV receiver, few can match the picture tube from the standpoint of annoyance and sheer aggravation. Although the wires are right in front of you, there is no way to get at them with your test prods. Of course, you can always remove the socket, but this will not give you readings under load, nor will it show whether or not the picture-tube filament is good. These voltages must be checked, especially when the trouble is one of those no-picture, no-raster deals.

With this thought in mind, we went back about twenty years to find a solu-

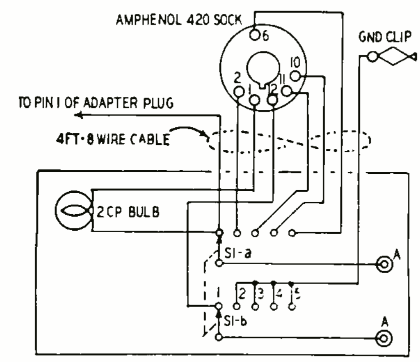


Fig. 1—Socket and selector schematic.

tion. Years ago, when you could count the number of tube types on your fingers, most analyzers came complete with adapter plugs. A plug was inserted in the tube socket of the set, the tube was placed in the adapter, and socket voltages were checked while the tube was functioning. This caused distortion and detuning in some circuits, but at least the set was operating and supply voltages were not affected.

Seeking a new twist for the old pretzel, we set about devising a quick, cheap, and efficient means of checking picture-tube voltages under operating conditions. This little device may be as simple or as elaborate as you care to make it, will tell at a glance if the filament is O.K., will measure filament, cathode, first-anode, and grid voltages (bias and signal), as well as focus-anode voltage of electrostatic-focus tubes. It does not interfere with normal operation of the picture tube. This convenience can be yours for an outlay of as little as five dollars.

For the basic instrument you will need an Amphenol 402 socket, a five- or six-pin duodecal base from a defunct picture tube, about four feet of 8-conductor cable, a 2-pole, 5-position switch such as a Mallory 173C, two pin jacks, a 2-contact automotive-type lamp socket, and a 2-candlepower automotive-type bulb. The bulb will show filament

TUBE ANALYZER

By H. L. MATSINGER

continuity and is far cheaper than a 0-1 a.c. ammeter.

Adapter plug and analyzer

A quick glance at Fig. 1 should give you a good idea of what we are trying to do. If you don't have a base from an electrostatic-focus tube, you will have to insert pin 6 in a standard 5-pin base. This is not much of a task. Drill a hole in the base in the pin 6 position, and cement in the extra pin.

Strip back the outer sheath at one end of the 8-conductor cable for a distance of about 8 inches. Then cut *all but one* of the exposed wires to a length of 2 inches. The long wire is used for a ground, and is fitted with a small alligator clip. Next, strip back the insulation on the seven remaining leads for about ½ inch, and tin them carefully. Now cut five pieces of No. 16 bus about 2 inches in length. If the cement in the base is dry and hard, cut off the tubular part with a hack-saw, leaving only the pin wafer and key, and make certain that the pins are not blocked by cement or solder.

Next, take the Amphenol socket, and solder a length of bus and one wire of the cable to terminals 2, 6, 10, 11, and 12. This should leave two unused wires. Solder one of these wires to the No. 1 pin of the socket. Nest all soldered wires in the channels of the socket, and align the bus leads from the socket with the corresponding pins of the plug. Insert the remaining free wire in the No. 1 pin of the plug and put each bus lead in its proper pin. Work the plug over the leads gently until it meets the socket firmly; then lock it in place temporarily by crimping over the No. 6 and No. 12 bus wires. Apply polystyrene dope generously around the base and socket. When dry, solder the bus and wire leads to the ends of the plug pins and trim off any excess.

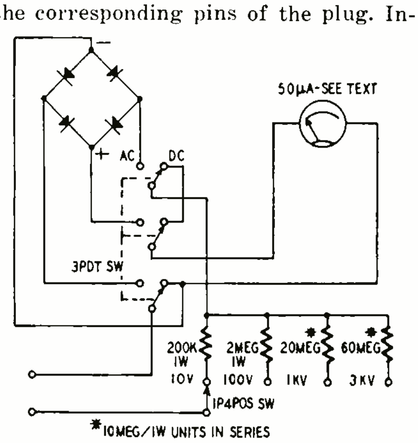
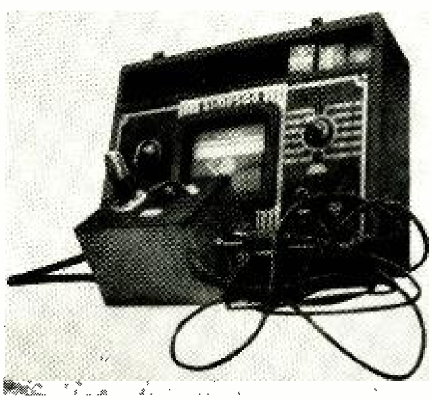


Fig. 2—Circuit of companion voltmeter.

Mount the 2-pole, 5-position switch on a panel, and wire it up as shown in Fig. 1. The automotive-lamp socket should be mounted on the panel near the switch. The panel may be ⅛- or ¼-inch tempered Masonite. If the whole business is mounted in a small box made of ¼-inch plywood, you will have a neat looking job. Use pin jacks for terminals A-A.

Using the analyzer

Insert the adapter between the receiver socket and the base of the picture tube, and connect the voltmeter to pin jacks A-A. With the analyzer switch in position 1, the bulb should light and the meter should show about 6 volts a.c. if the picture-tube filament is good. Positions 2 and 3 (grid and cathode, respectively) may show d.c. voltages anywhere from ±1 to ±150, depending on the method used to feed the video signal to the picture tube and on the circuit location of the brightness control. (Before checking voltages in these positions refer to the receiver schematic and voltage charts. The important factor is the voltage relation *between position 2 and position 3.* Position 2 (grid) should always be negative to position 3 (cathode), and the difference should *increase* smoothly as the brightness control is turned toward *minimum* brightness.—*Editor*)



Selector with commercial voltmeter.

When a signal is present there should also be a fairly high a.c. voltage on the pin receiving the video input, which can be varied with the fine-tuning control or by changing the position of the antenna. This makes it possible to use the voltmeter for orienting antennas. With enough 2-conductor cable the meter can be taken to the roof and the antenna system can be adjusted for maximum signal (a.c.) voltage.

Position 4 (the first anode or accelerator grid) should show between 200 and about 475 volts d.c., depending on the circuit and the size of the picture tube. Position 5 is used only with electrostatic-focus tubes. Low-voltage-focus types will read 0 to 500 volts, while high-voltage-focus types may have as much as 3,000 volts. With either type, the voltage should vary smoothly as the focus control is adjusted.

Two models of the analyzer-voltmeter. Large unit has filament a.c. ammeter.

Note: High-voltage-focus types are generally supplied from the flyback circuit through a separate rectifier and very-high-resistance voltage divider. Your voltmeter must have higher input resistance than the divider to avoid loading the circuit and reducing the voltage. Only a v.t.v.m. or a 20,000-ohms-per-volt meter with a suitable high-voltage range should be used.

Voltmeter unit

In the event that you decide to build a voltmeter to go with the analyzer, use the circuit shown in Fig. 2. By housing the meter in a separate case, and making connections to the switch box with banana plugs, you can take the meter to the roof for orienting the antenna.

The multiplier resistors should have the highest possible accuracy. The rectifier is a standard full-wave-bridge instrument type obtainable from most supply houses.

However elaborate or simple you decide to build your analyzer, you will find it of great value in speeding your trouble-shooting, and you will probably find even more uses for it than I have.

Materials for analyzer

Miscellaneous: 1 Amphenol type 420 duodecal socket or equivalent; 1—2-pole, 5-position switch (Mallory type 173C or equivalent); 1—2-contact automotive type lamp socket; 1—2-candle-power automotive type lamp; 2 pin jacks; 4 feet of 8-conductor cable; panel; cabinet; bus bar; alligator clip; hardware; solder.

Materials for voltmeter

Resistors: 1—200,000 ohms, 1—2 megohms; 8—10 megohms, 1 watt, ± 1%.
Miscellaneous: 1—0-50 d.c. microammeter; 1 full-wave-bridge instrument rectifier to match microammeter; 1—3-pole, 2-position switch; 1—single-pole, 4-position switch; panel; cabinet; hardware; wire; solder.

END

HIGH VOLTAGE SERVICE HINTS

By H. LEEPER

MOST of us enjoy seeing our names in print—but nobody wants to be featured in the obituary column. Every so often a nasty reminder comes along that service technicians—even the most experienced ones—are not shockproof. The most recent of these was the death of a Chicago technician—electrocuted by the h.v. circuit of a television receiver. (See RADIO-ELECTRONICS for September, 1952, page 90.)

In spite of the obvious hazards of high-voltage circuits, a far greater number of fatalities are caused by contact with that little old 117-volt line which many of us regard with such contempt. And the B supply circuits of modern TV receivers—with their extra-high-capacitance electrolytics — can store more death-dealing energy than any present-day h.v. supply.

Remember, *it takes less than 150 ma to kill a normal, healthy human being.* A quick look at Ohm's law (E=IR) will show you that very little voltage is required to push that current through your body if its resistance is low enough.

Keep your body resistance as high as possible, and avoid *any contact* with the live circuits of a receiver. At times, unfortunately, many of us forget the fact that the live circuits may include the chassis, or *any grounded object* (even the floor).

Every service shop should have a wooden floor. Where work must be done in homes or other locations with cement floors, insulate yourself from the floor with rubber mats. These mats are about 13 x 21 inches and are obtainable at any auto or department stores—inexpensively. (Photo A)

Dry boards may be used for the same purpose. A few 1-inch-thick boards about 10 x 60 inches will provide a safe working platform. They should be stood on end to dry when not in use.

When testing or repairing equipment near water pipes, radiators, steam pipes or grounded electrical conduits and switches, wood or masonite boards provide the necessary margin of safety. (Photo B)

A long, dry, wood stick or plastic rod is the best tool for probing around wiring near the picture tube or other live parts. (Photo C)

Where line-interlock switches must be held in the closed position with the receiver back off a wood tongue depressor is a lot safer than a screwdriver. Even if you're using only one hand inside the cabinet you might come in contact with the blade. (Photo D)

Always hold a high-voltage probe so that the guard ring is between your hand and the high voltage. *Keep your hand closed and away from the probe lead.* (Photo E)

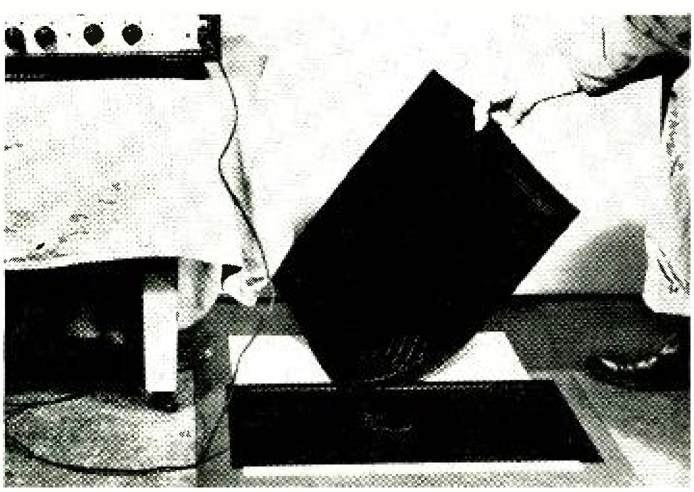
Don't depend on the wire insulation to protect you if the internal multiplier resistor should break down or arc over.

High-voltage probes are easier to carry, store, and keep dry, if they are taken apart. With the probe dismantled the multiplier resistor should be kept in a toothbrush container lined with soft, dry cloth. A small zipper bag is an ideal carrying case. (Photo F)

The outside of the probe should always be wiped dry before and after use. Moisture inside the probe can be removed with a narrow bottle brush.

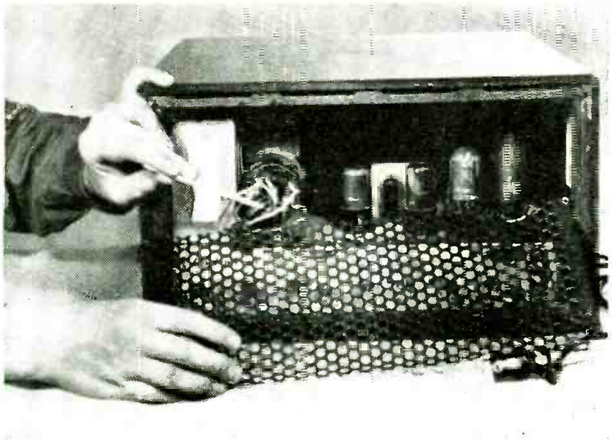
Wearing goggles while handling picture tubes is a common-sense precaution repeatedly emphasized by the tube manufacturers themselves. *They should know.* Still, many technicians refuse to wear them, especially if they already wear glasses. These impact-resistant goggles weigh only about 3 ounces and can be worn comfortably even over ordinary eyeglasses. They give unobstructed vision and cover considerably more of the face than the usual type. (Photo G)

Some picture tubes rest loosely on the metal chassis when the set is removed from the cabinet. An old bicycle inner tube makes a handy protective bandage. The ends of the inner tube can be anchored to the chassis to hold the picture tube firmly and safely in position. (Photo H) END



A

B



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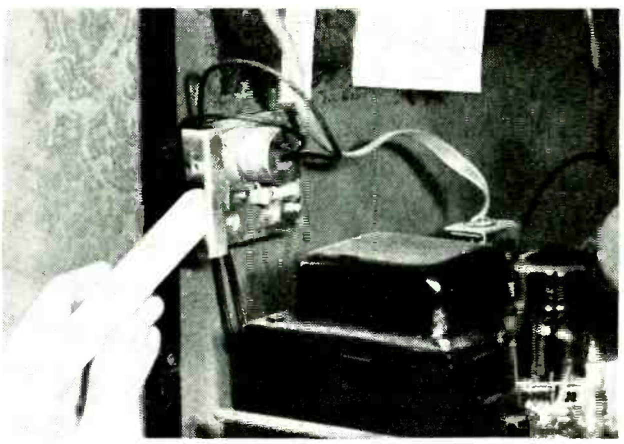

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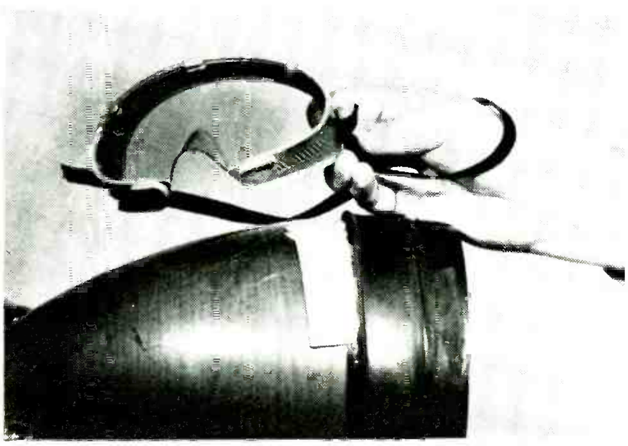

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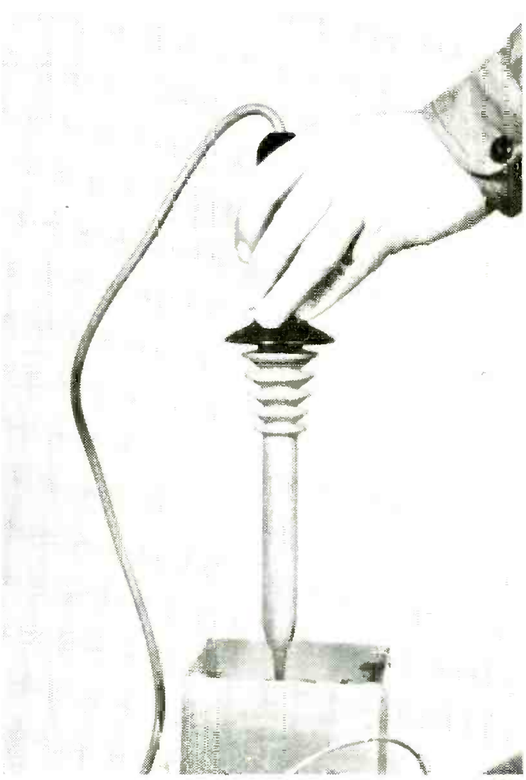


(E)

(H)

BY JOHN B. LEDBETTER*

ELIMINATING THOSE NUISANCE

IT HAS been said in the past that the major cause of nuisance service calls was lack of proper customer education. The author would like to say that lack of customer education is *still* the number one cause of profit-wasting callbacks. Callbacks not only represent a definite loss of profit to *you*, but—more important in the long run—they are a prime cause of dissatisfied customers.

After installing set after set, you yourself may have become so familiar with their operation and adjustment that a detailed explanation to the customer seems unnecessary. However, in most cases your customer is going to be a housewife who knows absolutely nothing about operating a TV set, and (according to her husband) usually has considerable difficulty in tuning a station properly on her $9.95 AM broadcast receiver.

Basic psychology

The following steps are very important in educating your new customer. Properly used, they will increase your list of satisfied customers and practically eliminate needless complaints.

1. Your first step, whether installing the set or servicing it, is to gain the customer's confidence and respect. Do this by appearing in neat, clean clothes and by using professional courtesy.

2. Ask the customer where *she* would like the set. If her choice is impractical or impossible, make the proper suggestions *tactfully* and *explain why* another location is better or necessary.

3. If you must use tools inside the house, lay them out *neatly* on a drop-cloth. Keep the solder and soldering iron where there is no chance of burning or scratching the rug, floor, or furniture.

Proper customer instruction

1. When installing the set, go over all preset and rear-chassis adjustments carefully and note if any of these controls can be operated accidentally while housecleaning or moving the set. If any can, explain this possibility to the customer and *show* her the location of the control.

2. When the set has been installed and adjusted, give the customer a careful, simplified explanation of the tuning adjustments—*not* a fast run-down of each control's function, but a detailed, step-by-step explanation. Then ask the customer to try tuning the set herself, and explain the operation again as she goes through each step. Have her repeat the tuning adjustments several times until you are sure she is thoroughly familiar with the procedure.

* Engineer, WKRC-TV

SERVICE CALLS

3. Explain briefly how variations in weather or foliage in nearby trees can affect reception; and how poor films, incorrect lighting, or equipment troubles at the station can affect the quality of the picture. If the customer understands these possibilities she will be more tolerant of temporary troubles and less likely to call you for minor adjustments.

4. When explaining variations such as those just mentioned, be sure the customer realizes you are giving her useful information and not trying to alibi your way out of future servicing obligations.

5. If the focus control is accessible or can be moved accidentally, show her how to adjust it for the sharpest scanning lines, and have her adjust it once or twice.

6. Improper adjustment of the horizontal hold control is a frequent cause of nuisance complaints. Explain why this control should always be set in the middle of its range; show her how a proper adjustment on one station might

not be the best on another. Also caution against using the horizontal hold control *to center* the picture. (Many customers do this if the picture is slightly off-center and then fail to understand why horizontal sync is so critical or will not hold in.)

7. If the installation requires antenna switching, a beam rotator, or (in many city homes) an indoor antenna, find the best position for each channel, and make a small chart, if necessary, to help the customer find them again.

8. After you have explained the various operations and your customer is satisfied with the picture, leave the instruction book with her. Suggest that she use it regularly as a guide for obtaining the best possible picture. (Have your name, shop address, and telephone number stamped on the outside and inside of the booklet, as well as on the back of the set cabinet.)

9. If the instruction booklet does not contain full operating instructions, or if the booklet is missing, you might leave your own list of instructions. A mimeographed list costs next to nothing and is one way of showing your customer that you have a personal interest in her purchase. A typical list might follow the outline in the box below.

There may be times when your "install-and-run" competitor seems to be making installations faster than you. Rest assured that conscientious, well-organized installations, with proper customer instruction, will keep you busy with *new* customers while your not-so-considerate friend is making good on nuisance call-backs or creating dissatisfied customers by failing to make good on those calls. END

HOW TO TUNE YOUR SET FOR THE BEST PICTURE:

1. Turn the set on, turn the volume control about halfway up, and allow about 1 minute for warmup.
2. If your set is a combination model (AM-FM-TV-phono), see that the OPERATE switch is in the TV position.
3. Turn the station-selector switch or tuning control to the desired channel.
4. Adjust the fine-tuning control (if your set has one) for the best sound. Readjust the volume control if necessary for the desired volume. Do NOT regulate volume by turning the fine-tuning control back and forth.
5. Turn the brightness up until slanting white lines appear, then decrease it slightly until they just disappear. (This step may be omitted if the set has vertical-retrace blanking.—EDITOR)
6. Adjust the horizontal hold control (if necessary) until the picture locks in horizontally. Switch to another station to make sure it locks in on all channels. Readjust if necessary.
7. Adjust the vertical hold control if the picture is moving up or down.
8. Set the contrast (picture) control for the most natural shading. Readjust the brightness for the most pleasing picture.
9. Adjust the focus control (if necessary) for the sharpest picture. (Look at the fine black lines on your screen and adjust focus until these lines are the sharpest.)

NOTES:

Do not use the horizontal hold control to center your picture. If it is seriously off-center, call our shop for readjustment.

If your picture or sound is poor, see that the two wires going from your set to the antenna are still connected.

If you have troubles which cannot be corrected by carefully readjusting your tuning controls, call the TV Service at . We'll be happy to serve you.

TV SERVICE CLINIC

Conducted By
MATTHEW MANDL*

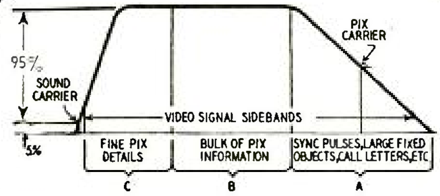


Fig. 1—Ideal i.f. response curve for intercarrier-type television receivers.

QUERIES from readers often include the following:

When does i.f. misalignment affect sync?

What quick check will show if alignment is needed?

Manufacturers recommend the picture carrier be set 50% to 60% down on the response curve. Which should it be?

Because these are important points for the servicing technician, it might be well to re-emphasize factors governing bandpass requirements in video i.f. stages. Fig. 1 shows a typical i.f. response curve for *intercarrier* receivers. The sound carrier is set 95% down to give proper heterodyning at the video detector and minimize intercarrier buzz. The picture carrier should not be down more than 60% on the response curve. The reason for this, aside from vestigial sideband correction, concerns the signal sidebands. The vertical lines in Fig. 1 illustrate sideband components. The group marked "A" are close to the picture carrier and represent the *low-frequency video-signal* components. The group marked "B" are the middle-frequency video components, while the portion indicated by "C" are the high-frequency picture signals.

When the picture carrier is more than 60% down the slope the "A" sidebands (which contain the low-frequency sync pulses) will be weakened. This will cause pulling or weaving if their amplitude is decreased slightly, or sync instability if they are diminished too much. Picture quality will suffer too. Fig. 2 shows the effect of poor low-frequency response. Note that the horizontal wedge is not as dark as the vertical wedge. (This has nothing to do with focus, for the horizontal wedge detail is clear.) Large fixed objects—representing relatively low-frequency signal components—will be fuzzy and may have trailing smears. Keeping the carrier in the 50% to 60% region of the response curve assures adequate low-frequency response and good sync stability. Setting the carrier higher than this is not recommended because low-frequency components will have excessive amplification. The 50% setting will not accent low frequency components too much, and will assure better stability, particularly in fringe areas.

If the top of the response curve is not flat, similar troubles may occur. If the response curve has an abnormal drop around the high-frequency signal components represented by "C" in Fig. 1, fine detail will suffer. This loss of high-frequency signal information would obscure the vertical wedge as shown in Fig. 3. This will have little effect on sync, but the picture will not be as sharp as it should be.

Resonant humps will have the same effect. A sharp rise in the response curve around the low-frequency picture sidebands overaccents low-frequency response and the high-frequency video signals will be down by comparison. If the response curve is humped around the "C" sidebands high-frequency signal components are accented. This can cause transient oscillations in the video amplifier and repeat lines at the sharp edges of objects shown on the screen.

Similar requirements also apply to tuner alignment and tracking, for the shape of the tuner response curve affects sync and picture detail in identical fashion.

A quick check of receiver performance can be made by studying a station pattern and comparing the clarity of the vertical and horizontal wedges. Additional checks and corrections can be made with a sweep generator with flat output, an *accurately* calibrated marker, and an oscilloscope.

Marker accuracy is extremely important because an inaccurate marker results in misalignment and will *produce* instead of eliminate the faults above.

Width control failure

On a Westinghouse H-251 receiver the width control keeps burning out. The receiver is now in use because I substituted a high-wattage fixed 1,500-ohm resistor, but this impairs horizontal linearity. Current through the resistor is 65 milliamperes. All tube voltages check normal and all waveshapes are as indicated in the service notes except at the grids of the 7A5 parallel output tubes. Here, the waveform is slightly distorted from that shown on the schematic. What can be done to reduce the width control current so I can replace the potentiometer? —S. S., Santa Clara, Calif.

A common cause of this trouble is failure to maintain the critical drive voltage required for the parallel 7A5 tubes. The cathode resistor R-467 does not provide enough bias for the 7A5's if the horizontal multivibrator drifts or the drive changes. (Fig. 4.)

Adjust the ringing coil for best horizontal-sweep stability and try slightly different values for the peaking components R-474 and C-427. You will have to determine the exact values experimentally so the grid-drive signal has the exact shape shown in the schematic. You can also increase cathode resistor R-467 to 200 ohms. These changes will decrease the current through the 7A5 tubes and reduce the wattage dissipated in the width-control potentiometer.

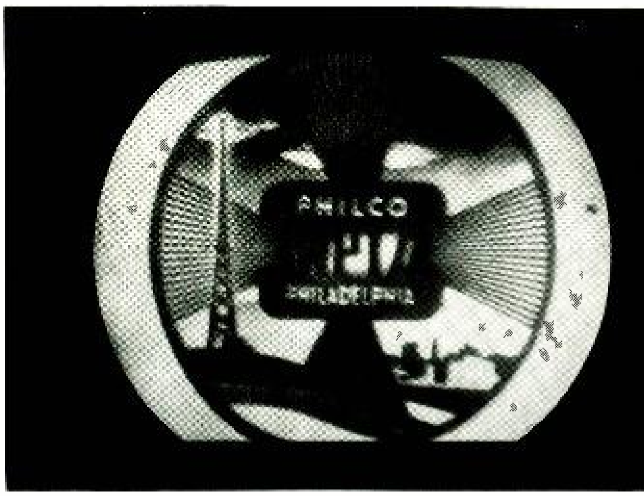
G-E production changes

In a General Electric model 12C107 I am encountering horizontal instability. The voltage and resistance measurements are virtually as called for on the manufacturer's schematic and I have replaced all tubes. The horizontal hold control is very touchy and holds sync only for a short time. Rear-panel controls don't help.—J. C., Bronx, N. Y.

This trouble is probably caused by one of several components which were found to contribute to instability and were changed in later production models of this receiver.

One improvement consisted of changing R-379 from 180,000 ohms to 270,000 ohms, ½ watt. (Fig. 5.) This resistor is in the bias-supply circuit feeding the a.f.c. control tube. Also check the 6-μμf capacitor (C-369) between the horizontal deflection coils and the 19BG6-G grid network. Its value

* Author of *Mandl's Television Servicing*



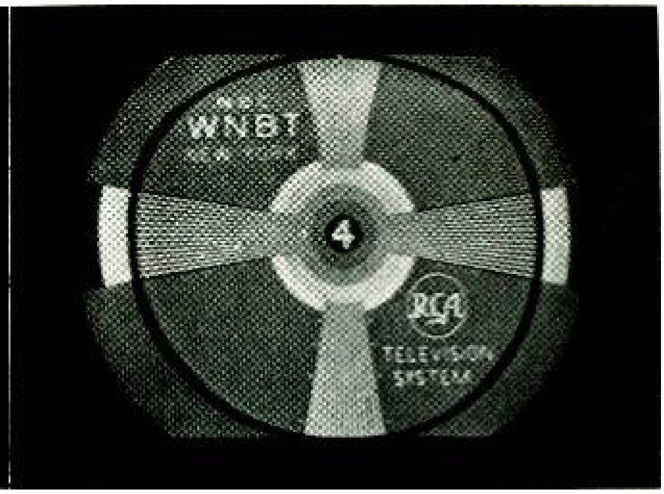


Fig. 2 (above left)—Poor l.f. response.
Fig. 3—(above right)—Poor h.f. response.

sometimes increases by 100 μμf or more, starting oscillation in the output stage. This causes severe sweep instability. Substitute a capacitor with higher voltage rating (Part No. RCU-300:6-μμf, 1,500-volt mica capacitor).

Intermittent centering

In a Sonora, Series B, model 700-ATV, there is an intermittent shift of the picture along a horizontal plane. This does not occur until the set has been operating about ten minutes and finally clears itself after about 40 minutes of operation. What causes this?—J. W., Clarksville, Tenn.

This indicates an unstable d.c. idling voltage in the horizontal deflection coils. This could be caused by a defective component in the low-voltage power supply or by a defective horizontal coil section in the yoke. This receiver has an elaborate low-voltage bleeder system for distributing various potentials to the circuits. Check all resistors and capacitors in the bleeder system and throughout the low-voltage power supply. Changes in any of these during warmup will affect the idling voltage and shift the position of the picture. This trouble would *not* be caused by changes in *sweep amplitude* (which would affect width).

A voltmeter across the output of the power supply will show any voltage change during warmup. The voltage is normally higher at first and drops during warmup but the decline should be gradual and not fluctuating.

Drive setting

I am having some horizontal linearity difficulty as well as excessive current and overheating in the horizontal output system. I would appreciate an explanation regarding what effect the drive control has on such conditions.—A. M., Tiffin, Ohio.

The drive to the grid of the horizontal output tube can have considerable effect on performance. Insufficient drive will decrease high voltage as well as width. It will also increase the d.c. idling current through the tube by reducing the bias. Overdrive will cause excessive signal currents through the tube. Either condition may overheat the tube and associated parts. Overdrive may stretch the left side of the picture and compress the center. The correct setting for the drive control is just below the point where left-hand stretch starts. A slightly gassy horizontal output tube will also cause overheating of parts.

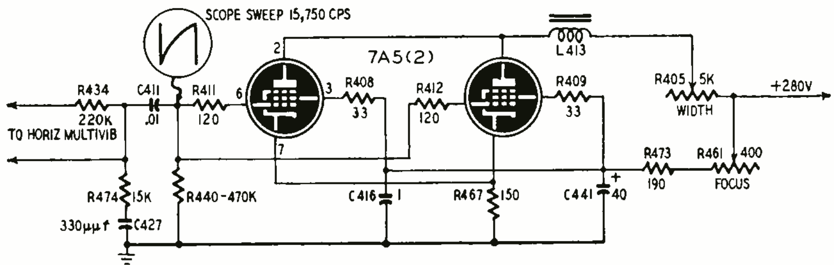


Fig. 4—Horizontal output stage of Westinghouse model H-251. Drive is critical.

Vertical linearity defects

In an Olympic model 766-U (752) receiver the scanning lines at the top and bottom are not as widely spaced as at the center. Neither the height or linearity controls will correct this condition which has existed since the set was purchased. Best sound and picture cannot be obtained by adjustment of the oscillator slug or the fine-tuning control. Can this condition be corrected?—M. B., Pittsburgh, Pa.

For the vertical linearity defects you mentioned, the following changes (see Fig. 6) in this receiver are recommended by the manufacturer:

Change C47 (4 μf) to 20 μf, 450 voltage.

Change R55 (3,300 ohms, 2 watts) to 1,000 ohms, 1 watt.

In the peaking network (R54, 3,300 ohms and C46, .05 μf, 600 voltage) disconnect ground side of the network and connect to pin 6 of the 6SN7-GT vertical sweep tube.

Check the 6SN7-GT and try several different ones.

Note: It is important that if one of the four changes mentioned is made, that all be made.

This is not an intercarrier receiver, therefore tuning for the best sound may not always give the best picture. This is more noticeable in fringe areas. With

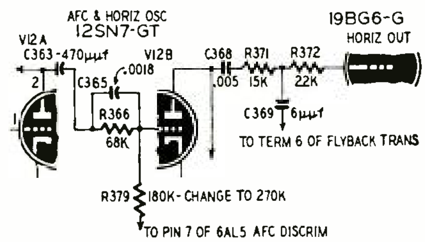


Fig. 5—Changes for improved horizontal oscillator stability in G-E model 12C107.

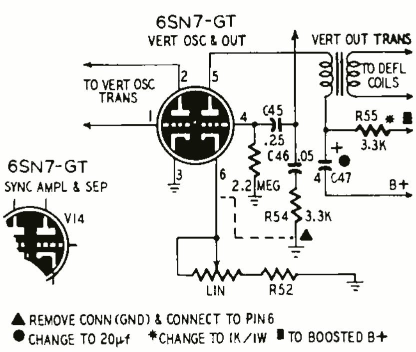
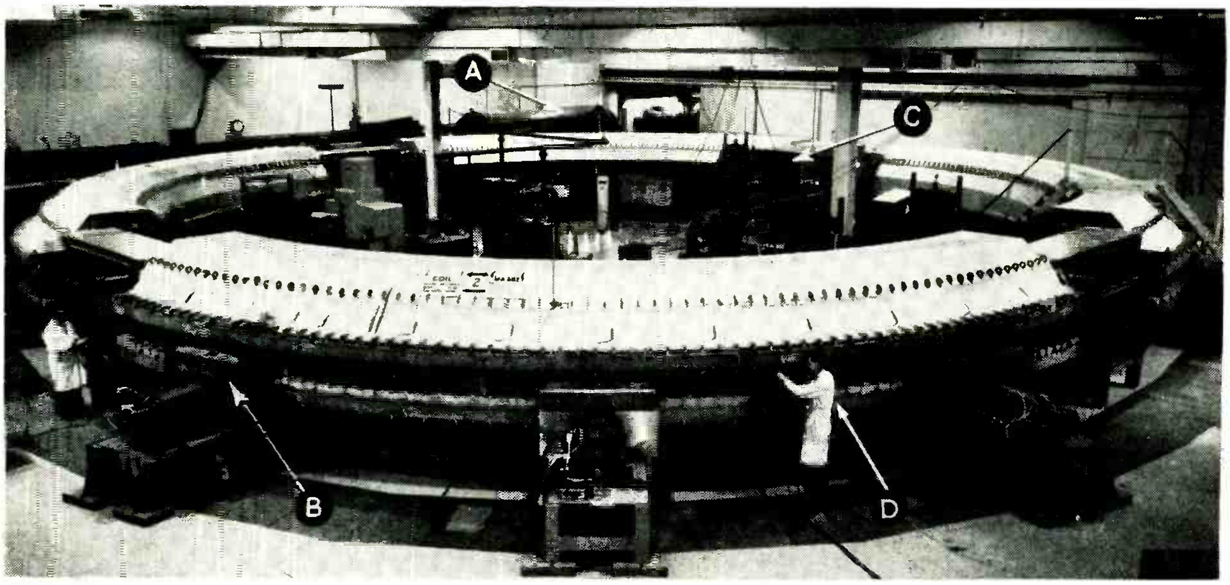


Fig. 6—Manufacturer's changes for better vertical linearity in Olympic 766-U.

proper alignment you should get a good picture at the best sound point.

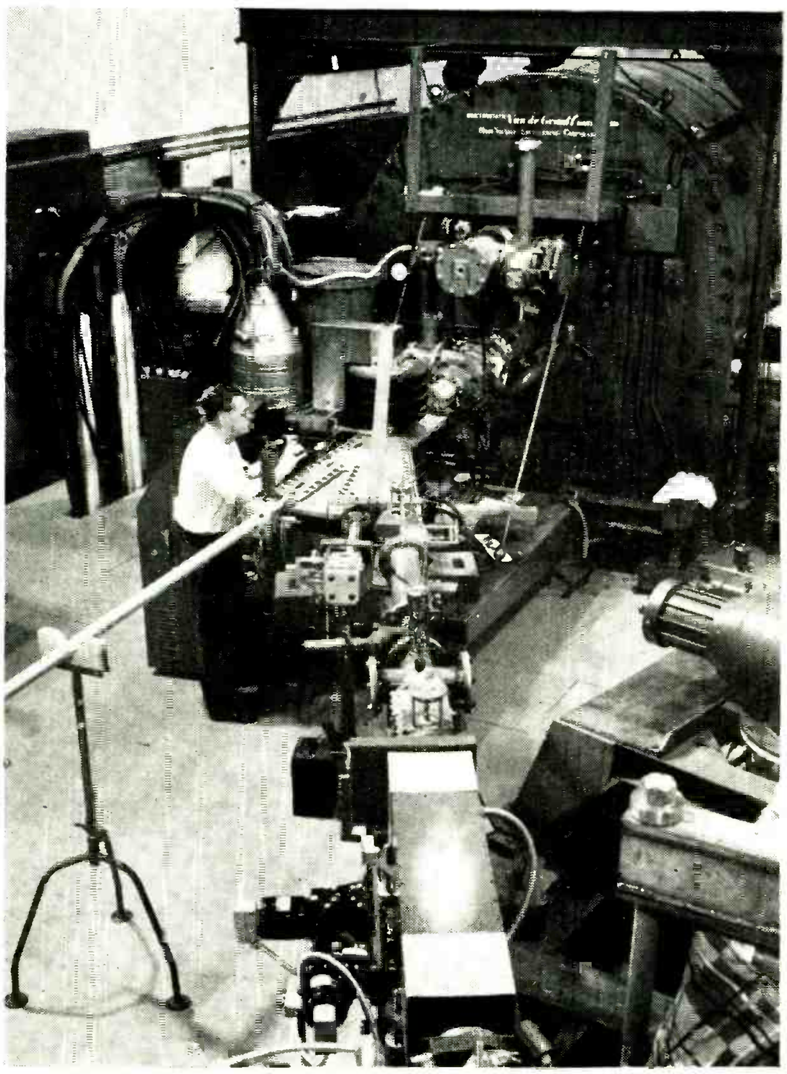
Note: Letters sent to the Clinic are answered directly and only those of general interest are printed each month. *There is no charge for this service to our readers.* When writing, give the name, model number and chassis number of the receiver, and what tests and replacements have been made prior to writing us. Give full details of symptoms. (Letters reproduced here have been condensed because of space requirements.) Enclose a self-addressed, stamped envelope. END

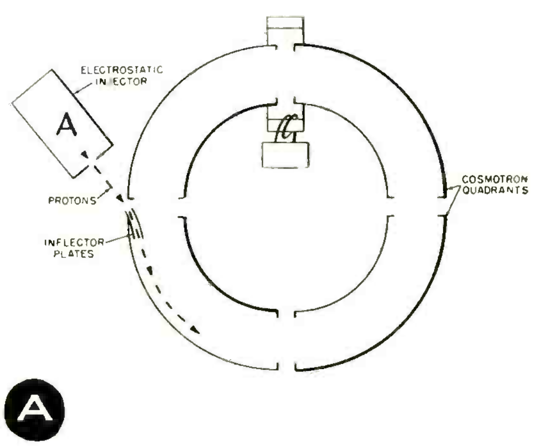


The Cosmotron at Brookhaven National Laboratory. Protons—positively-charged nuclear particles—circle the huge track at almost the speed of light, develop billions of volts of energy for non-secret atomic research. Labeled sections are shown in detail in the accompanying diagrams and photographs. In the foreground are three of the 12 oil-diffusion pumps that maintain vital vacuum in the stainless-steel tube. The technician at the right is at one of the "windows" where targets for bombardment are inserted in the raceway.

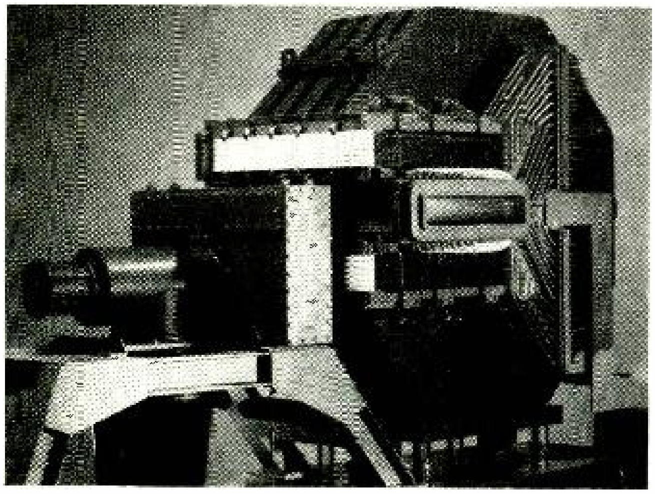
COSMOTRON

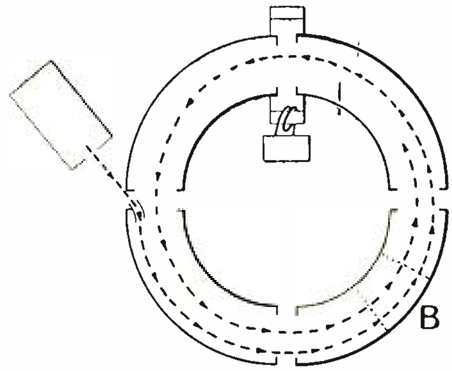
Three billion volts speeds particles to near speed of light





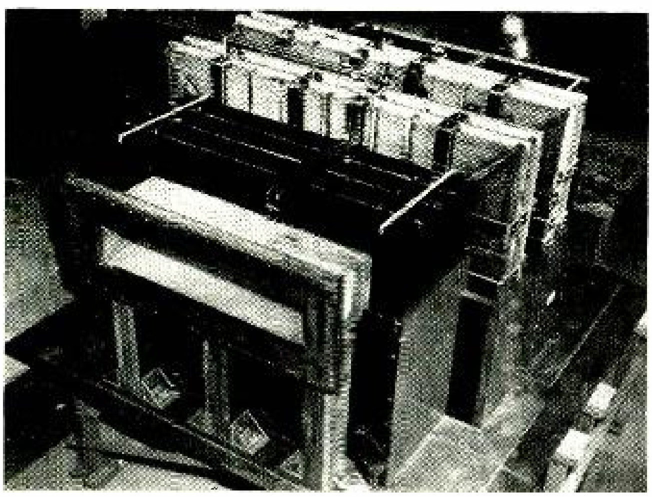
Proton source for the Cosmotron. Van de Graaff electrostatic high-voltage generator smashes hydrogen atoms, shoots protons and hydrogen ions at 3.6-million volt velocity down narrow tube at left for testing. When inverted L-shaped electro-magnet (center) is turned on, ions are deflected to center stub; lighter protons, deflected more, race through complex optical analyzers and rectangular inflector box to Cosmotron (lower right).

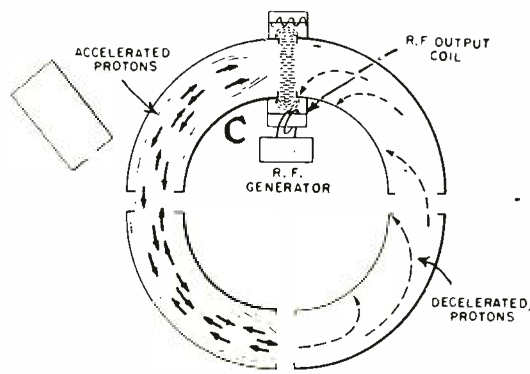




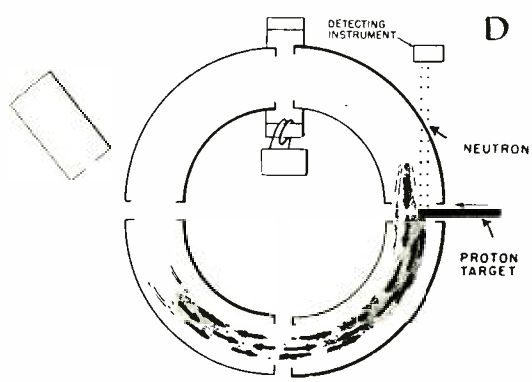
INCREASING MAGNETIC FIELD CAUSES PROTONS TO SPIRAL IN AROUND COSMOTRON MAKING 350,000 TURNS PER SECOND

B Progressively stronger magnetic fields in four quadrants force protons to follow spiral path as they circle tube 350,000 times per second. Cross-section through Cosmotron at B shows stainless-steel proton tube at magnet center, continuous-evacuation pump at left. Octagonal core laminations are eight feet across. Windings are hollow copper bars filled with liquid coolant to remove heat of 7,000-ampere current.



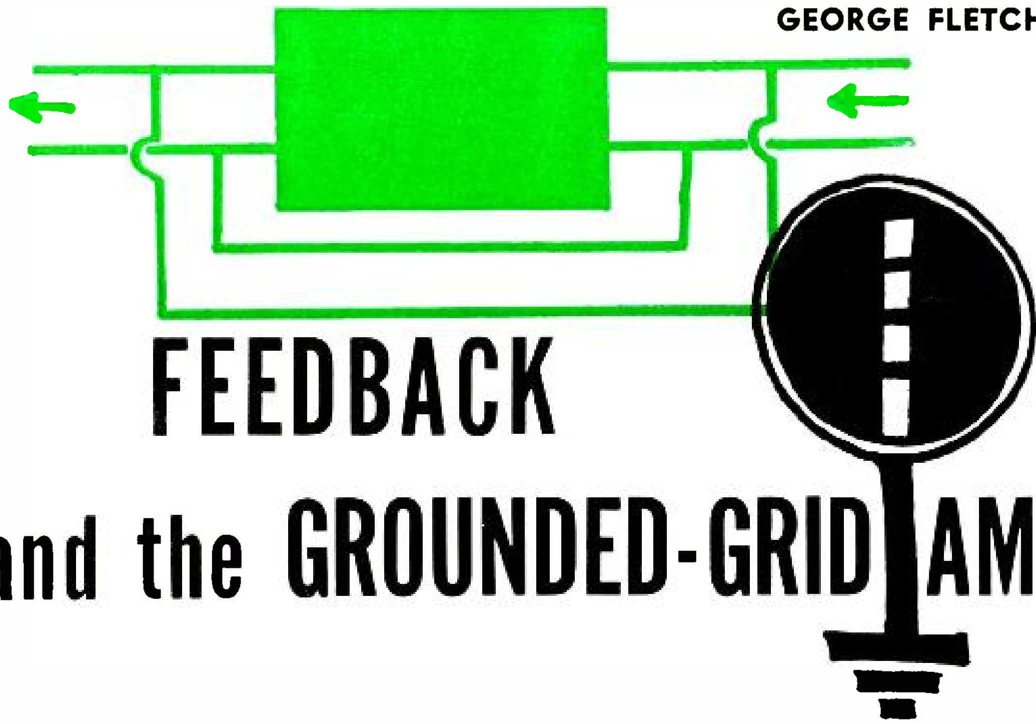


C Turning on r.f. generator C gives whirling protons a 500-volt kick 4 million times a second. Protons approaching the field of the huge output coil are accelerated by negative half of r.f. cycle, decelerated by positive half. Slowed protons spiral inward, are absorbed by chamber walls. Speeded protons cluster, race faster and faster, reach billion-volt level in less than a second.



D Protons at desired energy level strike a swiftly-inserted target, give up positive charges. Now neutrons unaffected by electric or magnetic fields, they continue in straight lines to detecting instruments outside the magnet. Photo shows Brookhaven scientists at the instant protons first passed billion-volt mark. Cosmotron later produced energy levels above 3 billion volts.

GEORGE FLETCHER COOPER



FEEDBACK and the GROUNDED-GRID AMPLIFIER

THE grounded-grid amplifier is familiar to designers who work at very high frequencies: it is used for the final stages of transmitters in the kilowatt class, and in some wideband low-noise-level amplifiers. The audio designers have ignored its potentialities, both in America, where they call it grounded grid, and in Britain, where they call it the inverted amplifier. A while ago I began to wonder about using grounded-grid stages in audio amplifiers, so I set my assistant to work, while I settled down and

"... wrote with a pen in each hand,
And explained all the while in a popular style
Which the reader could well understand."

The experimental work, which is still in progress, is being carried out with a 12AT7 double triode. This is not e actly a power tube: with plate supplies of 150 volts and a normal circuit you would not expect to get 100 milliwatts of power from one triode section. However, this happens to be just the sort of power I want for a particular amplifier. It gives me the opportunity to try out the grounded-grid stage with some feedback circuits which do not seem to be in the books. The reader who is interested can apply the theory to power amplifiers with the knowledge that he is on fairly new ground.

First of all, what is the grounded-grid amplifier? The basic circuit is shown in Fig. 1, where, as you can see, the input is applied between cathode and ground and the output is taken between plate and ground: the grid itself is connected directly to ground. Bias is provided in the usual way by the voltage drop in the cathode lead, and the input transformer can be dimensioned to provide the necessary secondary resistance. It is instructive to compare the three ordinary ways of connecting a triode amplifier: grounded cathode, grounded grid, and grounded plate. These are drawn in Fig. 2. They are three of the six possible ways of using the triode. The complete set of six connections is shown symbolically in Fig. 3.

The three elements of the tube are shown as terminals, with signal being applied and output taken as indicated by the arrows. An inward pointing arrow is input, and one pointing out is output. Thus, at *a* the signal is applied between grid and cathode and the output taken off between plate and cathode, as at *a* in Fig. 2. Of these, *a*, *b*, and *c* are already shown in Fig. 2; *d* and *e* appear to be quite useless; and *f* has been used for measuring high voltages. Negative plate voltages control the grid current with the grid held positive, the tube having an amplification factor of $1/\mu$.

Features of the circuit

The particular features of the grounded-grid amplifier, as we shall see, are low input impedance, normal output impedance, and the fact that the power which must be applied to the input is passed through the tube and mostly appears in the load. Let us see how these features are produced. The equivalent circuit is shown in Fig. 4: *e* is the input generator voltage, acting through an impedance R_1, which includes any cathode resistor, μ and R_p are the usual tube parameters and R_2 is the load resistance. The current through the circuit, *i*, is given by the equation $i = e - \mu e_g / R_1 + R_p + R_2$.

Now e_g is the grid-cathode voltage, which is here equal to $iR_1 - e$. Therefore $e(1+\mu) = i(1+\mu R_1 + R_p + R_2)$. The output voltage is, of course, iR_2, so that the voltage gain, iR_2/e, is equal to

$$\frac{(1+\mu)R_2}{R_p+R_2+(\mu+1)R_1}$$

If you remember the expression for the gain of an ordinary grounded cathode amplifier,

$$m = \frac{\mu R_2}{R_p+R_2+(\mu+1)R_2}$$

you will see that when there is no cathode impedance the grounded-grid stage gives the same voltage gain for a tube with an amplification factor μ, as a grounded cathode stage with a tube of amplification factor $1+\mu$. With a cathode resistor the term $1+\mu R$ appears in both cases.

The input impedance of the grounded grid stage is quite easy to calculate. It is, of course, just e/i, which is $R_1 + \frac{R_p+R_2}{1+\mu}$. For the grounded cathode stage, as you know, the input impedance is theoretically infinite. This input impedance may be simplified a bit to give an approximate expression which is easier to remember. Since we always use triodes in grounded grid stages, $R_2 \simeq R_p$. We have then

$$R_{in} = R_1 + \frac{2R_p}{1+\mu} \simeq R_1 + 2\frac{R_p}{\mu} \simeq R_1 + \frac{2}{g}$$

where g is the tube transconductance. For most of the tubes we are using nowadays $g = 2{,}000$—$10{,}000$ μmhos, so that $1/g$ may be of the order of 250 ohms and $R_{in} = R_1 + 500$ ohms. Let us take $R_1 = 500$ ohms, and we have $R_{in} = 1{,}000$ ohms.

For a small tube, a drive of 4 volts may be what is needed: the resulting power input is 16 milliwatts. This drives a current of 4 ma through the circuit, producing a power output in 10,000 ohms, again a typical value, of 160 milliwatts. If we scale up these figures, you see that a driver stage for a 16-watt grounded grid amplifier must deliver 1.6 watts: this is quite a contrast with the ordinary power stage which needs only a few milliwatts.

The output impedance is most easily calculated by remembering that if the output is matched it will produce one-half the open-circuit voltage. Since the open-circuit gain, obtained by letting $R_2 \longrightarrow \infty$, is $1+\mu$, the output impedance equals the value of R_2 for which the gain

$$\frac{\overline{1+\mu}R_2}{R_p+R_2+\overline{1+\mu}R_1}=\frac{1+\mu}{2}$$

This gives for the output impedance the not unexpected value $(R_p+\overline{1+\mu}R_1)$. Since the $\overline{1+\mu}R_1$ term is of the nature of a negative feedback the optimum load is not the matching load but the load settled by the tube characteristics and is about R_p.

Before we go any further let us summarize the results:

$$\text{gain} = \frac{(1+\mu)R_2}{R_2+R_p+\overline{1+\mu}R_1}$$

$$\text{input impedance} = R_1+\frac{R_p+R_2}{1+\mu}$$

$$\text{output impedance} = R_p+\overline{1+\mu}R_1$$

Notice also that the output is in phase with the input: the 180° phase shift of the grounded cathode stage is not obtained with grounded grid or grounded plate (cathode follower).

It has its uses

At this point you may ask why the grounded-grid stage should be used at all: the only important feature seems to be that it needs a lot of power to drive it. The answer is that it is very easy to drive it into grid current, because of the low-impedance grid path, and in consequence a triode can be driven over a much bigger plate swing. My 12AT7 is found to operate linearly up to $e_g = +3$ volts, instead of being limited to the negative grid voltage region. Just what this means can be seen by looking at the tube characteristics shown in Fig. 5: the positive grid characteristics were taken on a cathode-ray oscilloscope and are thus not very exact, but in view of the large tolerances which are normal for tube characteristics this is not particularly important.

If we consider the probable working range of the 12AT7 with positive grid drive, we see that instead of working through the point A (Fig. 5) with a load of 15,000 ohms we can work through B with a load of 5,000 ohms. For the first case we get a peak voltage of about 40, the maximum power will be $(40)^2/2\times15{,}000=53$ mw., while for the second case the peak voltage is 50, and maximum power is about $(50)^2/2\times5{,}000=250$ milliwatts. The actual power supplied from the plate supply increases, in this example, from $120\text{v}\times4\text{ ma}=0.48$ watt to $120\text{v}\times10\text{ ma}=1.2$ watt, but the efficiency is doubled. The audio designer who believes in triodes at all costs (and there are still quite a lot of people who distrust the pentode and tetrode) thus has a chance of getting more reasonable efficiency from his triodes.

The input impedance is made up of the cathode resistance and a term $(R_p+R_2)/(1+\mu)$ which, when the tube is matched, is simply equal to $2/g$. It is easy to see from Fig. 5 that g in the working region is about 6,000 μmhos, so that $2\times.250/g=80$ ohms. The input power needed to give our theoretical 250 milliwatts is thus, neglecting grid current, $3^2/2\times80=56$ milliwatts. Grid current will amount to about 2 ma extra current to be provided at the peak cathode current, and this will bring the input power needed by the grounded grid stage quite appreciably above the maximum power we can get from a conventional grounded-cathode circuit.

In practice we have found the limitations of the driver result in a maximum output power of about 200 milliwatts. The power gain obtained from a complete 12AT7, with transformers designed for the same input and output impedance, and covering the usual audio band, is about 50 db.

Positive feedback

Since the first half of a 12AT7 will not give enough power to drive the second half fully, we are in rather a spot. The solution is to make the second half, the grounded grid stage, help to drive itself. This we can do by means of our old friend positive feedback. What happens if we apply feedback to the grid of a grounded-grid stage? You will not, I think, find the answer in the textbooks, and so you must bear with just a little more mathematics. We go to our first equation, $e-\mu e_g=i(R_1+R_p+R_2)$, and now we say that to e_g we will add a fraction of the plate voltage kiR_2, so that $e_g = iR_1-e+kiR_2$.

Substituting this in the original equation we have

$$e(1+\mu)=i(\overline{1+\mu}R_1+R_p+\overline{1+\mu k}R_2)$$

From this we can see that the voltage amplification, iR_2/e, is

$$m=\frac{\overline{1+\mu}R_2}{\overline{1+\mu}R_1+R_p+\overline{1+\mu k}R_2};$$

the input impedance

$$e/i=R_1+\frac{R_p}{1+\mu}+\frac{1+\mu k}{1+\mu}R_2;$$

$$\text{the output impedance} = \frac{\overline{1+\mu}R_1+R_p}{1+\mu k}.$$

The amount of feedback is defined by the factor *k*. If *k* is positive, the feedback is negative, while a negative value of *k* corresponds to positive feedback. For use in our amplifier the choice of $k=-1/\mu$ is of special interest. This value of positive feedback gives;

$$m=\frac{\overline{1+\mu}R_2}{\overline{1+\mu}R_1+R_p},$$

input impedance $= R_1+R_p/1+\mu$, and output impedance $=\infty$ (infinity).

If we leave out the cathode resistor R_1 we see that the voltage gain is doubled by using this amount of positive feedback and taking a load resistance R_2 equal to R_p. At the same time the input impedance is reduced to $1/g$ instead of $2/g$. Consequently we need only one-half the previous driving power. This brings us very nicely into the range of the grounded-cathode driver stage. The way is thus cleared for the design of a simple audio amplifier. The circuit diagram appears in Fig. 6.

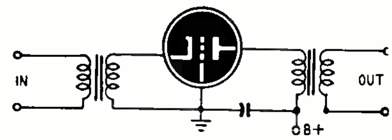


Fig. 1—The grounded-grid amplifier is much better known in the u.h.f. spectrum than at audio frequencies.

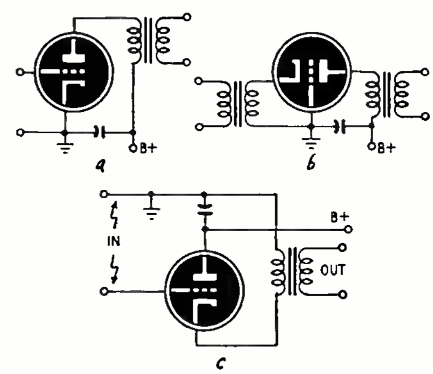


Fig. 2—The three practical ways in which an amplifier can be hooked up: with grid, plate or cathode grounded.

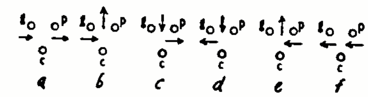


Fig. 3—All possible ways of hooking up a triode tube. Two are impractical and one used only in special circuits.

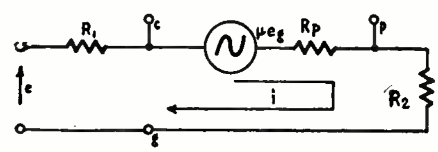


Fig. 4—Circuit of the grounded-grid amplifier drawn in equivalent form.

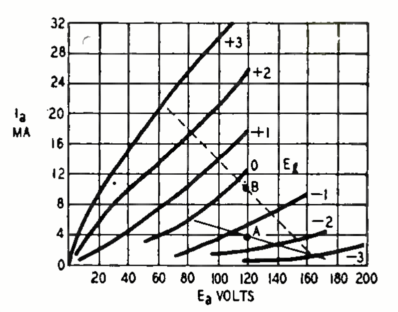


Fig. 5—The grounded-grid circuit can be run into the positive-grid region.

The output transformer, T3, has three windings: the main windings are designed to suit the load, and I shall take a 500-ohm line for design purposes. The optimum plate load is 5,000 ohms, from Fig. 5, so that the turns ratio will be $\sqrt{5{,}000/500} = 3.16:1$. The step-down from the plate winding to the grid is to be $1/\mu$, which is 40—1. If we want the amplifier to have a response extending below 100 cycles, we can take a line inductance of 1 henry, which gives a 3-db drop at 80 cycles. The other inductances are then 10 henries and $10/(40)^2=6$ mh. This last winding must have low d.c. resistance, so that grid current can flow, but there will not be much trouble with such a low inductance. The interstage transformer must match the ordinary class A stage to the cathode circuit, and must therefore have a ratio of $\sqrt{(15{,}000/160)}$ or about 10:1.

Including an interstage transformer makes it fairly straightforward to add negative feedback either from the output plate itself or from the line side of the output transformer. There are difficulties in practice, of course, especially if you want to take the feedback from the line winding, because then there are two transformers in the loop, and the resulting 24 db/octave slope of the total cutoff means you must stagger the cutoffs rather well. If the feedback is taken from the plate the shunt capacitor shown in Fig. 6 will help to supply you with the needed stability.

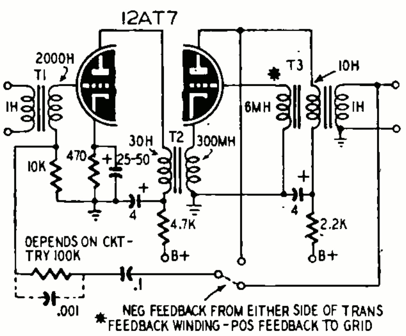


Fig. 6—Practical grounded-grid amplifier circuit, with both positive and negative feedback. Special transformers are required in the circuit.

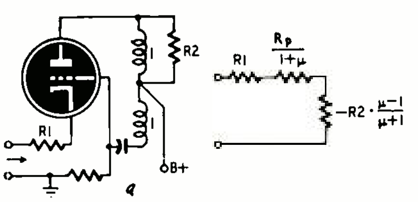


Fig. 7—Negative-resistance circuit.

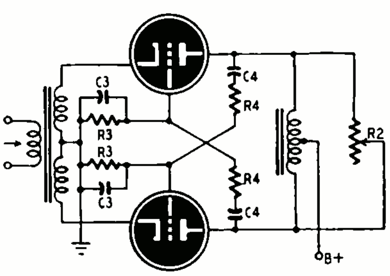


Fig. 8—This push-pull negative resistance circuit can be used as an oscillator or a high-gain amplifier.

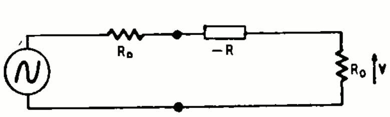


Fig. 9—Equivalent diagram of the negative-resistance circuits above.

The outline of the simple 12AT7 amplifier will, I hope, help you to design something more powerful. The sort of amplifier most readers will find interesting is probably a booster amplifier, to tack on behind an existing power amplifier. This is how the radio-frequency designers use the grounded grid: They take a 300-watt transmitter and add a 1-kw stage, and then a 3-kw stage, and so on. If you have a 3-watt audio amplifier you can use this as a driver for a 10-watt grounded-grid stage: the low impedance output of your present 3-watt amplifier will probably give enough volts to drive the grounded grid input, and it is easy to check this in the tube characteristics.

Negative resistance

I have skipped through this aspect of grounded-grid use in order to have space to look at some other consequences of the equations. As we saw above, with positive feedback of $k=-1/\mu$ the output impedance is infinite. The general equation for the input impedance,

$$R_{in} = R_1 + \frac{R_p}{1+\mu} + \frac{1+\mu k}{1+\mu} R_2$$

reduces, if $R_1=0$ and $R_2=R_p$ to

$$R_{in} = \frac{2+\mu k}{1+\mu} R_2$$

By taking $k=-2/\mu$ we make the input impedance zero. At the same time the gain becomes infinite. This is therefore a rather important value of positive feedback: any more feedback will make the input impedance negative.

The other interesting value of k is $k=-1$. This makes the input impedance

$$R_{in} = R_1 + \frac{R_p}{1+\mu} + \frac{1-\mu}{1+\mu} R_2$$

Now μ is usually fairly large: for the 12AT7 it is about 40-60. Consequently $(1-\mu)/(1+\mu) \simeq -1$ and the input impedance is

$$R_1 + \frac{R_p}{1+\mu} - R_2.$$

As R_2 is about the same order as R_p the term $R_p/1+\mu$ does not have much effect on the negative impedance. It is not very difficult to show that if μ changes by 10%, the term $\frac{1-\mu}{1+\mu}$ changes by $\frac{2}{1600}$ of 10%. The circuit thus provides a very stable sort of negative resistance. Before explaining how we can use this I shall show how we actually obtain it. The essence of the circuit is shown in Fig. 7-a, in which a 1-1 transformer—a center-tapped choke—provides the phase reversal to make $k=-1$. The R-C circuit in the grid is just to keep the plate-supply voltage away from the grid. The equivalent circuit is shown in Fig. 7-b. Nowadays we usually seem to get two small triodes in every bottle, so we can elaborate Fig. 7 into Fig. 8, a push-pull version of the same circuit. For audio work, we can have R4=10,000 ohms and R3=1 megohm. C4 is chosen to produce a cutoff in the region of 200 cycles, say 0.1 µf, while C3 provides a top cutoff, which may be at 5,000 cycles, and then C3 will be 75 µµf. At frequencies in the middle of the band, when C4 can be taken as a short circuit and C3 as an open circuit, $k=-0.99$. The input impedance is then $\frac{2R_p}{1+\mu} - \frac{R_2}{n^2}$.

Without going into too many details, it is sufficient to say that the value of n is chosen in the same way as if the transformer was to work into a resistance of R2, and R2 should be about 10,000—15,000 ohms for a 12AT7 tube.

What is the object of producing this negative resistance? There are three sorts of job for which negative resistance is useful. It can be used with a tank circuit to provide an oscillator, it can be used in a filter to improve the Q of a coil; or it can be used in a special sort of amplifier circuit. This last is the application for which the circuit of Fig. 8 is of special value. Consider the very simple circuit of Fig. 9. A generator of impedance R_o is connected to a load R_o through a negative resistance $-R$. Current is $i=e/(2R_o-R)$ and the voltage across the load will be $eR_o/(2R_o-R)$. The voltage without $-R$ in circuit would be $e/2$, so that the negative resistance produces a gain of $2R_o/2R_o-R$. This can be rearranged as $1/(1-R/2R_o)$. Suppose we adjust R_2 in Fig. 8 to make $R=\frac{3}{2}R_o$. The gain will then be 4 times, or 12 db.

Fig. 9 is completely symmetrical, and if the voltage e acted in series with the R_o on the right there would be a gain of 12 db in transmitting from right to left. A negative resistance amplifier can thus be inserted in a line to give a gain in both directions.

An amplifier of this kind is an ideal form of amplifier to add to an intercommunication system when a gain of about 6-12 db will make all the difference between comfort and strain to the user. The actual circuit is described by Merrill, in the *Bell System Technical Journal* (Jan. 1951, XXX, p. 88), and the amplifier is known to Bell as the El repeater. Mr. Merrill's description, however, is strictly long-haired.

For the future

Two topics have been left in the air in this article. One is the design of a genuine power-stage grounded-grid amplifier. I do not see much hope in the near future of getting down to the construction of a stage of this kind. The reader who is armed with the analysis above and the characteristics of his favorite tube can try one of them for himself.

The other topic is the general one of negative resistance, which is more complicated than you may think. I shall try to clear my own mind on this subject, and then see if I can explain it to you. END

UNIVERSAL SPEAKER for the SERVICE BENCH

By ALAN G. SORENSEN

SERVICE TECHNICIANS often require a test speaker unit. One which can be built easily is a welcome addition to the shop. Almost all television sets and radio-phono combinations have their speakers mounted in the cabinet or at other locations and not on the chassis. In servicing this type of equipment a bench speaker saves labor and time.

This unit also provides a line transformer. This feature is very useful in audio work where 500-ohm lines are often encountered. The output transformer is a universal type and can be substituted for almost any transformer the service technician will find. Primary impedances from 1,500 to 20,000 ohms can be matched by only two switches.

Fig. 1 is the circuit diagram of the unit. The wiring is simple and straightforward. The output transformer is a Stancor A-3852, which is a very flexible unit. The chart supplied with the transformer was glued to the underside of the hinged cabinet lid. Secondary taps for impedance matching are selected by switches S3 and S4, whose positions are marked 1 through 6 to correspond with the chart. The function switch (S1) may be set to OFF position and an external speaker connected to terminals VC or set to the OUTPUT position to operate the internal speaker.

Small color dots of blue, red, and brown were painted above the letters P, B, and P at the output transformer primary pin jacks. For single-tube output the brown P and red B are used; plate and B plus, respectively. For push-pull operation all three are used.

The line transformer is a Stancor type A-3883 and matches a 500-ohm line to voice-coil impedances of 4, 6, 8, and 15 ohms. This transformer is useful in working with audio equipment and communications receivers. Switch S2 was placed on the lower right-hand side of the panel, while the line transformer pin jacks were positioned on the upper left-hand side. This balances the panel layout and improves the unit's appearance. Again, the function switch may be positioned either at LINE or at OFF, depending upon whether the internal speaker is to be used or disconnected. The VC terminals may be used for an external speaker.

When the function switch (S1) is set at INT the internal speaker is connected to the INT SPKR terminals and may be used separately.

The FIELD switch (S5) may be used to replace virtually any field coil at power levels up to at least 10 watts. All resistors in the string are rated at 10 watts with the exception of the 4-ohm unit which is rated at 20 watts. A chart was made and glued to the top of the chassis. Since the switch has 30-degree spacing it was decided to use a National HRS-3 knob to simplify panel marking.

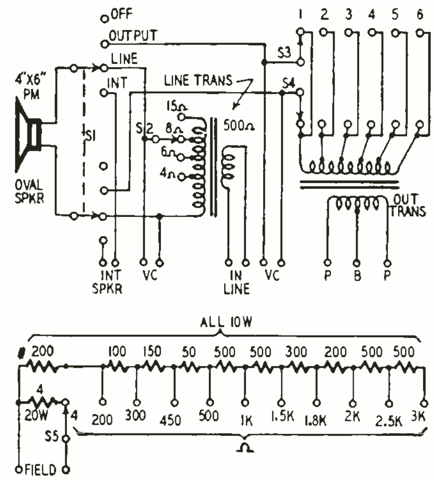


Fig. 1—Circuit of the universal unit.

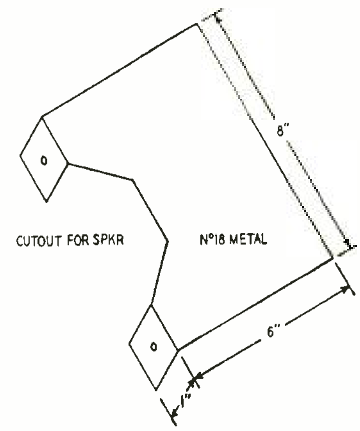


Fig. 2—Details of chassis plate.

The cabinet is an ICA 3926, 8 x 12 x 8 inches. The finish is gray wrinkle. The 8-inch chrome strip which was added for decoration was obtained from Allied Radio; number 86-366. A white flocked screen and a brass grill were placed over the speaker opening. The chassis is an 8 x 7-inch piece of No. 18 sheet metal cut and bent as shown in Fig. 2. Exact size and shape will depend on the speaker used. The wiring is point-to-point. Parts placement is not critical and the layout may be changed to suit the individual constructor.

The technician will find a test speaker unit a worthwhile addition to any service bench. The saving in labor time can easily pay for it in a short time. END

Materials for test speaker

Resistors: 1—50, 1—100, 1—150, 2—200, 1—300, 4—500 ohms, 10 watts; 1—4 ohms, 20 watts.
Switches, rotary: 1—4-contact, 2—6-contact, 1—11-contact; 1—2-gang, 4-contact.
Transformers: 1 output transformer, Stancor A-3852 or equivalent; 1 line transformer, Stancor A-3883 or equivalent.
Miscellaneous: 1 speaker, good quality, PM type, big enough for type of work to be handled. Cabinet and chassis, as per text. Jacks, hardware, wire, etc

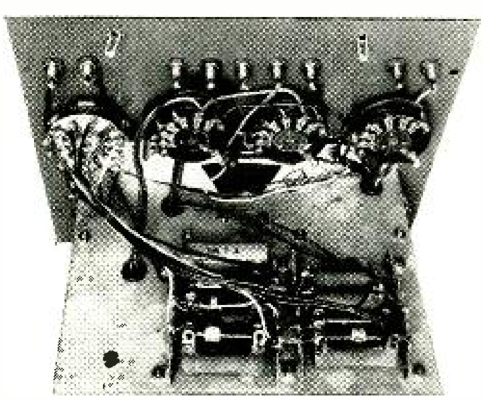


Fig. 3—Field resistors and switches.

Fig. 4—Balanced layout of large components.

HI-FI COMES TO THE MUSIC LOVER

De luxe trailer studio carries quality home-type audio equipment on nationwide demonstration tour

By HOWARD SOUTHER*

THE story of the Electro-Voice Audio Caravan starts with a discussion of the conditions which brought it into existence.

Present day radio-phonograph combinations do not satisfy the quality requirements of most serious music listening. Passing only 5 octaves out of a possible 10, the usual home listening setup arouses little emotional stimulus, and serves as only a fair means of communicating the barest intelligence.

During recent years, the country has experienced unusual developments in the art of high-fidelity reproduction. There exists now a fast-growing coterie of high-fidelity enthusiasts. They assemble this changer, that amplifier and tuner, and a choice of five or six makes of fine high-quality loudspeaker systems, to achieve a musical result in their own home that is startling in its satisfying realism.

Good reproduction of fine musical programs has just recently come into being, emerging from a dubious art into a rather well-founded science. The enthusiast or hobbyist has nursed this new business through its growing pains; now the manufacturers of high-quality sound equipment have discovered that they have products with a thoroughly universal appeal. The target of this appeal consists of the millions of *music lovers* throughout the United States and —somewhat secondarily—the world.

This target is reached only by exposing the product—in other words by advertising, which takes many forms. The advertising form most suited to high-fidelity is *actual demonstration*. Demonstration, along with *making the product available for sale*, constitutes *merchandising*, insofar as it concerns high-fidelity equipment.

Here lies the rub. The radio-music dealer has found it difficult, and has been reluctant to merchandise high-fidelity sound. In the past he was either not technically qualified to handle its complexities, or he was kept too busy merchandising television to bother. The upshot was that the wholesale radio parts distributor was forced to engage in selling direct to the ultimate consumer. So far this consumer has been only the hi-fi enthusiast, and the music lover has been left waiting to be exposed to the new thrills of home-reproduced quality sound.

The hi-fi enthusiast is used to seeking out the parts distributor, because the essence of his hobby is not just music listening, but includes assembly and experiment, and in his enthusiasm, he will go to great lengths to ride his hobby. The music lover, on the other hand, is a subjective individual concerned solely with the final delivery of fine music to his ears. He hardly knows what a parts distributor is. He is conditioned to making his purchases from community retailers and the downtown department and music stores—so the experience of home high-fidelity listening completely misses him.

The reasons for the Electro-Voice Audio Caravan are to engender interest in high-fidelity on the part of the dealer and distributor *and to take quality sound directly to the ears of the music lover.*

This could be augmented by the presence of the Audio Caravan at technical seminars, conventions, electronic shows, universities, and all the varied types of meetings conducted by civic and national groups.

The tide in the affairs of high-fidelity appears to be at the flood, so one day the boss said, "Go ahead—let's start the trailer project!"

We called the Freuhauf Trailer people and found out that their largest trailer was 38 feet long and contained 1,800 cubic feet. The proportions were pretty good, with head-room to spare, so we ordered one.

The metal shell of the trailer was just that—a shell. We had plenty to do. Generous quantities of *Kimsul* insulation against noise and weather were installed between 16-inch joists. Over this we applied heavy wood paneling to form a foundation for the fixtures, platforms, and showcases which were to come later. The ceiling was formed of a fine acoustic tile called *Transite*. The wall covering was a simulated cloth made of plastic, which turned out to be colorful, durable, and, most important, washable.

While this work was going on, our cabinet maker constructed the massive "picture-frame" showcases, and the sound channel was designed to provide the link between the Electro-Voice microphones and cartridges to the vari-

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Part of the trailer interior. Mixer console and tape reproducer are at the left. Special acoustic treatment was needed to overcome space limitations.

ous Electro-Voice-Klipsch loudspeaker systems which were to be demonstrated.

Considerable care was given to this phase of the project. We talked to Art Davis of the Cinema Engineering Company in Burbank, California, and decided that we should use a standard professional mixer setup, such as those used in recording and motion-picture studios. This would permit easy switching of all the types of input sources we wanted to use. These were phonograph, radio, microphones, and tape. In addition, we required high quality and serviceability to insure an effective and lasting demonstration setup.

Using the ready-built amplifier components supplied by Cinema Engineering made the construction of the mixer and sound channel quite simple, resolving the matter into one of straightforward mounting and interconnecting. The first time the power was applied, everything worked to perfection!

Adequate switching facilities provided instantaneous A-B comparisons between speakers. In addition, records, tape, microphones, and radio can be faded in and out at will for playback, tape recording, and tape dubbing.

Several days before the Chicago Radio Parts Show last May, we put the finishing touches on the Audio Caravan and hitched on our prime mover, a Chevrolet cab-over-engine affair. Blithely we took the rig for a short spin and nonchantly stopped at a filling station for a fill-up of gas. We understood the eagerness with which the filling station attendant took our order when he presented us with a bill for 175 gallons!

There were more surprises in store for us. On our first field trip, or shakedown cruise, we found that the trailer performed beautifully on the road. The ride was smooth and easy; steering and handling were much more simple than anticipated. Perhaps a contributing factor was the enthusiasm with which the competing traffic got out of the way at the sight of this rolling behemoth.

Brimming over with confidence, we pulled up on the main street and attempted to park next to the curb in a spot which had been reserved for us. After twenty-five minutes of fruitless backing and filling, a kind truck driver who was stalled behind us came over and expertly placed the Audio Caravan next to the curb. He agreed with us that we needed quite a number of additional driving lessons.

This was our first showing to the consuming public on a main thoroughfare. The crowd which had been watching our parking operation with tongue-in-cheek, immediately filed into the trailer and we proceeded to put on our demonstration with some rather unusual results.

One end of the trailer interior is raised to simulate a stage. When we mounted the rostrum to begin our show, we, as well as the audience, were thoroughly discomfited to find only one loudspeaker which could be used. This was the large Empire system on the platform—the rest of our speakers were spotted on the floor and low platforms, with the result that the audience totally obscured and muffled them. (All speakers were raised at the first opportunity.)

Part of the exploitation program is to give away 7-inch Columbia transcriptions which contain excerpts of the disc and tape selections used during the demonstration. The demonstration lasts about seventeen minutes, but after three hours, we noticed here and there some of the same faces we had seen earlier in the day. These people were sitting through the same program, time after time, in order to receive a duplicate and triplicate free disc. We solved this problem by announcing that everyone could have as many copies of the give-away disc as they nad use for.

It would appear that the Audio Caravan has high appeal, not only for those who view it, but for us who operate it. Especially since we plan definitely to include Florida in the itinerary of the demonstration unit in December! END

H. F. RESPONSE IMPROVED BY EGGSHELL IN SPEAKER

Rudi Pfenninger, noted German authority on synthetic music and high-frequency speakers, recently demonstrated an ingenious trick for improving the h.f. response of a cone type speaker. The pointed half of an eggshell, cemented in the center of the speaker cone, gives a remarkable improvement in h.f. response.

Cutting the shell requires care and patience. Place a hard-boiled egg, pointed end up, in an egg cup, and very carefully scribe a line around the outside (slightly below the greatest diameter) with a fine-bladed knife. Then slowly and delicately file through the shell along the line with the edge of a triangular needle file, *holding the egg only at the tip*. When the shell has been filed through all around, slice through the egg with a razor blade. Remove the yolk and white from the top half (don't crack the shell while doing this!) and let the shell dry completely. Then smooth the filed edge with fine sandpaper. Fasten the shell to the apex of the speaker cone with Duco or speaker cement.

The shell was tested on a handmade 10-inch speaker which had excellent bass response but was very poor on the highs. The improvement was remarkable. As was expected, the newly heard high frequencies were strongest along the axis of the cone.—*Funkschau, Munich, July 1, 1952*

(Some commercial speakers have been manufactured with egg-shaped dust caps over the voice-coil opening, but without any claims that this was done to improve high-frequency radiation. In this case, the extremely light weight and rigidity of the eggshell permit it to vibrate more effectively at high frequencies that the relatively heavy cone. The walls of the cone act as a reflector to direct the high-frequency vibrations toward the listener. The curvature of the main cone would determine the angle over which the highs are radiated.—*Editor*) END

TAPE RECORDING

By I. QUEEN
Editorial Associate

PART 3—Home and Office Models

A—Revere TR-200 with AM radio. B—Permoflux "Scribe". C—Universal Electronics "Reelest". D—Tapemaster PT-125.

THE machines described here sell for between $100 and $275. In most cases, tape speed is 3.75 or 7.5 inches per second or both. Fidelity is good to about 7 kc. These home and office models are portable and simple to operate. They perform well for long periods with little maintenance.

In these models, equalization varies from manufacturer to manufacturer. In each case the over-all compensation is correct, but some boost treble mostly during recording, while others may do it during playback. Because of this lack of standardization, tape recorded on one machine cannot always be played back on another without distortion.

Representative tape recording models are described below. Most of the manufacturers mentioned make more than one type. Many of them also sell tape accessories like continuous loop magazines, bulk erasure units, foot controls, and pickups for telephone conversations, especially for the higher-priced machines.

Pentron

Model 9T-3C has two speeds: 3.75 and 7.5 i.p.s. (inches per second). It has two input jacks—for mike and radio. Another jack is provided for an external amplifier or PA system and a fourth for an external speaker only. A 6V6-GT tube is the *power amplifier* during playback and the *h.f. oscillator* for recording. This model features an "editing key." The recordist can delete or add to a recording while the tape is playing. Tape is rewound at the unusually fast speed of 13 feet per second.

Fig. 1 shows the playback equalizer.

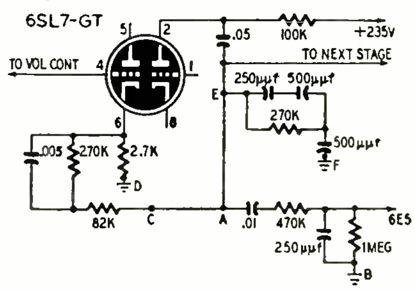


Fig. 1—Pentron playback equalizer. Inverse feedback network from pin 2 to pin 6 (C-D) raises bass response. The shunt network (E-F) reduces h.f. gain.

The network between points C and D is a high-pass circuit. It feeds back voltage from the plate of the second triode to the cathode of the first. It boosts bass. The electron-ray indicator is fed from a filter (between A and B). The main load of the second triode is the network between E and F. This also boosts bass.

Tapemaster

Model PT-125 is composed of two units: a transport and a preamplifier. It can be used with an external amplifier or radio. Speeds are 3.75 and 7.5 i.p.s. The preamplifier meets high standards. Wow is claimed to be less than 0.5% and maximum distortion less than 3%. The h.f. oscillator uses a push-pull circuit.

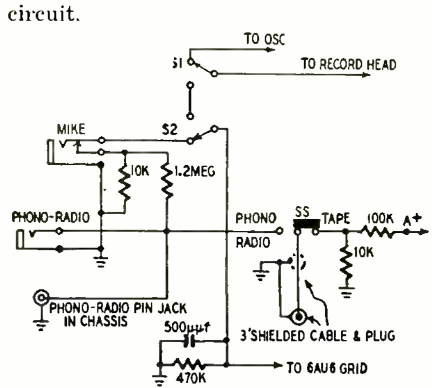


Fig. 2—The Tapemaster input selector.

The input circuit is shown in Fig. 2. A voltage divider reduces the relatively strong signal from a phono or radio. With SS on its left contact, phono-radio signals are shunted through a shielded cable as shown. This cable plug is inserted into the external radio or amplifier. Thus the preamp is taken out of the circuit without removing any connections. For tape listening, SS is switched to TAPE. The output of the preamp (point A) now feeds through the shielded cable and into the external amplifier.

Webster-Chicago (Webcor)

Model 210 provides 3.75 and 7.5 i.p.s. tape speeds. It is equipped with two motors, heads and associated parts. Each head contacts one of the tape tracks. One head is effective during *for-*

ward tape travel. The other is in the circuit during *reverse*. Heads are controlled automatically when direction is changed. This eliminates the need for rewinding the tape. When the roll comes to an end, the machine is reversed. This automatically ends the first track and starts the second. Reels don't have to be taken off their spindles and interchanged. One motor drives the capstan only, to assure minimum wow. The other drives the takeup reel.

This model has multiple output connections. They are: listen, external speaker; output (1-10 volts) for external PA or amplifier; low speaker level for monitoring. The recording indicator is an electron ray indicator tube. See Part I of this series for details of the equalization networks. Extensive service data and operating instructions are available from this manufacturer.

Webster Electric (Ekotape)

Model 114 has a speed of 3.75 i.p.s. Model 116 is built for 7.5 i.p.s. Otherwise these machines are similar. Each has an extra-large flywheel for minimum wow. Forward and reverse rewind is done at 20 times normal speed. These models may be adapted for a foot switch to aid in tape editing. A continuous-tape magazine is also available.

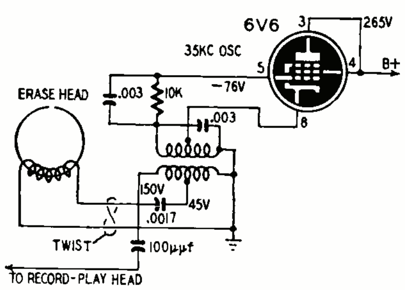


Fig. 3—Ekotape bias-erase oscillator.

Fig. 3 shows the h.f. oscillator. It operates at a frequency of 35 kc. About 150 volts of a.c. is fed to the record-play head. The erase head requires only about 45 volts. The 6V6 tube is inoperative during "playback."

Ampro

Model 731 is very compact. It weighs 17 pounds, and measures only 11 x 8 x 12 inches. It uses only three tubes plus a power rectifier. Tape speed is 3.75 i.p.s. There is a single (high-impedance) input channel. PM erasure is provided. This machine needs no lubrication. A continuous magazine (for 2½ minutes) may be added if desired.

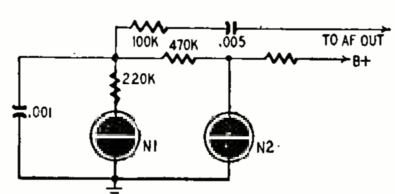


Fig. 4—Ampro level indicator. N1 flashes when peaks exceed d.c. bias from N2.

This model has a simple yet effective level indicator. See Fig. 4. N-1, the indicator, is supplied with both regulated d.c. and with a.f. from the power tube. The d.c. remains constant so N-1 actually indicates the a.f. peaks. N-2 is the regulator lamp, which compensates for line variations or changes in the circuit.

An adapter cable is available for radio recording. Two clips are attached across the speaker voice coil.

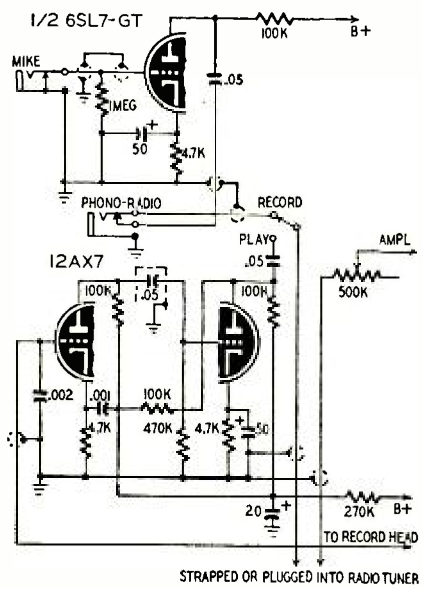


Fig. 5—Masco recorder input preamplifier and record-playback selector circuit.

Masco Electronic Sales

Series 52 recorders have two speeds: 3.75 and 7.5 i.p.s. Models R, LR, and CR also have AM tuners for recording direct from radio. All series 52 recorders have two heavy-duty motors with oilless bearings. A full 5 watts can be fed to an external 500-ohm speaker. Flutter is kept below 0.3%. The indicator neon lamp is used as a pilot during "playback." A separate "press-to-record" button prevents accidental erasure.

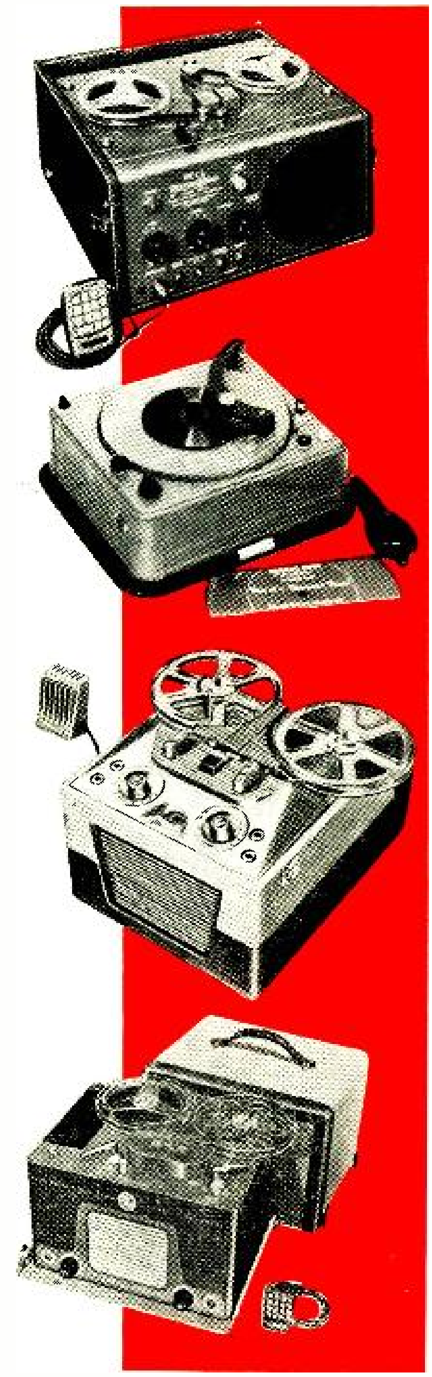
Input and preamplifier circuits are shown in Fig. 5. The 6SL7-GT triode is used for mike preamplification only. A 12AX7 is the tape preamplifier. Feedback between the second plate and the first cathode boosts bass. Note the shielded leads for radio pickup which feed directly into the main amplifier.

Universal Electronics

Reelest model C-1-A runs at 7.5 i.p.s. Unlike most other portables, it can play a 7-inch reel with covers *closed*. It also features automatic tape reversal. This is done by a contact sticker applied to the tape at the desired point. The metal sticker touches off a switch and energizes a solenoid. The level indicator is an electron-ray tube.

Model PT-3M has an unusual record-playback head. It is automatically moved upward during a forward run. Here it contacts the upper track. When the machine is reversed, the head is moved down where it contacts the lower track. Rewinding is eliminated and tracks may be changed without "flopping" or interchanging reels. This head has twice the life of ordinary types. When it becomes worn, simply loosen it and rotate through 180 degrees, and you have a second surface for further use. This model has two erase heads, one for each track (since the tape is always erased before recording). The erase heads are on either side of the recording head. They are switched automatically every time the tape direction is changed.

Fig. 6 shows input connections to the Reelest. Ganged switch SW1, SW2 has 4 positions: mike, phono, radio, and tape. Any one of the first three is recorded by turning on the recorder and switching SW as desired. The fourth position feeds tape signals for playback. SW2 connects any desired channel to an external amplifier. Phono or radio is fed



E—Bell RT-65 "Recordfone". F—Voice-Master magnetic-disc recorder. G—Pentron model 9T-3C. H—Masco model 52.

directly to the external amplifier. These need no preamplification, and therefore bypass the input stage.

Bell Sound Systems, Inc.

Model RT-65B is unusual in offering a choice of three speeds: 1⅞, 3¾, or 7½ i.p.s. It has input jacks for phono-radio and for mike. Monitoring may be done by headphone.

See Fig. 7 for the input stages. The first triode of a 12AX7 is a mike preamplifier. It is followed by a second triode amplifier and an equalizer. Note the 5% resistors and capacitors in the compensation network. At slow speed,

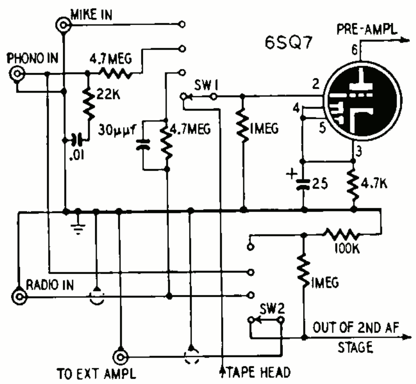


Fig. 6—Input connections and switching of Universal Electronics "Reelest".

a switch connects a capacitor to boost the highs still more. Tone control is effective during playback only.

Brush

Soundmirror model BK-442 is housed in a mahogany cabinet with handles for easy portability. Speed is 7.5 i.p.s. Signal-to-noise ratio is stated to be at least 40 db, and wow less than 0.3%. This is a single-channel machine which uses the entire width of tape as a single track for less background noise. The speaker is an 8-inch PM, unusually large for a portable.

Both high-level and low-level input jacks are provided. A jack for an external speaker or amplifier is also included. The level indicator is an electron-ray tube.

The Brush Co. supplies a 21-page maintenance manual to aid owners and technicians. The company also publishes "How to edit and program Tape Recordings" and "Soundmirror Book of 101 Uses," two very valuable recording booklets.

Eicor, Inc.

Model 115 has a speed of 7.5 i.p.s. With a conversion kit, 3.75 i.p.s. is easily added. In this recorder the head has separate windings for recording, playback, and erasing. Each is designed for optimum performance. This simplifies the switching.

Revere Camera Co.

Models TR are available with built-in radio for direct recording. T-100 and T-500 are recorders only. Each has a single speed, the first running at 3.75 and the second at 1⅞ i.p.s. The mechanism needs no oiling at any point. Each of these models holds up to a 5-inch reel.

Revere has recently introduced a new "Finger-Tip" model T-700. It accommodates a 7-inch reel. Speed is 3.75 i.p.s. This recorder has several unusual features. It is completely automatic. There are four push-buttons: "stop," "play," "speaker," and "record." A precision counter enables the recordist to locate any desired part of a recording. Two level indicators are included. At the correct level, the "normal" flashes. When the "distorted" indicator flashes, the level should be turned down. A foot control may be added if desired. It starts and stops the tape instantly with slight foot pressure. This is an aid during editing.

General Industries

Model 250 is a combination tape-disc travel mechanism. The phonograph section plays 78 r.p.m. discs. When using tape, the turntable acts as flywheel. Tape speed is 3.75 i.p.s. and a 5-inch reel can be accommodated. No amplifier is provided; the manufacturer suggests using the following tubes: 6AU6, 12AX7 (both triodes), and a 6AQ5. The schematic is available from the company. This amplifier should be constructed on a separate chassis, away from the mechanism. Erasure is by a permanent magnet. The motor shuts itself off automatically at the end of a roll of tape.

Model 250 can record from tape to disc and from disc to tape, as well as from radio or mike to tape.

Wilcox-Gay (Recordio)

Models 2A10-2A11 are two-speed models. The first runs at 3.75 and 7.5 i.p.s. The second is for 1.87 and 3.75 i.p.s. Otherwise they are identical. Each

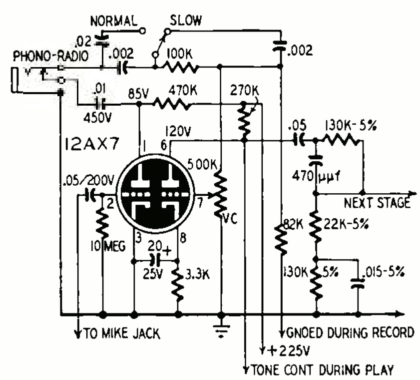


Fig. 7—Bell Sound Systems RT-65B preamplifier and tape-speed equalizer.

has full push-button control. Erasure is by a permanent magnet.

Three tubes are used in a 4-stage channel. Both triodes of a 12AX7 are used as amplifiers. These are designated V2, V3. A 6AQ5 tube (V4) is the power tube. In Fig. 8, V1 is shown as a transitron oscillator which feeds h.f. bias voltage to V4 where it mixes with the a.f. The mike signal is delivered to V3, the mike preamplifier. For playback, switch S1 moves one notch clockwise. In this new position, V1 becomes the tape preamplifier and feeds into V3.

These recorders have an external speaker jack. During recording, the speaker is disconnected but the jack delivers sufficient signal for headphone monitoring.

S2 automatically compensates for frequency response when speed is changed.

Scribe

The Permoflux Scribe is specially designed for business dictation, conferences, sales meetings, and interviews. Its speed is 3.75 i.p.s. It incorporates many unique and desirable features.

Tape is enclosed in a magazine which can be loaded in 2 seconds. The tape needs no threading and cannot unravel. At the end of a roll the machine stops automatically. An audible signal warns that the end is approaching. A luminous dial permits exact logging and timing. Shuttle speed, both forward and reverse, is 12½ times normal.

The amplifier uses a straightforward circuit employing 5 miniature tubes. Speech is fed in by a dynamic mike. Playback is done through a speaker, or earphones as desired.

Magnetic Recording Industries

The Voice-Master is not a "tape" machine but the principle is similar. Instead of tape, a flat *disc* is used. The disc has a paper or plastic base and a magnetic coating. A recording-playback head is connected in the phonograph-like arm to record and reproduce. The arm is indexed. Either paper or plastic "Magic-Discs" must be used. The paper ones may be folded for easy mailing. Six in an envelope need only a 3c stamp. This recording method is convenient for executives or salesmen who must dictate while on the road or in a hotel room.

A Codit attachment scrambles the message so no person can understand it without the decoding key. After transcription, the discs are instantly erased by moving a magnet over them. Then a new recording can be made. Magic-Discs can be reused 1,000 times. END

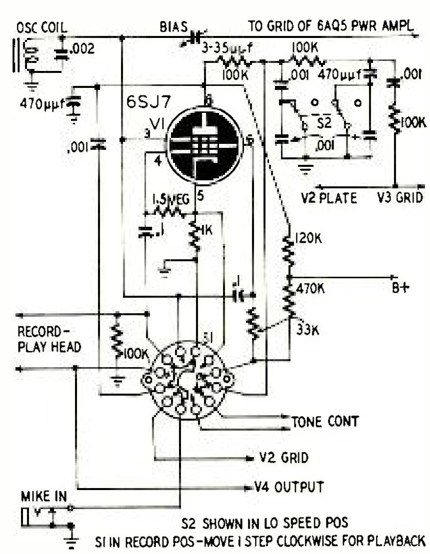


Fig. 8—Wilcox-Gay bias-erase circuit.

short circuits

Bandspread circuits and their applications in modern receivers

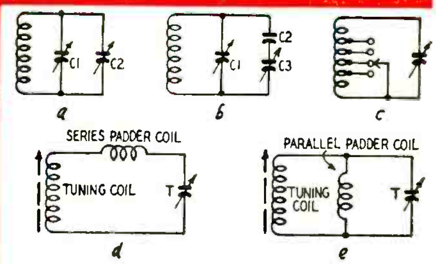
By ROBERT F. SCOTT
Technical Editor

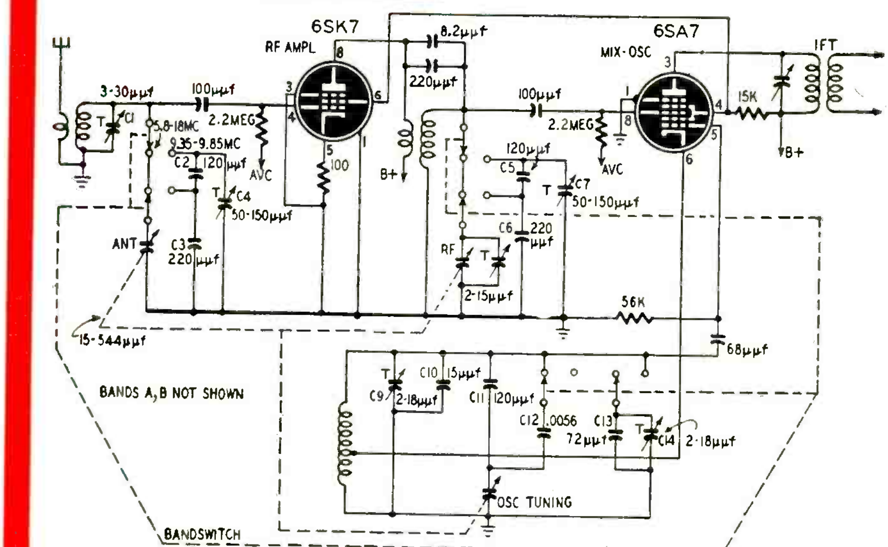
FOR several years I have wondered at the reluctance of the average service technician to attempt to realign the shortwave bands of an all-wave receiver. The man who tries to do the job may be a whizz on realigning broadcast sets but he is still quite apt to fail miserably on a shortwave job. If you don't believe it, just ask a ham or serious SWL.

Many all-wave sets cover the shortwave spectrum from 1600 kc to 18 or 25 megacycles in two or three overlapping bands which have frequency ratios of approximately 3 to 1. Shortwave tuning circuits for the antenna, r.f., and oscillator are usually identical to and just as easy to realign as the broadcast. Of course, the manufacturers' instructions should be followed to the letter. Since the dial scales of many of these sets are not closely calibrated and equipped for fine tuning, standard signal generators are good enough for the job and no special care is needed.

The jobs that really make the boys head for the hills are those which have elaborate electrical bandspread systems to spread each international shortwave broadcast band over one sweep of the tuning dial. As Table I indicates, the width of the bands vary from 400 kc to 1.6 mc. When these are spread across the dial, the frequency tuning ratio averages about 1.07 to 1. Since the tuning arrangements for these bands vary considerably from those for the broadcast band, we feel that service technicians will be interested in an explanation of the most commonly used bandspread circuit arrangements.

A considerable number of shortwave listeners is always with us, besides nearly 100,000 hams, a majority of whom do not own servicing equipment. The interest in shortwave seems to be increasing, possibly due to the large number of Americans who have been in foreign countries (some of whom brought shortwave receivers back with them) and the technician who is willing to realign them will have plenty of business.





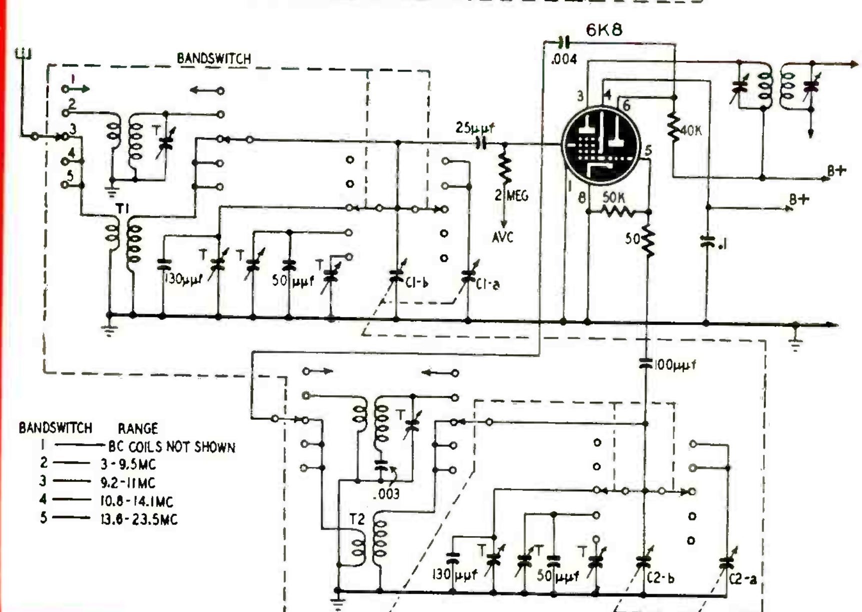


Fig. 1 (top)—Basic bandspread systems used in shortwave sets. Drawings at *a* and *b* show how bands are spread by reducing the variation in total capacitance over the tuning range. Circuits *c*, *d*, and *e* spread bands by varying the total tuning inductance. Fig. 2 (center)—Bandspread tuning circuit of RCA 111K—a version of Fig. 1-b. Fig. 3 (bottom)—Adaptation of Fig. 1-a in Sentinel 256.

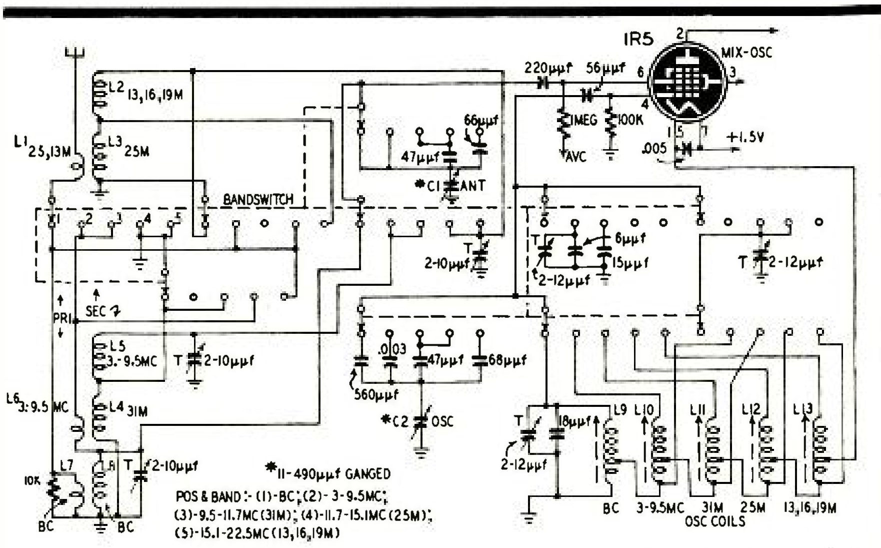


Fig. 4—Front end of RCA QB2 receiver. The spread bands use basic circuit in Fig. 1-b for antenna and a combination of Figs. 1-b and 1-c in the oscillator.

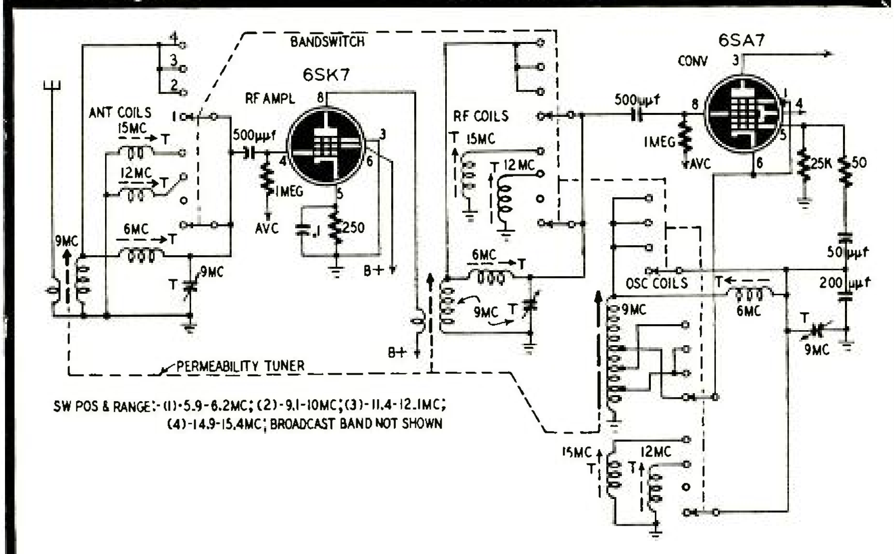


Fig. 5—Many Belmont and Airline sets are permeability tuned. The shortwave bandspreading system uses combinations of series and parallel inductance padding.

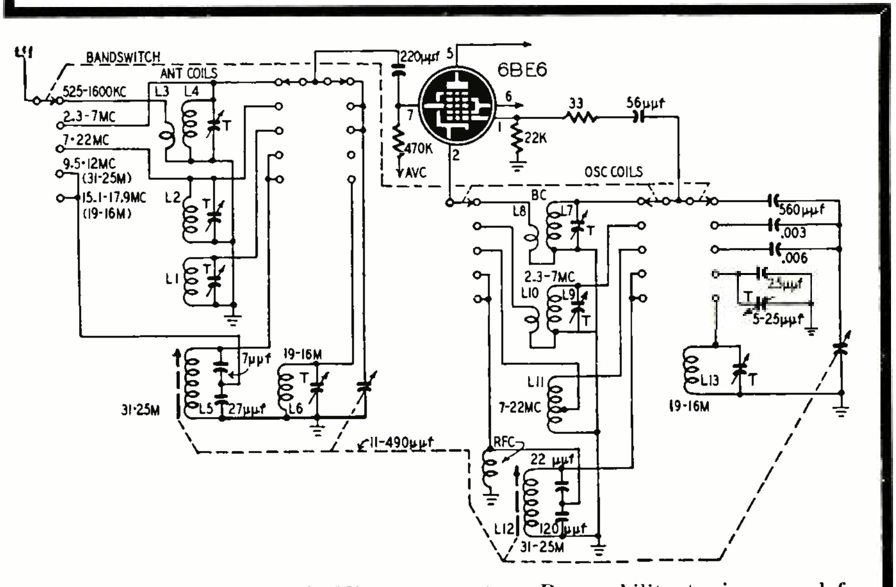


Fig. 6—One version of RCA's Microtune system. Permeability tuning—used for spreading shortwave bands—has coil slugs ganged with variable capacitors.

How bands are spread

Tuning capacitors with maximum values ranging from 300 to 500 μμf are commonly used for tuning the broadcast (550–1650 kc) band. Regardless of the maximum and minimum capacitances of the tuning capacitor, the practical capacitance ratio is usually limited to about 9 to 1 by circuit capacitances, which include the coil's distributed capacitance and stray wiring capacitances in parallel with the coil and tuning capacitor. This limits the frequency ratio to about 3 to 1—the square root of the capacitance ratio. When these tuning capacitors are used to tune shortwave bands, the frequency range becomes so great that tuning and logging of stations becomes extremely difficult. A span of several hundred kc may be covered by the width of the pointer.

Electrical bandspread systems have been developed to simplify tuning by spreading each international shortwave band over the entire span of the tuning dial. Basic bandspread circuits are shown in Fig. 1.

The circuit in Fig. 1-a is commonly used in amateur and communications receivers. C1 is the standard-size tuning capacitor. Its setting determines the minimum circuit capacitance. It is commonly called the *bandset* capacitor or control. C2 is the *bandspread* capacitor. Its maximum value is usually about 1/10 the maximum value of C1. With C2 wide open, C1 is used to tune the set to the high-frequency end of the desired band. By tuning with C2, a band of several hundred kc can be spread over the full scale of the dial of the bandspread control.

In Fig. 1-b, C1 is the usual trimmer capacitor, C2 is the padder, and C3 is the main tuning capacitor in a circuit identical to that used to tune the oscillator circuit in many superhet receivers. Since C2 and C3 are in series, the total capacitance is smaller than either. The minimum capacitance changes very little for any value of C2, but the maximum value changes over a wide range. C2 sets the lowest frequency of the circuit and is used as the bandset capacitor. The main tuning capacitor C3 becomes the bandspread capacitor.

The circuit in Fig. 1-c is familiar to builders of small regenerative receivers. By using a tapped coil and a comparatively small tuning capacitor, a wide section of the radio spectrum can be divided into a number of smaller overlapping bands by selecting the positions of the taps on the coil.

The circuit at *d* may be used with variable-capacitance or permeability-tuned circuits. When the padder inductor is in series with the tunable inductor, it lowers the resonant frequency and decreases the width of the band that can be covered with the tuning slug.

A parallel padder coil is shown in the circuit in Fig. 1-e. The padder coil reduces the effective inductance of the circuit and decreases the width of the

band covered by the adjustable core. Capacitors in *d* and *e* set the lowest frequency which can be tuned with the combination.

Tuning-capacitor padding

The circuit in Fig. 2 is the simplified schematic of the r.f., antenna, and oscillator stages of the RCA 111K receiver. When the band switch is in the 5.8–18-mc position, the antenna and r.f. circuits are tuned by the full capacitance range of the 15–544-μμf tuning capacitor. Although the capacitor has a ratio of approximately 36 to 1, the actual capacitance ratio is nearer 9.6 to 1 because it is shunted by stray capacitance and antenna trimmer C1. The frequency ratio is roughly 3 to 1. The mixer circuit tunes in the same way, but no trimmer is needed.

In the oscillator circuit, the trimmer consists of C9 and C10 in parallel. Padding capacitance consists of C11 and C12, totaling .00572 μf. When the band switch is set for reception on the 31-meter (9.35-9.85 mc) band, the frequency range is 1.0 to 1.05, so padding capacitors are switched into the antenna, r.f., and oscillator circuits to limit the capacitance ratio. In the antenna circuit, C2 is the padder, C3 is the fixed trimmer, and C4 is a variable trimmer used for bandsetting. C5, C6, and C7 in the r.f. circuit correspond to C2, C3, and C4 in the antenna circuit. C4 and C7 are adjusted to peak the signal in the center of the band (9.5 mc).

In the oscillator circuit, the padding capacitance is reduced to 120 μμf by switching out C12 and leaving only the capacitance of C11. This is a modification of Fig. 1-b.

Parallel-capacitor bandspreading

The Sentinel 256 and 257 receivers use the method of bandspreading shown in Fig. 1-a. The simplified tuning circuits of these receivers are shown in Fig. 3. C1-a and C2-a are the usual tuning capacitors. C1-b and C2-b are small bandspread capacitors ganged with C1-a and C2-a. When the set is tuned to the broadcast or 3.0–9.5-mc bands, both sections of C1 are paralleled across the antenna coil and sections of C2 are paralleled to tune the oscillator circuit.

With both sections of C1 and C2 paralleled across T1 and T2, the frequencies between 9.2 and 23.5 megacycles would be crowded into one sweep of the tuning dial, making it difficult to separate and log stations. So, instead of using continuous tuning, the range is split into three overlapping bands. Capacitor sections C1-a and C2-a are switched out and semi-fixed bandsetting capacitors are substituted. C1-b and C2-b are then used as the bandspread capacitors.

Inductance-capacitance padding

A practical adaptation of the basic circuits in Figs. 1-b and 1-c is used in the tuning circuits of the RCA QB2 battery set shown in Fig. 4. On the broadcast band, the primary of the antenna transformer consists of L1 and L7 in series. L8 is the broadcast secondary tuned by C1. The oscillator circuit consists of oscillator coil L9 with tapped sections of L10 through L13 in series between the tap and the negative side of the oscillator filament. C2 is the oscillator tuning capacitor with a 560-μμf padder in series.

On the 3.0–9.5-mc band, the antenna primary is composed of L1, L6, and L8, the broadcast-band secondary, in series. L4 and L5 are connected in series and used as the secondary. The circuit is tuned by the full capacitance range of C1. In the oscillator circuit, the inductance is reduced by cutting out L9, increasing the padding capacitance to .003 μf, and switching in trimmer capacitors.

In the next three tuning ranges, the 9.5-22.5-mc section of the short-wave spectrum (frequency ratio about 2.36 to 1) is split into three overlapping bands, each having a frequency range of considerably less than 2 to 1. The oscillator inductance for each band is reduced by progressively cutting out portions of the series-connected inductors until only L13 is left. New padders and trimmers are switched in to control the maximum and minimum capacitance across the inductances.

On band 3, the antenna primary is the same as on band 2. The secondary is tuned to the higher range by short-circuiting L4 and adding a 47-μμf padder capacitor in series with C1. On band 4, L1 is used alone as the antenna primary. The tuned secondary consists of L2 and L3 in series tuned by C1 and the 47-μμf padder. For band 5, L3 is shorted out and a new (66-μμf) padder is connected in series with C1.

Permeability-tuned circuits

The circuit in Fig. 5 is used in many Airline and Belmont sets. It is a combination of the basic circuits shown in Figs. 1-d and 1-e. The tuning arrangement for the broadcast band—a conventional permeability-tuned arrangement—is not shown. The main tuning slugs are in the cores of the 9-mc (31-meter) antenna, r.f., and oscillator coils. When tuning in the 49-meter (6-mc) band, the required inductances are made up by connecting the 6-mc inductor in series with the 9-mc tuned coils. For 31 meters, the 6-mc coils are shorted out. On bands 3 and 4 (11.4–12.1 and 14.9–15.4 mc) the 6-mc coils remain shorted out and the 12- or 15-mc shunt padding inductors are connected in parallel with the 9-mc coils to lower the inductances to the proper values.

RCA Microtune circuit

The Microtune bandspread system uses permeability tuning to spread one or more short-wave bands on all-wave sets which employ variable capacitance on bands where the frequency ratio is approximately 3 to 1. The circuits in the model 5QA5 are shown in Fig. 6.

TABLE I

Band (meters)	Range (mc)	Bandwidth
49	5.90— 6.30	. 400 kc
41	7.03— 7.50	470 kc
31	9.29— 9.80	510 kc
25	11.5 —12.2	700 kc
19	14.8 —15.7	900 kc
16	17.4 —18.5	1.1 mc
13	20.8 —22.4	1.6 mc

On the first three ranges, the variable-capacitance-tuned circuits are conventional. Permeability tuning is used in the 9.5–12-mc and 15.1–17.9-mc bands. The tuning slugs in the cores of the 9.5-12-mc coils are ganged to the main tuning control and dial. When these coils are switched into the circuit, the variable tuning capacitors are switched out. The highest frequency bands are tuned by shunting the 19–16-meter coils across the slug-tuned coils which are used alone for the 31-25-meter range. This bandspread system is similar to that in Fig. 5. END

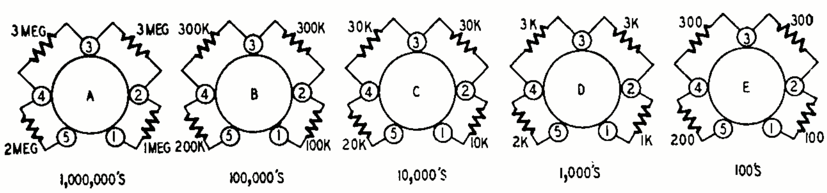
DECADE RESISTANCE BOX

The most common decade resistance substitution boxes require nine or ten resistors and a tap switch for each range. The resistor decade shown in the diagram uses only 20 resistors and 5 5-prong sockets to cover the range from 100 to 9,999,900 in steps of 100 ohms. Short jumpers fitted with phone tips are used to connect the required resistors in series. Each figure in the desired resistance value is obtained by using a jumper to select the resistance corresponding to it. If the figure is zero, bypass that particular decade.

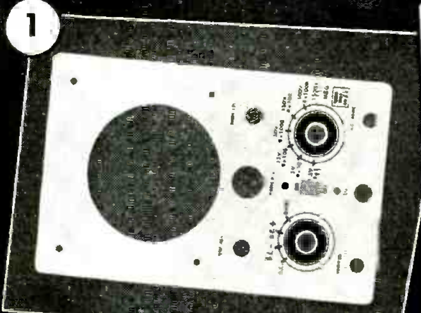
The decade box is easy to use. No chart is required. Assuming that the desired resistance is 7,468,500 ohms, we take the following steps to obtain the exact value:

1. Test lead into 1A (the letter indicates the socket and the number indicates its pin.)
2. Jumper from 4A to 1B.
3. Jumper from 3B to 2C.
4. Jumper from 4C to 2D.
5. Jumper from 5D to 3E.
6. Test lead into 5E.

It's easy when you get the hang of it.—*C. W. Griffee*



Check these ADVANTAGES FOUND *Only* in HEATHKITS

1 

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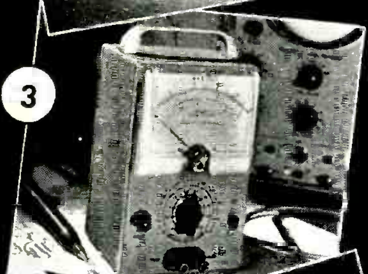
3 

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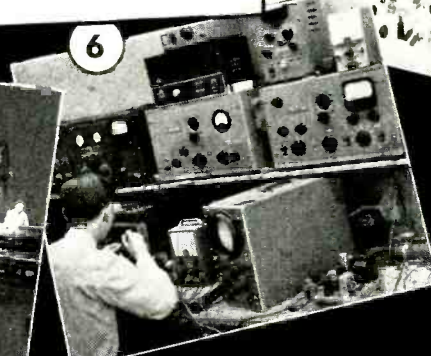
6 

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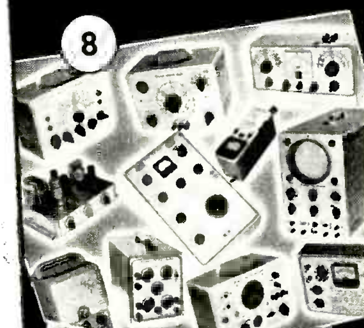
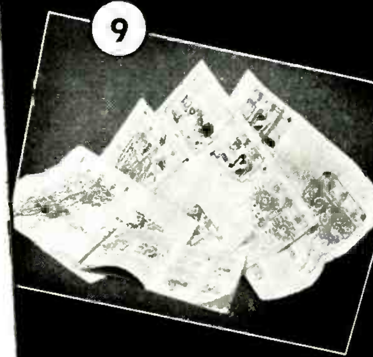
8 

9 

1. Baked Enamel Lifetime Finish Panels — Oven baked finishes for maximum durability and freedom from mars, scratches and discoloration. Panels that can really take service shop and laboratory abuse.

2. Save Money — You save all expensive factory wiring costs when you build your own. And, direct factory to customer sales eliminate all middle man profits. You can have a complete Heathkit laboratory or service shop for what one or two pieces of ready built equipment cost.

3. Modern Styling — New "fitted panels" and formed cabinets with rounded corners present a smart, professional appearance. Dignified appearance for prestige.

4. Quality Components Used Throughout — Heathkits use well known, time and quality tested components such as Simpson, Chicago Transformer, Wilkor, Allen-Bradley, Altec-Lansing, Centralab, Cinch, Oak, Grigsby-Allison, Mallory and many others.

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9. Detailed, Complete Instruction Manuals — Comprehensive manuals tell you exactly how to build your Heathkit. Manuals contain easy-to-follow instructions, clear, large pictorials, schematic, detail drawings, etc. They make construction easy, fun, and educational.

Nine New Heathkits This Year!

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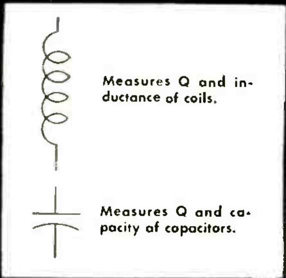
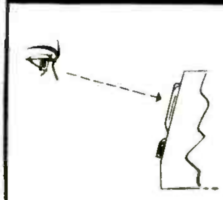
NEW *Heathkit* "Q" METER KIT

• A HIGH QUALITY Q METER AT LOW COST.

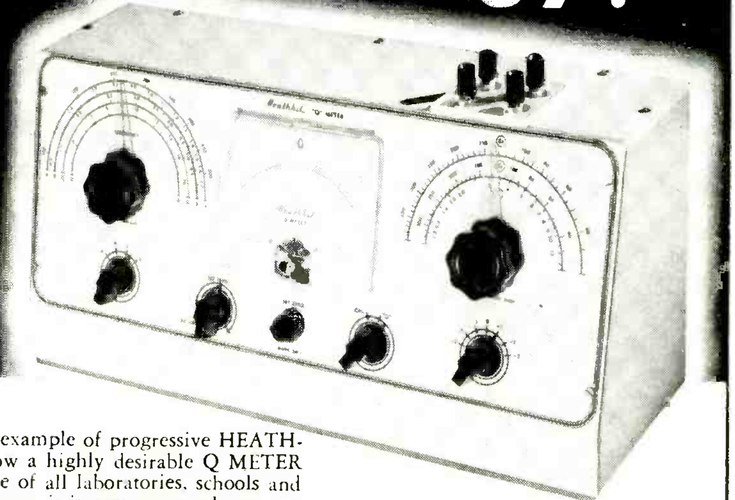
MODEL QM-1
SHIPPING WT. 12 LBS.

$39.50





Slant face cabinet for ease in reading the meter.



- First Q METER within the price range of all.
- Read Q's of 0-500 directly on calibrated scale.
- Stable oscillator supplies R.F. frequencies of 150 kc to 18 megacycles.
- Calibrated capacitor with range of 40 mmf to 450 mmf with vernier of ±3 mmf.
- Simple, easy operation.
- Can be used to measure small inductances or capacitors.
- Measures Q of condensers, RF resistance and distributed capacity of coils.
- Measures capacity by substitution, capacity by resonance, inductance by resonance.
- Slanted panel for convenient operation.

Another outstanding example of progressive HEATHKIT engineering. Now a highly desirable Q METER within the price range of all laboratories, schools and experimenters. No longer is it necessary to deny yourself the many measurement advantages offered by this instrument.

Use the new HEATHKIT Q METER for the following simple basic measurements: capacity by substitution, capacity by resonance, inductance by resonance and Q at the OPERATING frequency all can be read on the calibrated scales. The method used to obtain information regarding the Q of condensers, RF resistance, distributed capacity in coils, etc., is only slightly more involved. In the HEATHKIT Q METER, the generated RF signal is coupled through a cathode follower and injected across a low impedance condenser which is included in the resonant circuit under test. Large 4½" 50 microampere Simpson meter reads Q directly. The resonating condenser and vernier condenser are calibrated in mmf for substitution method capacity tests. The resonating condenser is also calibrated in effective capacity for resonance tests. The inductance calibration serves for rapid determination of the approximate inductance of a coil. The HEATHKIT Q METER has a generator frequency range of 150 kc to 18 megacycles. Vernier capacity covers ± 3 mmf and the resonating condenser is calibrated from 40 mmf to 450 mmf actual capacity or 40 mmf to 350 mmf effective capacity. Meter reads Q directly up to 250. Higher and lower full scale readings can be obtained by varying the injection voltage levels.

The entire kit consists of 12AT7, 6AL5, 6C4, OD3 and 6X5 tubes, 50 microampere Simpson meter, power transformer, cabinet and all other parts necessary for construction as well as instructions for assembling, testing and operation of the completed instrument.

Heathkit DECADE RESISTANCE KIT

The HEATHKIT DECADE RESISTANCE KIT is widely used by schools, experimenters and laboratories because of the extremely wide resistance range offered and the useful, dependable service provided. The DECADE consists of 5 rotary 2 deck ceramic wafer switches with silver plated contacts and twenty 1% precision resistors in a circuit which provides the resistance range of 1 ohm to 99,999 ohms in 1 ohm steps. The HEATHKIT DECADE RESISTANCE KIT is simple to construct and is housed in a beautiful polished birch cabinet with an attractive panel. The DECADE will furnish years of accurate trouble-free service.

Individual decade sections of above can be purchased separately for special applications.

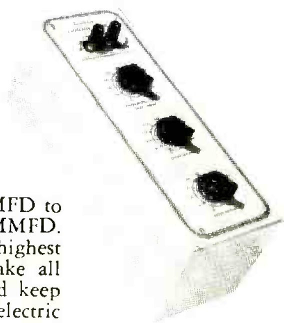
MODEL DR-1
SHIPPING WT. 4 LBS.

$19.50

NEW *Heathkit* DECADE CONDENSER KIT

Extremely useful in all experimental and design work such as determination of condenser values for: compensating networks, filters, bridge impedances, tuned circuits, etc. *Uses all precision silver mica condensers within ±1% accuracy.* Values run in three decades from 100 MMFD to 0.111 MFD in steps of 100 MMFD. Smooth acting, positive detent, highest quality ceramic wafer switches make all capacitor values easy to set up and keep losses to a minimum. Low loss dielectric terminal board mounts on outside of panel for easy cleaning. Heathkit binding posts accommodate a wide variety of test leads. Comes complete with all parts, including polished birch cabinet.

Individual decade sections of above can be purchased separately.



MODEL DC-1
SHIPPING WT. 4 LBS.

$16.50

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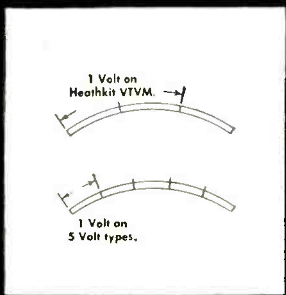
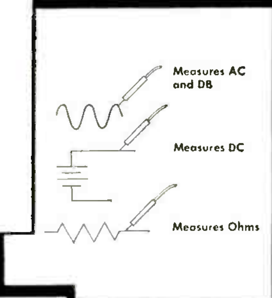
Heathkit VACUUM TUBE VOLTMETER KIT

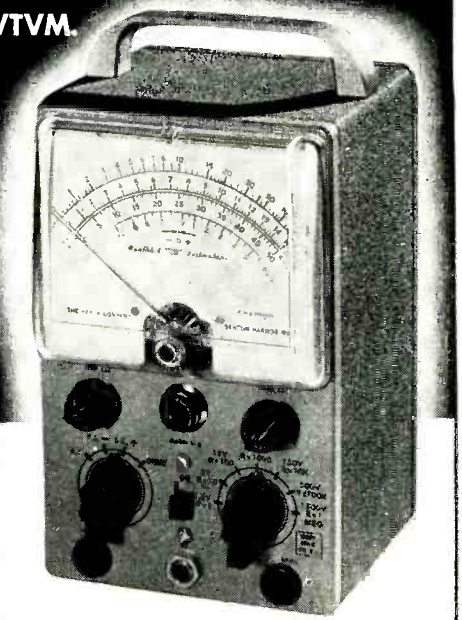
• NEW 1½ VOLT RANGE ON 1953 VTVM.

MODEL V-6
SHIPPING
WT., 7 LBS.

$24.50







- New 1½ volt low range gives over 2" of scale per volt instead of less than ¾" found on 5 volt range type.
- Increased accuracy due to expanded scales.
- New 1500 volt DC high range gives 50% greater coverage.
- Seven ranges in all. 1½, 5, 15, 50, 150, 500 and 1500 volts DC (1000 volts maximum AC only).
- Provides proper service ranges 150 volts for AC DC work and 500 volts for AC type service.
- High input impedance, 11 megohms minimizes circuit loading.
- Variety of accessory probe kits available.
- 1% precision resistors in multiplier circuits.
- 200 microampere Simpson meter.
- Center scale zero adjust.
- Transformer operated.
- Test leads included.
- New cabinet styling.
- Large, clearly marked meter scales indicate ohms, AC volts, DC volts and DB.

The 1953 Heathkit V-6 VTVM has improved ranges! The lowest range has been moved way down to 1.5V full scale. This gives 3½" of actual scale length for the 1.5V covered — *that's 2⅓ inches per volt!!* Now you can make your low level measurements faster and with greater accuracy.

And the upper range has been moved up. *Readings up to 1500V DC* can be readily made with new, improved VTVM — plus readings up to 1000V on AC. Higher ranges for extended use.

New vertical chassis mounting gives added chassis space for really easy wiring — no tight corners to worry about. Uses only highest quality components throughout. Simpson 200 microampere meter movement combined with 1% precision resistors in multiplier circuit insure highly accurate and dependable readings.

AC and DC voltage ranges are 0-1.5V-5V-15V-50V-150V-500V-1500V. (1000V max. reading on AC) — a total of seven ranges for convenient, accurate readings. Instrument also measures resistance from .1 ohm to over 1 billion ohms in seven handy ranges of RX1, X10, X100, X1000, X10K, X1 Meg., — all convenient multiples of 10 with no skips. Has Db scale in red for easy indentification.

New panel has tough *baked on enamel finish* for freedom from scratches and maximum durability. Modern styled, formed, compact cabinet with rounded edges and crackle finish is truly handsome.

Comprehensive, detailed instruction manual with step-by-step instructions, figures, pictorials, etc. makes assembly a cinch.

Be sure and look over the special accessory VTVM probes below — for added usefulness.

Heathkit R. F. PROBE KIT

SHIP. WT 1 LBS. No. 309 **$5.50**

Extends RF range of HEATHKIT 11 megohm VTVM to 250 megacycles ± 10%.

Heathkit 30,000 V. D.C. PROBE KIT

SHIP. WT. 2 LBS. No. 336 **$5.50**

Provides DC multiplication factor of 100 for any 11 megohm VTVM.

Heathkit PEAK TO PEAK VOLTAGE PROBE KIT

SHIP. WT. 2 LBS. No. 338 **$6.50**

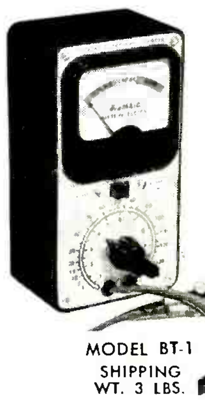
Reads on DC scale of any 11 megohm VTVM 5 kc to 5 megacycle range.

NEW *Heathkit* BATTERY TESTER KIT

The new Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three-color GOOD-WEAK-REPLACE scale that your customers can readily understand. Operation is extremely simple and merely requires that the leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for A or B battery types.

The Heathkit Battery Tester features compact assembly. An accurate meter movement and wire wound control mount in the portable, rugged plastic case.

Use the BT-1 to check portable radio batteries, hearing aid batteries, lantern batteries and photo flash gun batteries.

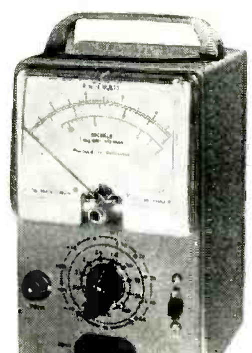


MODEL BT-1
SHIPPING
WT. 3 LBS.

$7.50

Heathkit AC VACUUM TUBE VOLTMETER KIT

A new AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Ten full scale ranges of .01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts RMS. 10 DB ranges from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 kc. Simpson 200 microampere meter with large plainly marked meter scales. Precision multiplier resistors. Two amplifier stages using miniature tubes. A unique bridge rectifier meter circuit and a clean layout of parts. Order the AV-2 today and become acquainted with the interesting possibilities offered by this instrument.



MODEL AV-2
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WT. 5 LBS.

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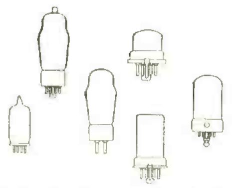
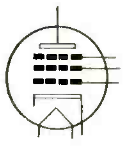
Heathkit TUBE CHECKER KIT



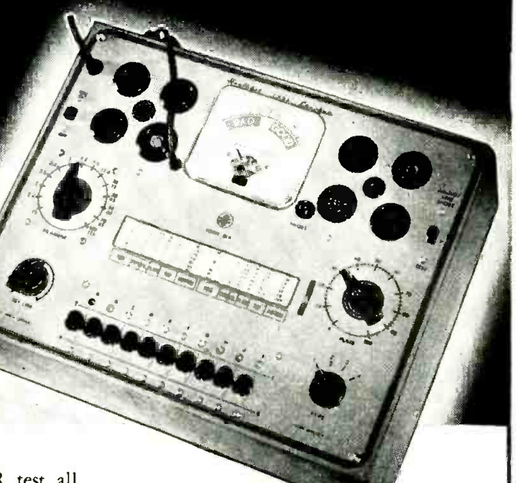
Checks 7, 8, 9 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, pilot lights.



Checks for opens, shorts, emission, filament and filament tap continuity.

MODEL TC-1
SHIPPING
WT. 12 LBS.

$29.50



- Beautiful counter type birch cabinet.
- 4½" Simpson 3 color meter.
- Simplified setup procedure.
- Built-in gear driven roll chart.
- Checks emission, shorted elements, open elements and continuity.
- Complete protection against obsolescence.
- Sockets for every modern tube.
- Blank for new types.
- Individual element switches.
- Contact type pilot light test socket.
- Line adjust control.

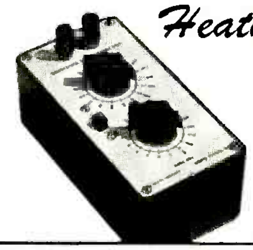
With the HEATHKIT TC-1 TUBE CHECKER test all types of tubes commonly encountered in AM-FM and TV receiver circuits. Test setup procedure is simplified, rapid and flexible. Tube quality is read directly on a beautiful 4½" Simpson three color BAD - ? - GOOD scale that your customers can readily understand. Panel sockets accommodate 4, 5, 6 and 7 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, a blank socket for new tubes and a contact type socket for quick checking of pilot lights. Built-in gear driven roll chart for instant reference. Neon short indicator, individual three position lever switch for each tube element, spring return test switch, line set control to compensate for supply voltage variations. At this low price, no service man need be without the advantages offered by the HEATHKIT TUBE CHECKER.

Heathkit TV PICTURE TUBE TEST ADAPTER

Use your HEATHKIT TUBE CHECKER with this new TV TEST ADAPTER to determine picture tube quality. Check for emission and shorts, independent of TV power supply. Consists of standard 12 pin TV tube socket, 4 feet of cable, octal socket connector and data sheet. Quickly prove TV picture tube condition to yourself and your customer.

No. 355
Ship. Wt. 1 lb.
$4.50

Heathkit RESISTANCE SUBSTITUTION BOX KIT



MODEL RS-1
SHIPPING
WT. 3 LBS.

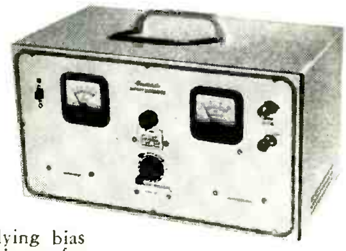
$5.50

NEW HEATHKIT RESISTANCE SUBSTITUTION BOX KIT provides switch selection of any single one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 megohms. This coverage available in 2 ranges in decades of 15, 22, 33, 47, 68 and 100. Housed in rugged plastic cabinet featuring new HEATHKIT universal type binding posts. The entire kit priced less than the retail value of the resistors alone.

Heathkit BATTERY ELIMINATOR KIT

A clean 6 volt d-c supply source is definitely required for successful automobile radio servicing. Has a continuously variable d-c output from 0 to 8 volts. It can be safely operated at a steady 10 ampere level and will deliver up to 15 amperes for intermittent periods. The voltage output terminals are completely isolated from the chassis to accommodate additional service applications such as supplying bias voltages or d-c substitution voltages for battery operated tube filament circuits.

The output of the Battery Eliminator is constantly monitored by a d-c voltmeter and a d-c ammeter. The circuit features an automatic overload relay of self resetting type. For additional protection, a panel mounting fuse is provided. Build this kit in a few hours and pocket a substantial savings.



MODEL BE-3
SHIPPING
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$24.50

Heathkit VIBRATOR TESTER KIT

Repair time is valuable, and the Heathkit Vibrator Tester will save you hours of work. Instantly tells the condition of the vibrator under test — and the check is thorough and complete. Checks vibrator for proper starting, and the easy-to-read meter indicates the quality of output on large BAD-GOOD scales. Tests both interrupter and selfrectifier types of vibrators. Five different sockets for checking hundreds of vibrators.

Operates from any battery eliminator capable of delivering continuously variable voltage from 4 - 6V at 4 amps. The Heathkit BE-3 Battery Eliminator is ideal for operating this kit.

Faulty vibrators can be spotted within seconds and you're free to go on to other service jobs.

MODEL VT-1
SHIPPING
WT. 7 LBS.

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... BENTON HARBOR 20, MICHIGAN

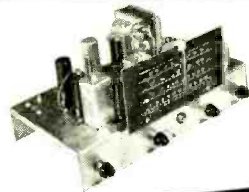
Heathkit SUPERHETERODYNE RECEIVER KITS

- High gain dual iron core tuned type IF transformers
- AC transformer operation for safety
- Continuously variable tone control
- Sturdy punched and plated steel chassis
- Ideal for custom installation
- Full AVC action
- Inverse feedback for improved frequency response
- Kit supplied with all necessary construction material except speaker and cabinet. (Available separately if desired).

6 tube all wave circuit. 3 ranges, continuous coverage 550 kc to over 20 megacycles, shipping wt. 11 lbs.

Model AR-1

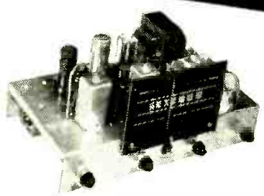
$23.50



5 tube broadcast band 550 to 1600 kc coverage, shipping wt. 11 lbs.

Model BR-1

$19.50



Two excellent radio receiver kits featuring clean design and open layout for simplified construction. Satisfy that urge to build your own radio receiver and select the model which meets your requirements. Both receivers feature continuously variable tone control, a radio phono switch and phono input and an AC receptacle for the phono motor. A six inch calibrated slide rule type dial with a 9 to 1 ratio vernier dial drive insures easy tuning.

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	Heathkit Intensifier Kit (O-8 only) No. 339 (1 lb.)	7.50	
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	Heathkit Scope Demodulator Probe Kit No. 337 (1 lb.)	4.50	
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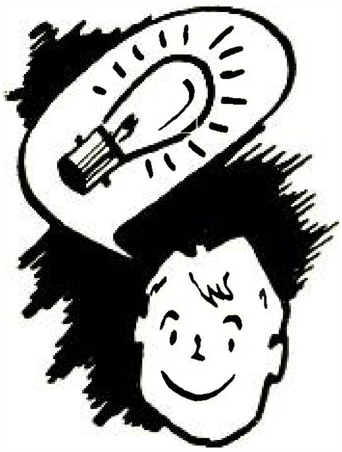


PETER AND THE PILOT LIGHT

By HARRY A. NICKERSON

"THAT'S a wreck of a heck of a set," said Peter.

Peter, is my right-hand man (or rather boy). He dusts off the chassis, makes repairs strictly as directed, handles the screwdriver and soldering iron almost as well as a girl set-assembler in a factory. He's also a pump, that pulls up my radio wisdom or lack of it and sometimes stores it in his small reservoir of a brain.

"Look at the dial—there's not even a pilot light," he continued. "How would you take care of that?"

Sure enough, there was no pilot-light socket or bulb. The set was an old a.c.-d.c. using .3-amp tubes; the line cord had been completely removed.

"Well," I said, somewhat cautiously, "you take down that radio catalog and look up pilot lamps." He did, and this is the rather lengthy list:

No.	Volts	Amperes
Screw-base tubular		
41	2.5	0.50
42	3.2	0.35
40	6.3	0.15
46	6.3	0.25
48	2.	0.06
292	2.9	0.17
Bayonet-base tubular		
43	2.5	0.50
44	6.3	0.25
45	3.2	0.35
49	2.	0.06
47	6.3	0.15
291	2.9	—
1490	3.2	0.16
Screw-base round		
50	6-8	0.20
Bayonet-base round		
51	6-8	1 c.p.
55	6-8	2 c.p.

"Now," said I, "In practice you seldom see any except 0.15 and possibly 0.25-ampere bayonet-base pilots that operate around 6 volts, but in the older sets there were mostly screw bases, and in one old set, a 4-tube a.c.-d.c. I repaired once, there was a plain 0.50-ampere pilot in series with the string of 0.3-amp. tubes."

"What is that No. 51 and 55 c.p.—certified public stuff?" queried Peter. I explained that years ago electric lamps were usually classified according to candle power.

Being in a generous mood, I explained further that the filament inside the glass bulb was supported near its base by a bit of colored glass called a *bead*. "You can usually depend on a brown bead to mean a 0.15-amp and a blue bead to mean a 0.25-amp filament, while a white bead very likely is a 0.50-amp type, although if you are replacing a pilot light, it is better to put in one of the same number as marked on the brass base, rather than depend on the bead."

Peter was not interested. "Let's get back to the set! I can see you putting in a 6-8-volt bulb on a 6-volt a.c. set where all the tubes are in parallel; you just put the pilot in shunt with the tube filaments; but how do you work this resistance line cord and pilot light business with a.c.-d.c.?"

"Well, Peter, I think I've explained how to calculate a line cord's resistance for you eleventeen times, but here goes again. You add up the total voltages of the tubes in series, subtract it from 117 (the line voltage) and divide what you have left by the amperage flowing through the string of tubes in series to find the resistance. Now if you want to put in a pilot, you put it in series with the tube filaments too, but to do it right you find the resistance of the pilot as shunted by a proper resistor and make the line resistance cord that much less ohms value. Suppose you have two 25-volt and two 6-volt tubes; they add up to 62 volts. Subtract 62 from 117 and you get 55 volts. That is the voltage drop. If you have 0.3-amp tubes, you divide the 55 by 0.3 and get about 180 ohms for your line cord. If you have a 6.8-volt, 0.15-amp pilot shunted by a 25-ohm resistor, as frequently is the case, their combined resistance in ohms will be found by figuring the resistance of the pilot as 6.8 divided by 0.15, or about 45 ohms; then since the resistance of two resistors in parallel is equal to their product divided by their sum,

$$\frac{45 \times 25}{45 + 25} = 16 \text{ ohms}$$

So you really ought to use a resistance line cord of 180 ohms less 16, or about 165 ohms value, with the pilot bulb and its shunt resistor also in the circuit."

"But," protested Pete, "if you say that the resistance of the pilot lamp is 45 ohms, and it burns 0.15 amp, why don't you just put a 45-ohm resistor across it? Then the lamp will get half the 0.3 amp current, and will light up O.K. without all the figuring. Why do they want to use a 25-ohm resistor?"

"There's a good reason," I told him. "Actually, if you did it your way, it would work out all right, at least for a while. But the pilot would be burning at full brightness, and would flare up every time you turned the set on. So they make the resistor take a little *more* than half the current. Then when the set is turned on, the light does not go up much higher than its rated voltage, and when the filaments warm up, it settles down to about 5 volts. That's bright enough, and the light lasts longer.

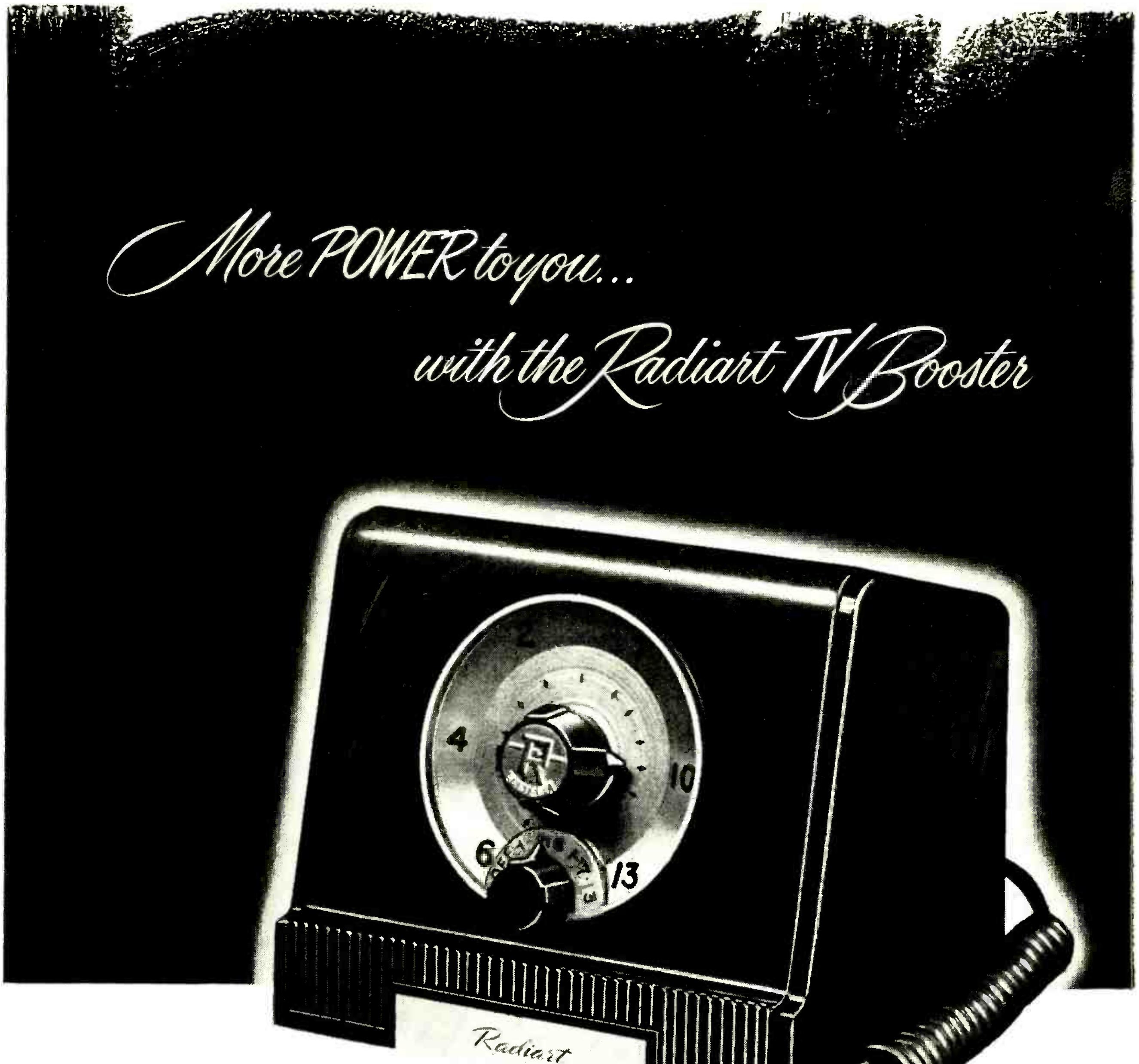
Besides, if it does burn out, the voltage across the 25-ohm resistor only goes up a volt or two, and the set works just as well as with the light in circuit. With 0.3-amp tubes, use about a 2-watt resistor in shunt with the pilot."

"I just noticed this old hunk o' junk doesn't have any glass dial or place for a pilot light to shine through," observed Peter.

"There are two ways at least you can fix that," I told him. "Hang a dial light from the top of the speaker, running two insulated wires through one of the holes on the edge of the cone frame, and let the light hang in the middle of the speaker cone. It will shine through the grille cloth and at least show that the set is turned on. Or drill a hole through the metal dial, put in a rubber grommet just big enough to let through a pilot light socket at the back of the dial, then push in a bayonet type No. 51 small round dialite, which will project a bit at the front of the dial."

"These jobs with the pilot hooked in with a ballast tube puzzle me. What do the numbers on ballast tubes mean?" asked Peter the inquisitive.

"They aren't uniform," I answered. "A lot of them are marked to kill three birds with one stone, but we have some General Electric ballasts that we have to look in the catalog to tell what they are. The three-bird kind might be marked K55B or BK55B. The K or BK means that a 0.15-amp filament lamp is to be used with the particular ballast tube; the 55 means the voltage drop (for a 0.3-amp tube string the hot resistance of the ballast would be around 180 ohms); and the B stands for the wiring of the resistances inside the tube; so you know what prongs of the ballast are to be connected to the tubes and which to the pilot. Most of the octal-base ballasts have the pilot connected across pins 7 and 8, and the resistance of the ballast in series with the tubes (besides that across 7 and 8) would be the resistance from pin 3 of the ballast to pin 8. The letter B stands for a single pilot, other letters stand for one or more pilots and their method of connection across pins of the ballast. I generally look it up in an old "Mye Technical Manual" which has a lot of good stuff in it that I never get around to memorizing. An L55B would be intended for use with a 0.25-amp; M55B probably with a 0.20-amp pilot. Sometimes a fourth wire in a line resistance cord provides a shunt for a pilot, but somehow or other I don't use that. Besides the low-voltage pilot lights, of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course some old sets used small 110-volt pilots. At least one old-time Colonial had them, and some very old RCA's. You still see some 4-tube a.c.-d.c. sets with two 110-volt (about 7-watt) lights of very small size in series. Usually these are cheap Jap bulbs that would have burned out very soon, if only one had been put across the line; but by putting them in series, they burn a little dim but last a lot longer. There's a 4-watt candelabra-base 117-volt pilot, too."

"Any other uses for these nawsty little bulbs?" asked Peter.

"Plenty of shops use them as fuses in the center-tap of the bench power supply. When there's a short somewhere they usually blow before something else does. Good thing for an experimenter, too, and almost necessary in the B-negative lead if you have a setup for working on battery radios. And laboratories use them where they need a nonlinear resistance. One of the original audio volume expanders used a couple of them across a special output transformer. With weak signals, they took a lot of current. As signals got stronger, they lit up a little and their resistance got higher, so more of the signal went through the voice coil. And some high-class audio oscillators stabilize their output by using a 117-volt pilot lamp in a cathode circuit, so it supplies negative feedback that rises with the output. And it seems to me I remember a Crosley that had a pilot lamp in series with a capacitor somewhere in an audio circuit as a rather successful tuning indicator—to show when the station was exactly tuned by the brightness—" "O.K., O.K." said Pete. "Boy, when you start letting your knowledge loose you can sure pilot on—"

Which was about the usual thanks I get from Peter. END

ALIGNMENT OF GATED-BEAM DISCRIMINATORS

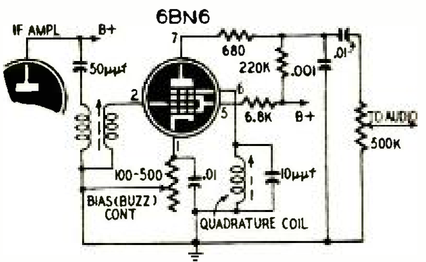

Fig. 1

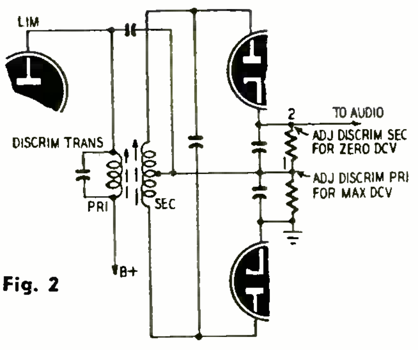

Fig. 2

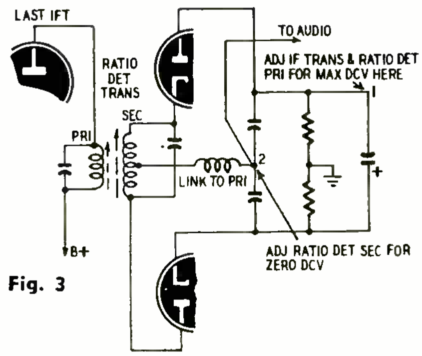

Fig. 3

By CHARLES ERWIN COHN

THE 6BN6 gated-beam FM detector (Fig. 1) has many advantages over older circuits, but there is one difficulty in using it. The Foster-Seeley discriminator (Fig. 2) and the ratio detector (Fig. 3) have circuit points where d.c. voltages can be measured to indicate correct alignment. This is the principle of the familiar "center-zero" tuning indicators such as the 6AL7-GT twin-beam tuning eye. The gated-beam circuit (Fig. 1) has no voltage which goes through zero at the correct tuning point, so the technician who doesn't have sweep equipment must align by ear. Here is a method that should give good accuracy of alignment without instruments.

The first step is to line up the i.f. stages. If these are not too far out of alignment merely tune the receiver away from any stations and peak the i.f. slugs for maximum interstation noise. Adjust the 6BN6 cathode rheostat for *maximum* noise during this step. If more than two or three turns of any screw is necessary, or if any screws refuse to peak at all, the circuit should be checked thoroughly.

The next step in the alignment is to adjust the quadrature coil on a station. In intercarrier TV receivers (where the 6BN6 is most often used) the 4.5-mc center frequency of the sound i.f. is the fixed separation between the sound and picture carriers. It is not affected by front-end tuning adjustments, so it is only necessary to tune the quadrature coil for best sound quality. In split-sound TV sets or FM receivers, the sound i.f. depends entirely on the oscillator frequency. Harmonics and subharmonics of the oscillator frequency and the FM carrier can beat together in the mixer and produce responses from a single station at several points on the dial. The trick is to tune the coil so that the best sound is obtained when the station is exactly in the middle of the i.f. response curve, and not somewhere off on the skirt.

First disable the quadrature coil by screwing its slug all the way in or out to throw it off frequency, or by grounding the 6BN6 quadrature grid (pin 6). This converts the circuit into an AM detector. Now tune across an FM station. There will be two areas of clear reception, with an area of distorted reception between them. (This is similar to the tuning pattern of the Fremodyne and other slope-detection FM sets: the areas of clear reception are on the skirts of the i.f. curve, with the area of distorted reception at the peak.) Tune the set to the exact center of the area of distorted reception and adjust the cathode rheostat for minimum sound.

If you previously placed a short across the quadrature coil, remove it at this point. Be very careful not to disturb the dial setting. Now tune the quadrature coil for clearest sound. If tuning the screw through its range has little or no effect on the sound, or if sound is clear over more than two or three turns, either the previous step was not done correctly, the dial setting has changed, or the quadrature coil is defective.

(If the first a.f. amplifier is a high-mu triode operated with grid-leak bias—the most common method in commercial receivers—the bias voltage can be used for alignment. *Use a v.t.v.m. for this measurement.* The grid-leak resistor is usually several megohms, and even a 20,000-ohms-per-volt instrument will load down the circuit on a range low enough to give a readable indication.—Editor)

If you are converting an older FM set to use the gated-beam circuit, the discriminator or ratio-detector transformer can be used as your quadrature coil. Open the can and remove the *primary* and all wires associated with it. The two windings can be told apart easily; the secondary is usually a bifilar winding of fairly heavy wire, while the primary is a smaller coil of much thinner wire. You can make sure by tracing the terminal connections. Be especially sure to remove all coupling capacitors or links between primary and secondary. If it is too difficult to remove the primary completely, it can be left in place, with all its leads disconnected. The quadrature circuit connections are made to each end of the secondary, which need not be disturbed. This applies to conventional transformers, with separate tuning slugs for each winding. If the one in your set has some special tuning arrangement, its usability must be determined by trial. If it won't work, you can always use one winding of an FM i.f. transformer, the other winding being removed or disconnected. END

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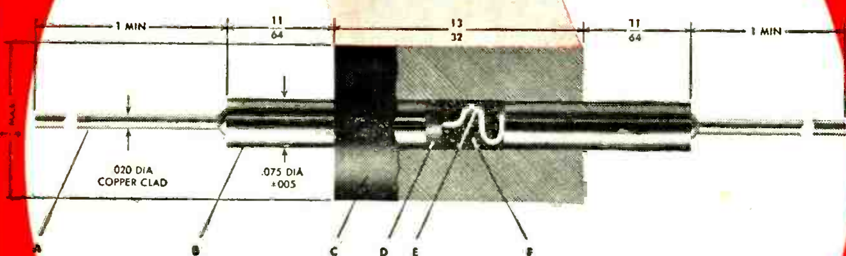

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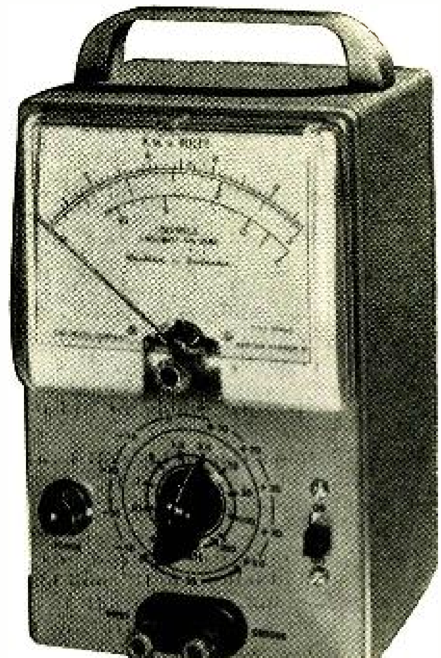


By RUFUS P. TURNER

WHAT is the signal voltage at the preamplifier grid? How much combined hum and noise is there at the output of an amplifier? Exactly how effective is a tuned filter? Is a bridge actually balanced to a perfect null? What is the output voltage of my microphone? How sensitive is my oscilloscope?

Questions like these are always coming up in the minds of audio experimenters. Such small voltages cannot be read accurately (if they can be seen at all) on the most sensitive a.c. range of a service type v.t.v.m.

Much serious audio experimentation and performance testing has been hampered by lack of an a.c. millivoltmeter. The professional audio engineer has access to ultra-sensitive instruments such as the Ballantine, Hewlett-Packard, Daven, and others. But these are priced way out of reach of most technicians and hobbyists. Some experimenters have built their own a.c. millivoltmeters; others have tried wide-band amplifiers ahead of ordinary v.t.v.m.'s, but results have not been eminently successful.

Now a sensitive, accurate instrument is available as an inexpensive kit. The Heathkit model AV-2 (shown above), permits measurements from 0.2 millivolt to 300 volts r.m.s. in 10 ranges: 0–10, 0–30, 0–100, and 0–300 millivolts; 0–1, 0–3, 0–10, 0–30, 0–100, and 0–300 volts. Ten decibel ranges (based on 1 milliwatt 600 ohms) cover the total spread from –52 to +52 dbm. This new instrument is a.c. operated, has only one selector control (the range switch), and requires no zero adjustment. Input impedance is 1 megohm at 1,000 cycles, and frequency response is plus or minus 1 db from 10 cycles to 50 kilocycles. Power consumption is only 10 watts. No elaborate equipment or methods are required for calibration—just one setting of the internal calibration control. The broad range of readings and extreme simplicity of this new audio meter recommend it for easy construction and for wide use in audio design, testing, and servicing.

Fig. 1 is the complete circuit of the instrument. The first stage is a 6AU6 high-gain pentode voltage amplifier. The second stage is a 6AT6 current amplifier. Following the current amplifier is a full-wave modified-bridge rectifier (two 1N34 germanium diodes with two 4,700-ohm resistors) which drives a 0–200 d.c. microammeter. The meter bridge circuit is also part of a feedback loop returning to the input-amplifier cathode. Feedback stabilizes operation of the circuit, making it substantially independent of variations in tube characteristics and supply voltages. It also improves the frequency response and linearizes the meter scale. With feedback in the circuit, response is proportional to the average value of the applied signal voltage, a desirable feature in an audio v.t.v.m.

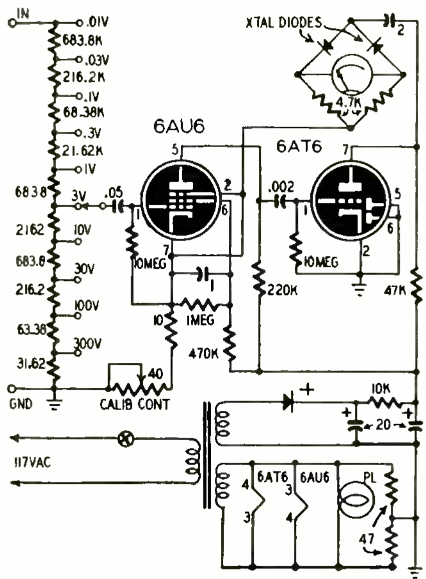


Fig. 1—Schematic of the AV-2 v.t.v.m.

Operating voltages are furnished by a miniature a.c. power supply. For compactness and cool operation, a selenium rectifier is used. A resistance-capacitance filter smooths out the d.c.

The single calibration control is a 40-ohm potentiometer in the 6AU6 cathode circuit. This control is mounted inside the case, since it requires adjustment only when the instrument is first calibrated or when replacing tubes. The instrument is only $7\frac{3}{8}$ inches high, $4\frac{11}{16}$ inches wide, and $4\frac{1}{8}$ inches deep, and weighs slightly over 3 pounds. The 4-inch rectangular meter has wide scale divisions for high readability.

Although the components are mounted close together, there is no trouble from stray coupling and feedback if ordinary care is used in mounting and wiring. A box behind the meter shields it from the under-chassis components and wiring.

Calibration is very simple. Apply an accurately known a.c. voltage to the input terminals after the instrument has had a 5- to 10-minute warmup. This voltage should be as near as possible to the top of one of the ranges. Adjust the calibration control to bring the meter pointer exactly to the proper reading on the scale. This automatically calibrates the instrument on all ranges, since precision resistors are employed in range switching. The frequency of the calibrating voltage is not important, although most experimenters will probably find it convenient to use the power-line frequency. A small transformer with any secondary rating up to about 250 volts, and an accurate a.c. voltmeter are all you need. The power line may be used directly for calibrating the meter on its 300-volt range.

There is no substitute for an audio millivoltmeter of this type on the technician's bench. Amplifiers, loudspeakers, transformers, chokes, filters, microphones, pickups, and a host of other audio components and systems may be checked for performance at conventional low signal levels. Resistors and capacitors may be checked for noise in operating circuits. END

TRANSMISSION LINES SIMPLIFIED

Like one-way streets, they're fine if they take you where you're going—but watch out if you have to turn around!

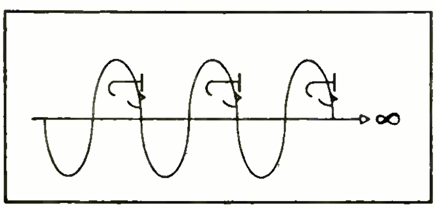
By HECTOR E. FRENCH

IT'S usually easy enough to take electrical energy from one place to another—all that's needed at low frequencies is some wire for a conductor, and Ohm's law to figure out what is going to happen. But at high frequencies, Ohm's law seems to be a failure. The voltages and currents do all sorts of queer things along the line, and we don't find it easy to visualize what's really happening.

But it's really not too difficult. Watch.

First, imagine a transmission line that reaches out to infinity,

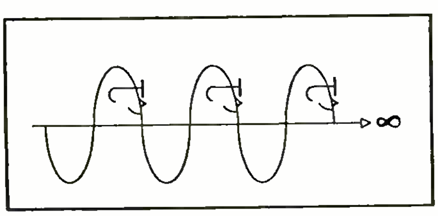
and apply a signal to the line.



The ratio of the voltage to the current is the *characteristic impedance* of the line,

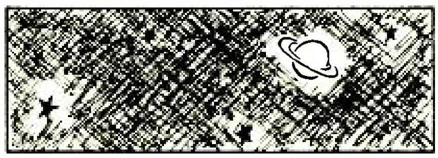
CHARACTERISTIC IMPEDANCE
IS
VOLTAGE ÷ CURRENT

and if the line has no losses, both the voltage and the current can keep going forever



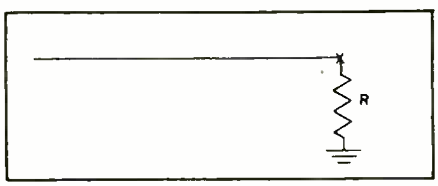
without dying out. And no matter how far or how long the signal travels, it will continue to see ahead of it the same identical value of characteristic impedance. Which is a monotonous situation indeed.

So to break up the monotony, imagine that you're located somewhere out in space along the line a couple of million miles ahead of the oncoming signal



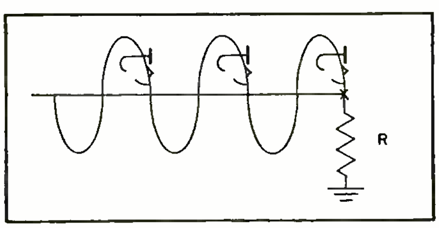
and cut the line.

Now connect a resistance between the cut end of the line and ground, with the value of the resistance exactly equal to the characteristic impedance of the transmission line.

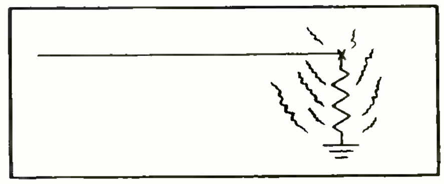


(Don't ask where the ground comes from—it's like learning to play chess.)

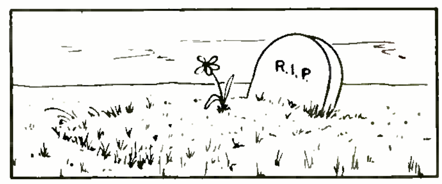
Not too many seconds later, the signal will come whooping up the line at just a little less than the speed of light, and will run up against the resistance.



To the approaching signal, the resistance will appear to be just a continuation of the line, because the terminating resistance has exactly the same value as the characteristic impedance of the line. So all the signal energy flows down back into the ground through the resistance and is dissipated as heat.



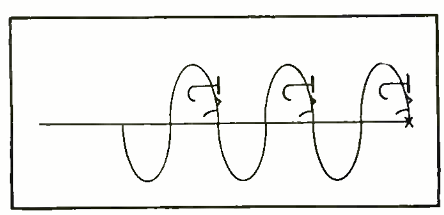
And that's all there is to that side of the picture.



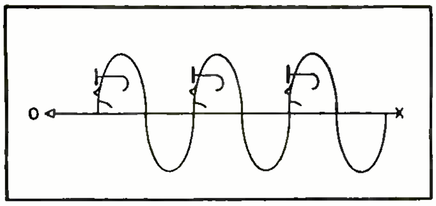
This is what is called a *properly terminated transmission line*. All the energy pumped into one end of the line goes directly through the load at the other end, assuming no losses in the line. The only requirement is that the load impedance be the same as the line's characteristic impedance. A good example is a transmitting antenna whose feeders are correctly matched to the radiating element, or a receiving antenna whose feeders are correctly matched to the receiver.

But this isn't the only possible way to terminate the line. What if the line were cut and no resistance load put on at all?

Then when the signal gets to the unloaded end of the line it can't go any farther.

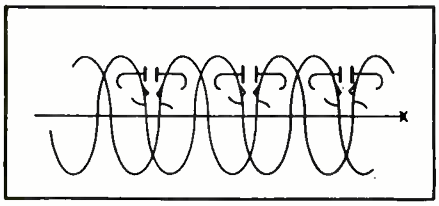


The only conductor available is the one that brought the signal away out here to the end of the line—so the transmitted signal does the only thing it can do. It promptly turns around and goes back along the same line, like a



reflection—back toward the beginning of the line.

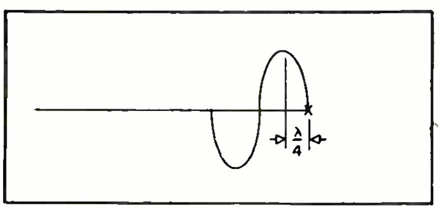
The trouble is, this reflected signal is on the same line at the same time as the transmitted signal. And the combination



starts to look like a very confusing situation.

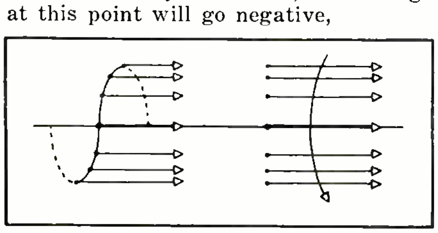
But it's not as complicated as it looks. To see how easily the system can be analyzed, watch what happens to the voltage at the end of the line. This end is completely open. Nothing there at all to hold down the voltage. So, *at the end of an open-circuited transmission line, the voltage is a maximum.* This shouldn't be so very difficult to remember. Why shouldn't the voltage at the end of an open line be at a maximum—what is there to stop it?

To analyze another point on the same line, simply back up from the end of the line by a quarter wave

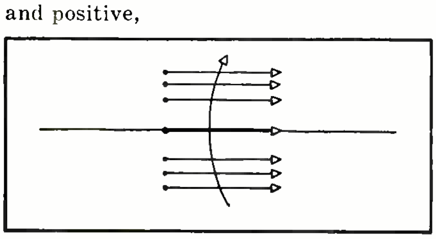


and watch what happens to the voltage at this point as the transmitted signal goes by.

Just like any other a.c., the voltage at this point will go negative,

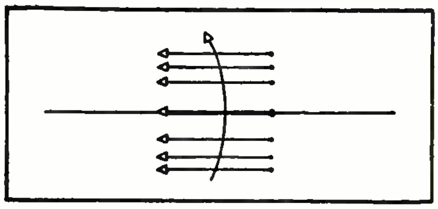


and positive,

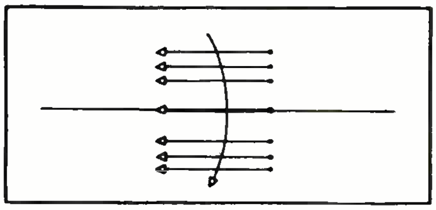


and keep on repeating the cycle as long as there is any transmitted signal.

Now watch what is happening to the reflected voltage at the same point. This reflected voltage will be going through the same cycle as the transmitted voltage, obviously enough. But the reflected voltage is going positive

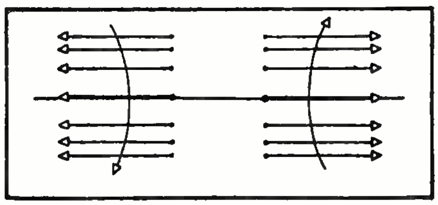


when the transmitted voltage is going negative, and the reflected voltage is going negative

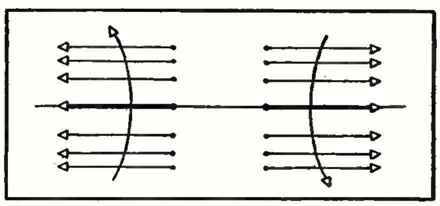


when the transmitted voltage is going positive!

So whether the combined voltages at the quarter-wave point are considered like this:



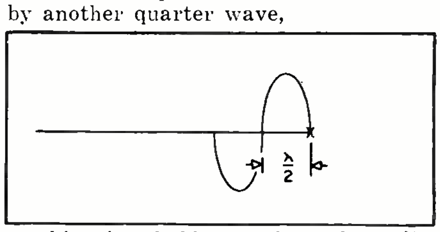
or this:



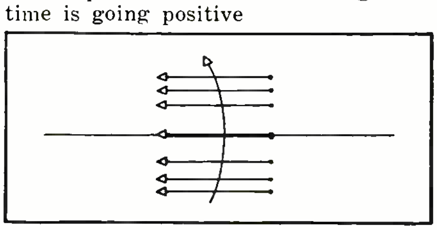
the two voltages *will always be in opposition* and will balance out to zero. Therefore, *at a point a quarter wave back from the end of an open-circuited transmission line the voltage is always zero.*

This surely differs from a conventional a.c. circuit—here is a point along a hot line where there is zero voltage!

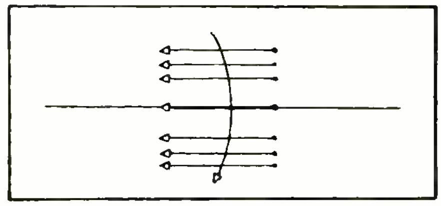
Now back up from the end of the line by another quarter wave,



(making it a half wave from the end), and watch what happens to the voltage at this point. The reflected voltage this time is going positive

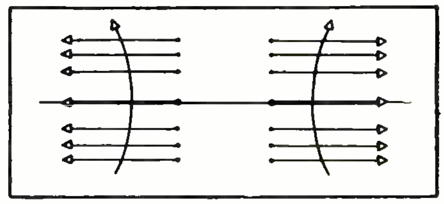


when the transmitted voltage is going positive, and the reflected voltage is going negative



when the transmitted voltage is going negative.

So whether we look at the combination like this



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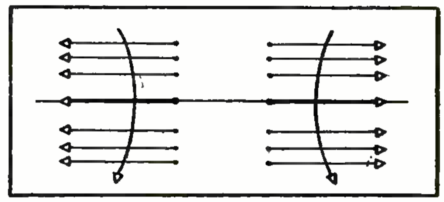
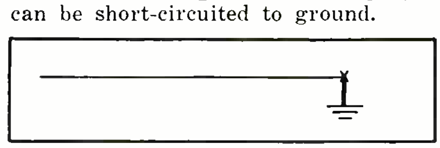


the two signals *will always be aiding* each other. Therefore, *a half wave back from the end of an open circuited transmission line the voltage is a maximum.* Just the same as it was at the very end of the line.

If these measurements are repeated at quarter-wave intervals along the line, the same sequence repeats, giving points of maximum voltage along the line with points of zero voltage between them. This is known as a system of standing waves, and it is possible to make a general statement for the whole system: *with an open-circuited transmission line, at all even-numbered quarter waves from the end the voltage is a maximum, at all odd-numbered quarter waves the voltage is zero.* Plus, of course, the very end of the line, where the voltage is a maximum also.

Now there's still one more thing that can be done with this transmission line. Instead of leaving the cut end open, it can be short-circuited to ground.

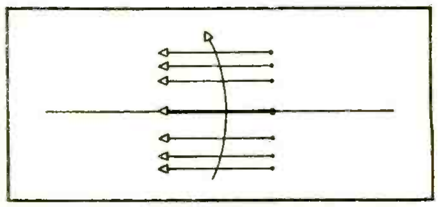


Don't ask where I got the ground this time, either—it's still like learning to play chess.

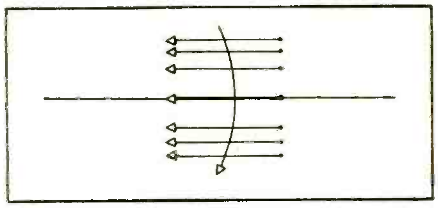
There's no problem at all this time with figuring out the voltage at the end of the line. There's a dead short to ground, so, *at the end of a short-circuited transmission line the voltage is zero.*

Now back up from the end of this short-circuited transmission line by a quarter wave, just as was done before. At this point, both a transmitted voltage and a reflected voltage will be

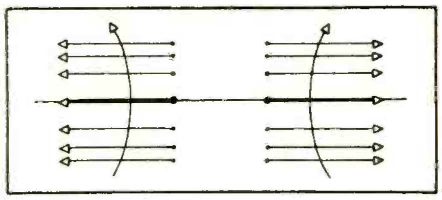
present, just as in the open-circuited case. But this time the reflected voltage is going positive



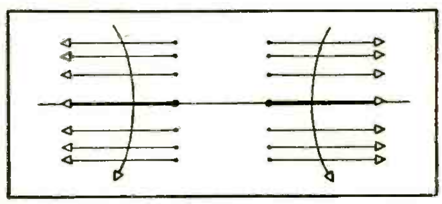
when the transmitted voltage is going positive, and the reflected voltage is going negative



when the transmitted voltage is going negative. So whether we look at the combination of voltages at this point like this:

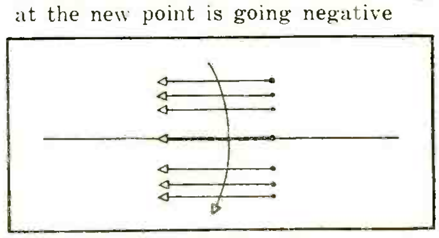


or this:

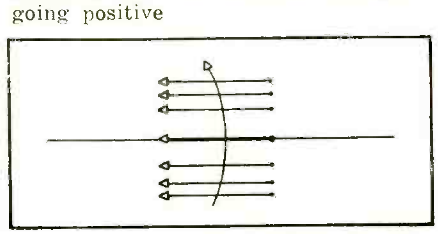


the two signals will always be aiding each other. Therefore, *a quarter wave back from the end of a short-circuited transmission line the voltage is a maximum.*

Now back up along the line from the end by another quarter wavelength, just as before. This time the reflected voltage at the new point is going negative



when the transmitted voltage is going positive, and the reflected voltage is going positive



when the transmitted voltage is going negative. So whether the combination is viewed like this:

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This is not a contest . . . nothing extra to buy. Just watch for the 1,500,000th WALSCO antenna. Your jobber may have the lucky antenna *right* now. It will come in a *regular carton*, with no special markings.

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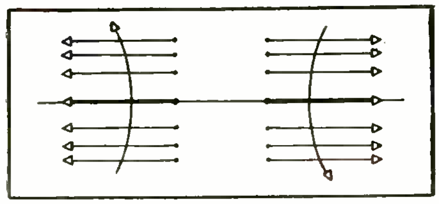
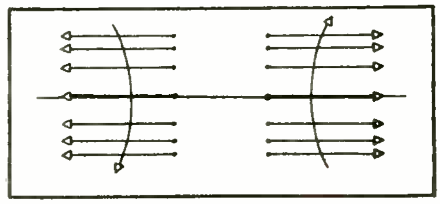


or this:



the two signals will always be in opposition and balance out to zero. Therefore, *a half wave back from the end of a short-circuited transmission line the voltage is zero.*

(You may ask: "Why is *any* signal reflected from a grounded-end transmission line? It is easy to understand reflection from an open-ended line—the electrons pile up and—having nowhere else to go—come back along the line. But why doesn't the signal just run into ground and disappear?"

The answer is easy. We have very large currents at the end of the line—the type we might expect at a short-circuit. These create a tremendous magnetic field around the line. When the signal has gone, the field collapses, producing a current that travels back along the line.)

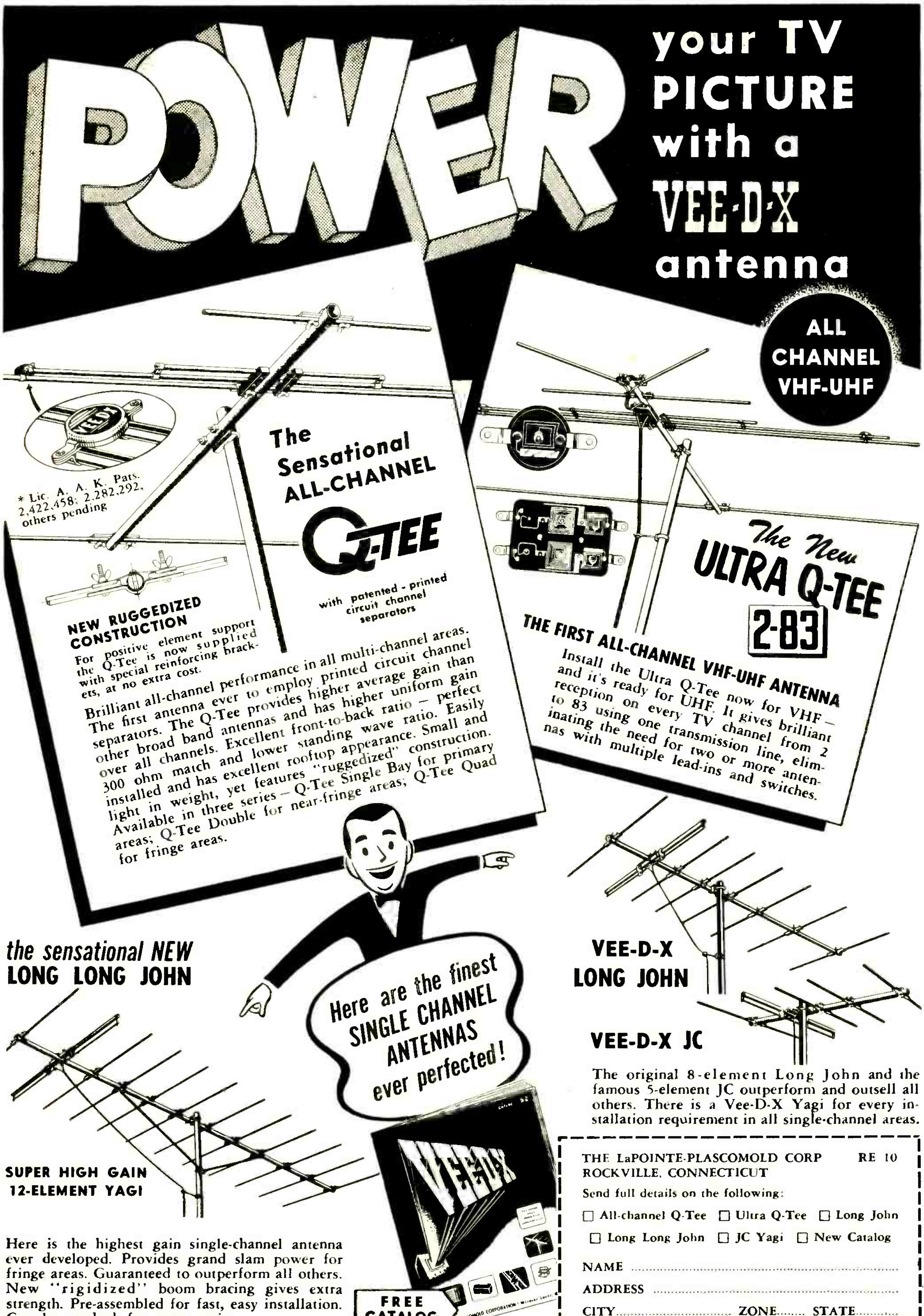
With this short-circuited transmission line, a system of standing waves is found, similar to the open-circuited transmission line. And a similar general statement can be made: *with a short-circuited transmission line, at all even-numbered quarter waves from the end the voltage is zero, at all odd-numbered quarter waves the voltage is a maximum.* Plus, of course, the very end of the line where the voltage is zero.

The process for current is identical with that for the voltage, so there is no purpose to repeating the same details over again. The whole business can be put in one simple table:

VOLTAGE AT	OPEN CIRCUITED	SHORT CIRCUITED
ODD QUARTER WAVES	ZERO	MAXIMUM
EVEN QUARTER WAVES	MAXIMUM	ZERO
CURRENT AT		
ODD QUARTER WAVES	MAXIMUM	ZERO
EVEN QUARTER WAVES	ZERO	MAXIMUM

That's all there is to getting a picture of what is happening along a transmission line. When properly terminated, all the energy in the line goes into the load with no reflection. But when the line is either open-circuited or short-circuited, a reflected signal is present which aids the transmitted signal at some points, and opposes the transmitted signal at other points.

This reflected voltage travels all the way back to the generator at the beginning of the line—but that's a complete story in itself, for another time. END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☐ Long Long John ☐ JC Yagi ☐ New Catalog
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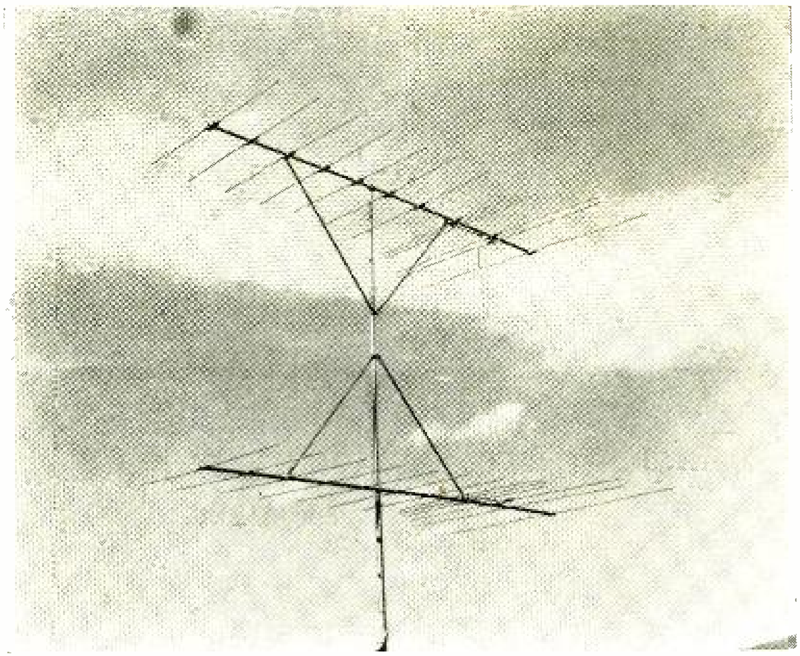

FUTURAMIC ANTENNA

has Yagi gain and directivity plus multi-channel coverage

By HAROLD HARRIS* and HARRY GREENBERG**

THE recent end of the television freeze means that hundreds of new v.h.f. stations will be going on the air in the near future. It also means that 30 of the present stations will have to change channels. One of the many problems created by this change and expansion is the need for new types of antennas.

In the past two years the Yagi has become one of the most popular fringe-area antennas. Despite its high gain and excellent directivity it has one serious limitation. The Yagi will work on only one or possibly two channels. Wherever existing channels are changed or new v.h.f. stations are added, present Yagi antennas will have to be augmented or replaced. All new installations will have to provide for future channels.

What is needed is an antenna with the outstanding gain, directivity, and structural qualities of the Yagi plus the ability to cover a number of channels. This article explains the theory and operation of a commercial broadband Yagi antenna, the Channel Master *Futuramic*.

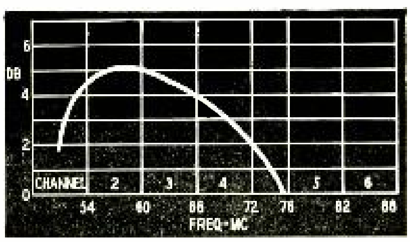

Fig. 1—Folded dipole-*reflector* response.

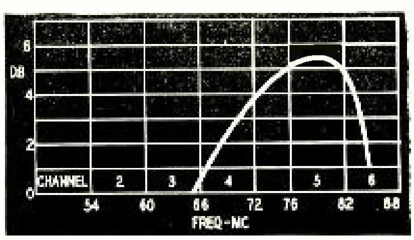

Fig. 2—Folded dipole-*director* response.

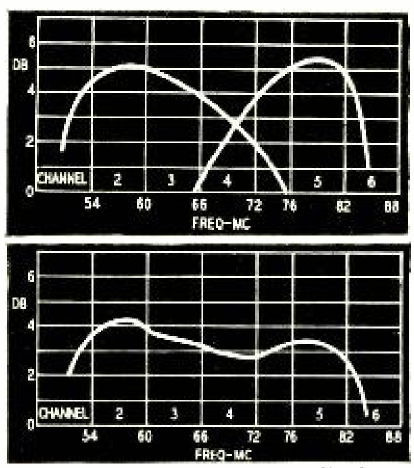

Fig. 3-a (above)—Matched dipole-*reflector* (low end) and dipole-*director* (high end). Fig. 3-b (below)—Overall response of the combination.

Parasitic antennas

It will be helpful to review some of the characteristics of parasitic antenna systems. The gain curve of a folded dipole *with reflector* cut for a specific channel is shown in Fig. 1. Its response falls off sharply at the low end, but the high-frequency end extends over two additional channels with gradually diminishing response. A folded dipole *with director* (Fig. 2) has slightly higher gain than the reflector type, but differs in two important respects: First, its bandwidth is not as great; and second, its response drops sharply *at the high end, and gradually at the low end.*

Fig. 3 shows how these characteristics are used in the Futuramic antenna. A folded dipole *and reflector* cut for channel 2 is combined with a folded dipole and *director* cut for channel 5. The opposite slopes of the two antennas in the center of the band (3-a) give uniform sensitivity over channels 2, 3, 4, and 5 (3-b). The same principle enables two dipoles of proper length to cover the entire high band (channels 7–13).

Adding directivity

The next step was to make the combination unidirectional. Fig. 4 illustrates the basic principle used in the Futuramic antenna. Dipoles A and B are cut respectively for the low and high ends of the band to be covered. They are spaced 45 electrical degrees (one-eighth wavelength) at the mid-band frequency, and are connected by a section of transmission line 135 degrees (three-eighths wavelength) long.

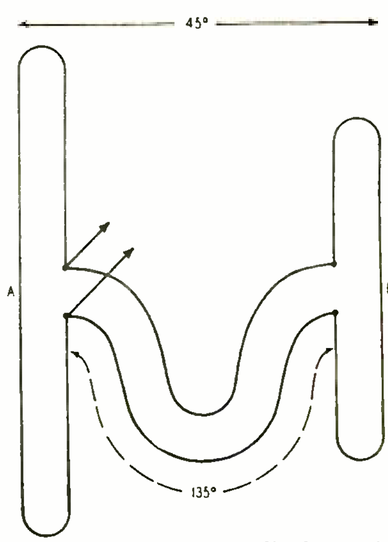

Fig. 4—Basic Futuramic dipole spacing.

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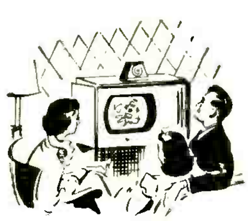

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The antenna feed points are at the terminals of dipole A.

A signal from the left hits dipole B through space 45 degrees *after* it hits dipole A. This signal is then fed back from B through the line section, which shifts the phase an additional 135 degrees. The feedback signal reaches dipole A 180 degrees out of phase with the original signal. Thus signals from the left cancel at the feed point. (Fig.5-a)

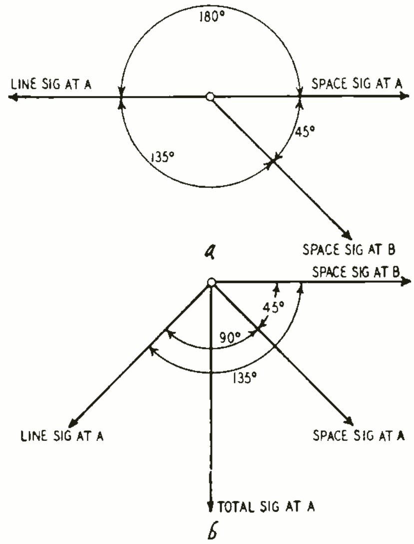


Fig. 5—Phase relationships in spaced dipole system: (a) signals coming from left; (b) signals arriving from right.

A signal from the right hits dipole B first. The space signal hits dipole A 45 degrees later, but the signal traveling through the line from B to A is shifted 135 degrees. As a result, two equal signals reach A 90 degrees (135 minus 45) apart, and their sum is 1.4 times

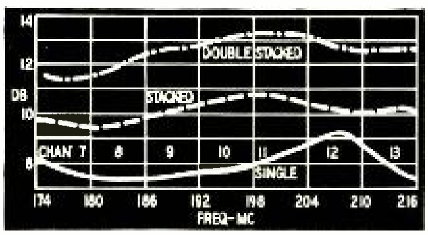


Fig. 6—Response of high-band type.

the original signal. (Fig 5-b.) The basic two-dipole network thus has a 40% voltage gain (3 db) forward and rejects signals from the rear.

In the commercial models, the trans-

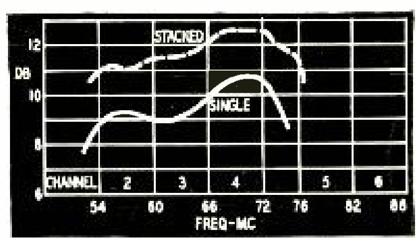


Fig. 7—One- and two-bay response curves for 3-channel Futuramic.

mission-line section is actually 60 degrees (one-sixth wavelength) long, with the feed points 45 degrees from dipole B. This compensates for the inductive signals, and for the capacitive reactance reactance of dipole A on higher-channel of dipole B on lower-channel signals.

Increasing forward gain

Fig. 3-b shows that the natural sensitivity of the two-dipole system is greatest at the low-frequency end of the band. A single reflector element (behind the low-frequency dipole) raises the forward gain at the low end about 4 db. Additional reflectors do not give any substantial increase in sensitivity. Seven director elements provide high gain at the high end.

A single Futuramic covers the entire

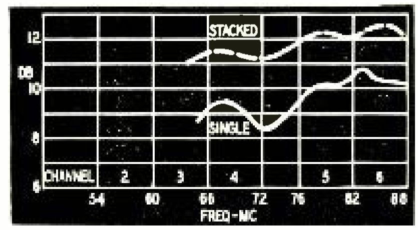


Fig. 8—One- and two-bay response of another 3-channel low-band Futuramic.

high band (channels 7–13) and models were designed for covering either three or four channels of the low band. Gain curves for single and stacked antennas are shown in Figs. 6 through 10. In these figures, the terms stacked and double-stacked refer to 2-bay and 4-bay antennas, respectively. The high-band antenna can be stacked in four bays.

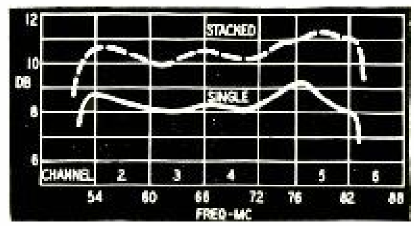


Fig. 9—Response of Futuramic 4-channel low-band model with 1 and 2 bays.

Note that antenna gain increases with frequency. This offsets the higher losses in the lead-in, and tends to keep the voltage fed to the receiver constant for all channels in the band.

The significant stacking gains were achieved by using the Channel Master Z-Match system. Most television antennas are stacked with ⅜-inch tubing, spaced 3 inches to give a characteristic

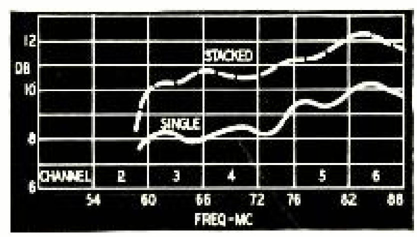


Fig. 10—Another 4-channel model.

impedance of 325 ohms. Since Yagi antennas are stacked a half-wave apart, the stacking bars function as a pair of quarter-wave transformers, transforming the impedance of each antenna to a different value at the feed points in the center of the bar. The formula for the transformer is

$Z_M = \sqrt{Z_i \times Z_o}$, where Z_M is the impedance of the matching section (stacking bars), Z_i is the input (antenna) impedance, and Z_o is the output (line) impedance.

TRIO ANNOUNCES SENSATIONAL NEW ZIG-ZAG ANTENNA

Patent Pending

Higher Gain than any Yagi!
Plus
All-Channel VHF Performance!

Here's the greatest advance in TV antennas since TRIO'S introduction of the dual channel yagi! The sensational new TRIO ZIG-ZAG antenna is basically a multiple element yagi type antenna on each channel, yet one 2-bay antenna — and in some models a single bay antenna — covers all VHF channels!

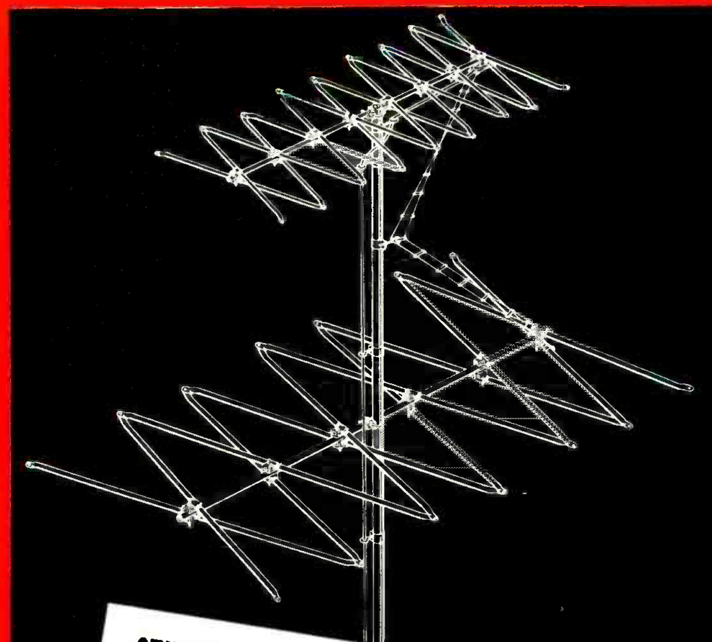
This sensational antenna has sharper directivity and higher front-to-back ratio. It provides snow-free pictures, and fade-free sound even in the most remote fringe areas.

Tremendous forward gain is accomplished without long, bulky, arrays that operate on only one channel. With the new fringe area model ZIG-ZAG antenna, one bay provides tremendous gain on all low channels, 2 thru 6, and the other bay provides similar high gain on channels 7 thru 13.

HOW THIS AMAZING ANTENNA WORKS

Trio ZIG-ZAG antennas utilize a new principle whereby an array is composed of a series of elements, one or more of which is resonant on any one channel while the remaining elements, which are non-resonant on that channel, provide parasitic voltages having the proper phase relative to the direct voltage. These act as very efficient directors and reflectors. All elements are directly connected to the feed-line.

The various models, listed below, are designed to provide a simple installation for all areas, from metropolitan to extreme fringe. Two bay models, like the single bay models, are operated with a single 300 ohm lead-in to the set, with less than a 3:1 standing wave ratio.



STURDY, VIBRATION-PROOF CONSTRUCTION

Rugged strength is designed into all models. Antenna is shipped with all hardware mounted on the boom with the exception of the mast clamp. Complete assembly consists only of matching color-coded elements to the color-coded boom and tightening nuts which furnish clamping action. Complete assembly is accomplished in minutes.

8 MODELS FROM WHICH TO CHOOSE:

ZZ12L

ZZ16H

FOR EXTREME FRINGE RECEPTION — ZZ16H provides over 14 DB voltage gain as compared with a resonant reference dipole on Channels 7 thru 13; and ZZ12L provides gain of 12 to 14 DB on Channels 2 thru 6. Gain of the ZZ12L is 12 DB on Channels 2 and 3 and is 14 on Channels 4, 5 and 6. These models have narrowest forward lobe and highest front-to-back ratio and should be used in areas where co-channel interference is a problem.

ZZ8L

ZZ8H

FOR NORMAL FRINGE RECEPTION — Where maximum gain is not necessary, these models are ideal. The ZZ8H for Channels 7 thru 13 and the ZZ8L for Channels 2 thru 6. Voltage gain is 9 DB on Channels 2 and 3 and 11 DB on Channels 4 thru 13. These models have patterns comparable to a well designed multi-element single channel yagi.

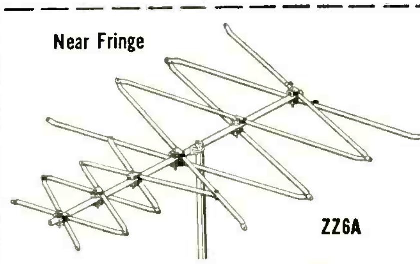
ZZ6L

ZZ6H

WRITE FOR CATALOG

FOR NEAR FRINGE RECEPTION — These models provide a voltage gain of 8 to 9 DB on Channels 2 thru 13. These models have pattern and gain comparable to a cut-to-channel yagi. ZZ6L covers Channels 2 thru 6. ZZ6H covers Channels 7 thru 13.

Near Fringe



ZZ6A

Suburban

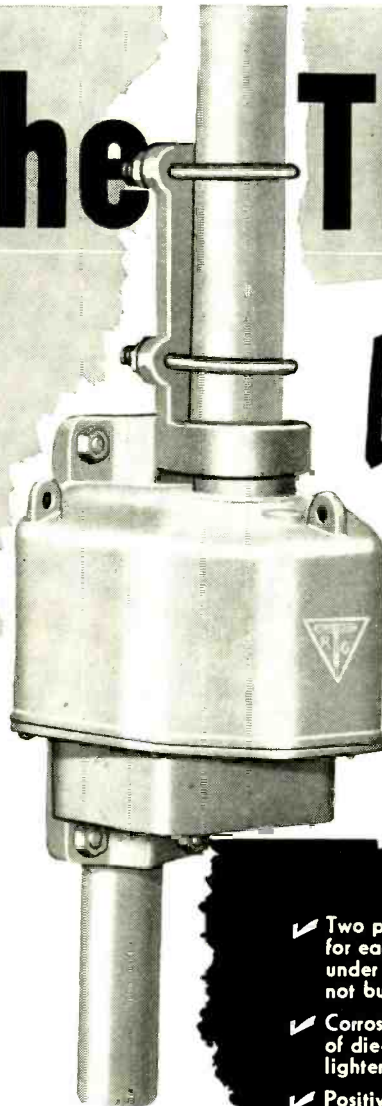
ZZ4A

SINGLE BAY ALL-CHANNEL RECEPTION — Model ZZ4A is a single bay antenna providing adequate gain and directivity on all channels, 2 thru 13, in suburban areas. Model ZZ6A is also an all-channel single bay antenna providing greater gain for near fringe use.

TRIO

TRIO MANUFACTURING COMPANY • GRIGGSVILLE, ILLINOIS

The TRIO ROTATOR



Easy to Sell!

It's easy to sell a product with as many plus features to talk about as the TRIO ROTATOR. In design, in construction, appearance; it is by far the outstanding TV antenna rotator in the market today!

Stays Sold!

In addition to providing a powerful sales story, the features listed below are your assurance of complete customer satisfaction: Assurance that the TRIO ROTATOR will give dependable performance year in and year out — in all kinds of weather!

- Two powerful 24 volt motors used — one for each direction of rotation. Each motor under load only fraction of time — will not burn out!
- Corrosion resisting, weatherproof housing of die-cast aluminum for greater strength, lighter weight, perfect alignment of parts!
- Positive electrical stops at ends of 360° rotation prevent damaging or twisting of leads!
- Will support heavy TV arrays — even in 80 MPH winds!
- Permanently lubricated with special grease that functions perfectly in high and low temperature extremes!
- Ball-bearing end thrusts on all shafts, including motor! Main shaft vertical load carried on large oversized "Oilite" self-lubricating bearing!
- All motors, shafts and gears mounted on a rugged, one-piece casting for true alignment and longer life!
- 11/16" diameter tool steel main shaft and mast holder will withstand 4500 inch pounds bending moment!
- Rotator and mast holder fits any pipe size up to 2" OD!
- Precision built to extremely close tolerances!

Smartly Styled

DIRECTION INDICATOR

The TRIO Direction Indicator is housed in a sturdy plastic cabinet of graceful lines. It is a beautiful instrument that will blend harmoniously with any furniture style.

Utmost ease in selecting the desired antenna direction is provided by a new "finger tip" control that operates at a light touch and the easy-to-read dial face that clearly and instantly indicates the exact antenna position.

FULLY TESTED BEFORE SHIPMENT

Each TRIO ROTATOR is thoroughly factory tested to the equivalent of 3 months of constant operation. This, plus an additional torque test guarantees each unit to be perfect in every detail of assembly.

The TRIO ROTATOR's sound design and construction has been proven by three years of extensive field testing under every extreme of weather.

TRIO *Manufacturing Company*
GRIGGSVILLE, ILLINOIS

When two 300-ohm Yagis are stacked with 325-ohm matching transformers, each Yagi is transformed to 350 ohms at the feed points. The two 350-ohm impedances in parallel equal 175 ohms, a mismatch of almost two to one (see Fig. 11-a). In the Z-Match system, the center bar is taken out of the rear folded

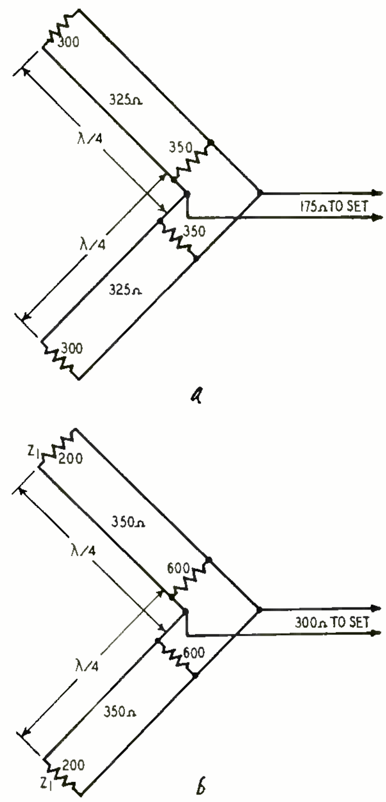
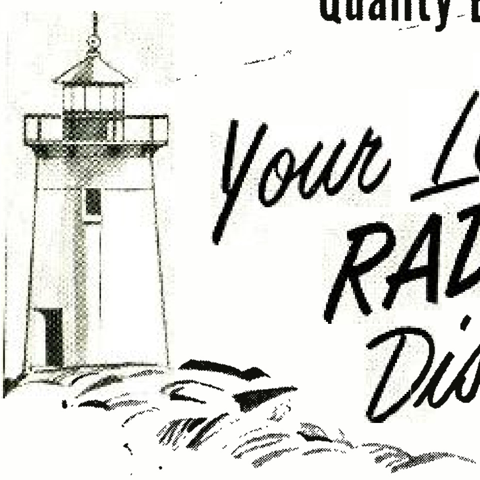


Fig. 11—Yagi stacking methods: (a) Conventional stacking with 300-ohm antennas and 325-ohm bars. (b) Channel Master Match system, using 200-ohm antennas and 350-ohm bars.

dipole, lowering the impedance of the array to 200 ohms. Stacking bars (quarter-wave transformers) are spaced to have 350 ohms impedance. The 200-ohm antennas are raised to 600 ohms each at the feed points. The two 600-ohm impedances in parallel total 300 ohms to match the transmission line (Fig. 11-b).

END

"We've been getting a lot of snow on our picture!"



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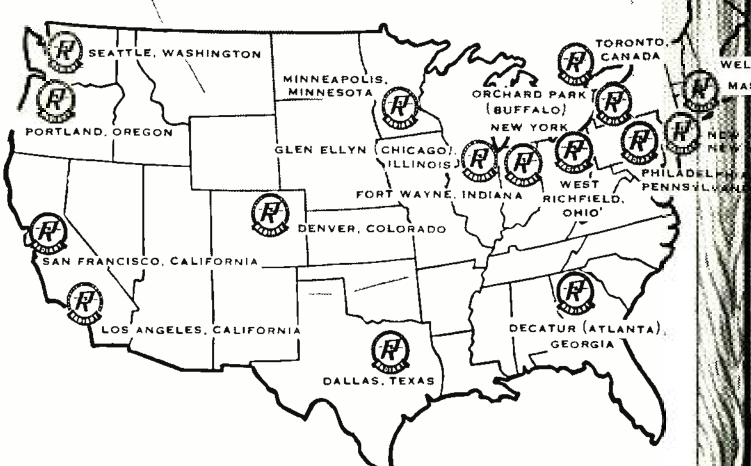
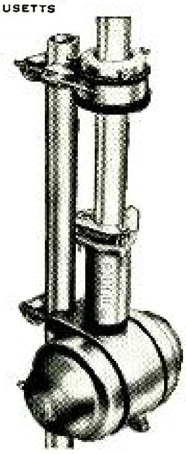


BUY OF THE MONTH



The CDR ROTOR... model TR-12 offers all you could ask for in an antenna turning device! It will support and turn with ease any TV antenna array...and has a handsome modern design plastic cabinet with meter control dial and finger-tip lever. Other features include speedy installation with no loose parts to assemble... 4 wire cable installation... quick mounting antenna mast collet and is dependable and trouble free in operation. See them at your jobber or write for literature.

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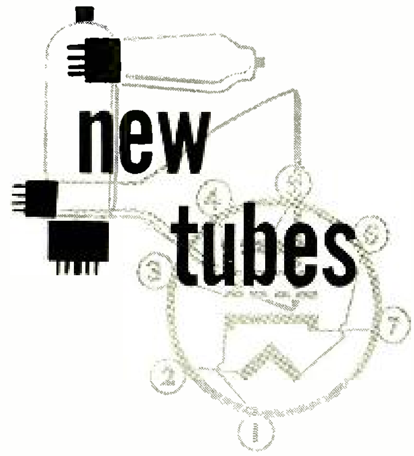


General Electric type GL-5965 is a miniature twin triode for use in digital computers. It is the companion tube to the GL-5844, which is used on a large scale in industrial computing devices.

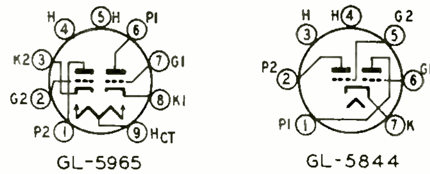
Both types have a special heater-cathode construction designed for dependability under frequent "on-off" switching conditions. The cathodes will maintain their emission capabilities even after long periods of operation under cutoff conditions.

Each triode section has high zero-bias plate current and a sharp cutoff characteristic. In addition, the cutoff characteristics of the two sections are closely matched. The GL-5965 has about twice the output of the GL-5844.

Average characteristics for each triode section of the GL-5965 with 150 volts on the plate: Heater, 6.3 volts at 0.45 amp, or 12.6 volts at 0.225 amp; cathode bias resistor, 220 ohms; amplification factor, 47; plate resistance, 7,250 ohms; transconductance, 6.500 micromhos; plate current, 8.2 ma.

In computer service the GL-5844 has the following characteristics: Heater, 6.3 volts at 0.3 amp. (each triode): plate supply, 150 volts; plate load resistor, 20,000 ohms; grid resistor, 47,000 ohms. "On" condition: grid voltage, 0; plate current, 4.8 ma minimum. "Off" condition: grid voltage, -10; plate current, 0.1 ma maximum.

G-E has also announced a 15-kilowatt Klystron tube for u.h.f. television transmitters. The 15-kw rating assures exceptionally good linearity at a peak signal (sync) output of 12 kilowatts. The new tube requires less than 100 watts of driving power, and can be sup-



Basing diagrams of GL-5965 and 5844.

GL-5965 twin triode for computer use.

plied for any frequency from 470 to 890 megacycles, to meet the requirements of TV transmitter manufacturers.

This is the second integral-cavity u.h.f. Klystron developed by Varian Associates of San Carlos, Calif., to General Electric specifications. The first, a five-kilowatt unit, was operated experimentally at Electronics Park for nearly a year.

The Cathode-ray Tube Division of Allen B. Du Mont Laboratories, Inc., has developed a new line of cathode-ray tubes employing electrostatic focus and magnetic deflection, primarily for radar installations.

The new tubes are: B1036P-, B1038P-, B1039P-, B1040P-, and B1056P-, which replace respectively the Types 5FP-, 10KP-, 12SP-, 12DP-A, and 7MP.

The new electron lens gives more uniform spot size and improves resolution considerably. Substantially automatic focus is achieved if the focusing electrode is operated at cathode potential.

In addition to their other advantages, these tubes require only -15 to +25 microamperes focus current compared to 118 to 161 milliamperes focus-coil current for equivalent magnetic types.

The reduced power requirements and the elimination of the focus coil are extremely important considerations in airborne radar, and allow substantial savings in copper. A newly designed glass-rod support for the electron-gun maintains spacing more accurately and makes these tubes much more resistant to vibration than earlier types.

Sylvania's new instant-firing ATR tube, type 6214, will permit the manufacture of more compact and less costly beacon radar equipment. A beacon located at a known point receives a radar signal from an approaching plane or ship and automatically transmits a coded answering signal which enables the vessel to determine its direction and distance from the beacon.

In radar systems using a common antenna for transmitting and receiving, the TR (transmit-receive) tube and its companion the ATR (anti-transmit-receive) protect the ultra-sensitive receiver from being damaged by the high-power transmitter signal; and prevent the weak reflected signal from being absorbed in the transmitter during reception.

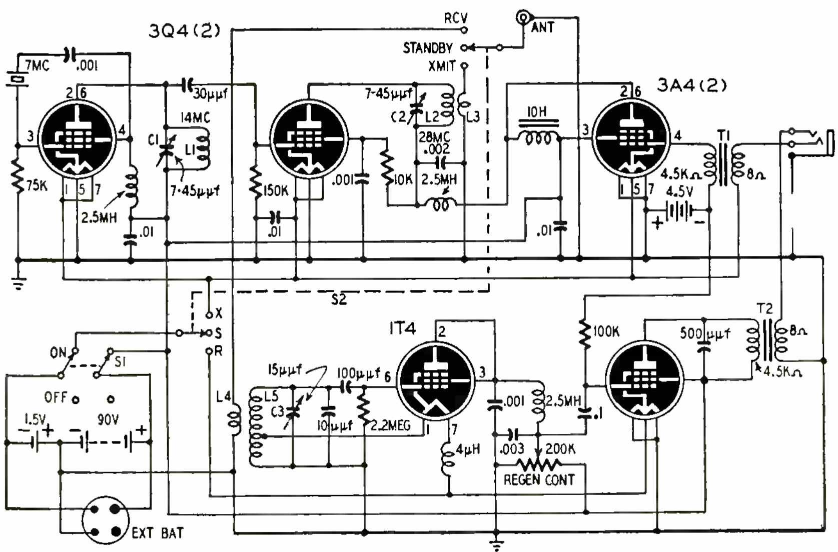
Conventional ATR tubes often fail to operate immediately when the transmitter starts, preventing proper transmission for possibly several seconds. Therefore, beacon systems have been engineered without ATR tubes, making separate transmitting and receiving antennas necessary. Type 6214 is capable of instantaneous operation on the first code pulse from the transmitter.

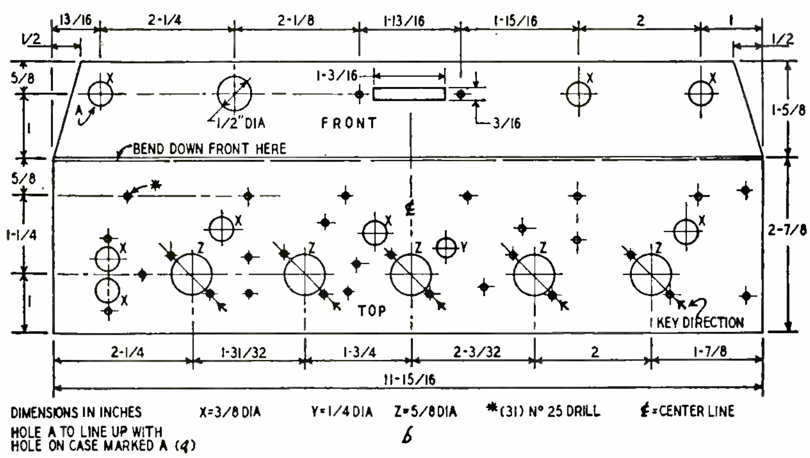
With an instant-starting ATR tube now available, a single antenna will handle both the receiving and sending functions.

The instant starting feature of the new tube has been achieved by adding an ignitor electrode to the end plate of the tube. The power supply for this ignitor is taken from the supply for the TR tube ignitor. END

10-METER WALKIE TALKIE

By MELVIN H. DUNBRACK, W1BHD





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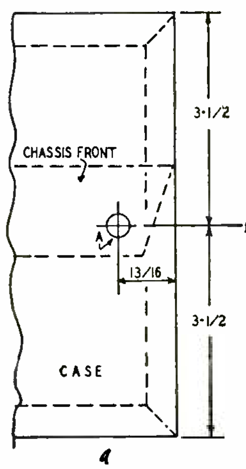
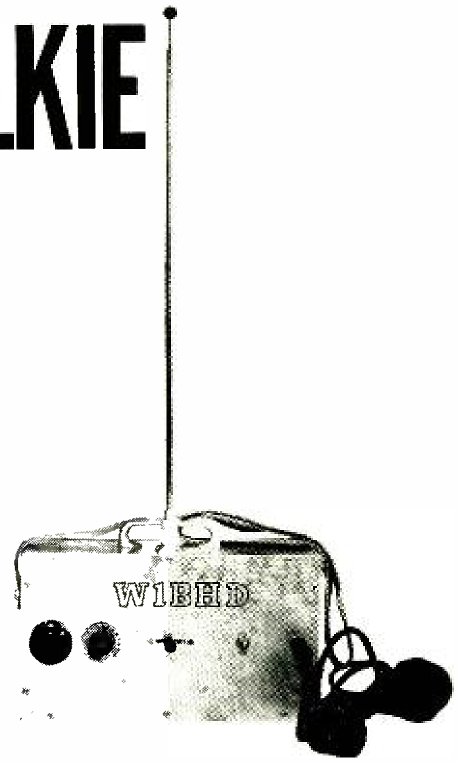


a

Fig. 1 (top)—Schematic of transmitter and receiver. Crystal-controlled oscillator-doubler is followed by amplifier-doubler with one-stage modulator. Receiver uses a highly efficient, low-radiation superregenerative circuit.

Fig. 2-a—Drawing of right-front edge of front panel. Dashed lines show position of chassis and lip of cabinet. Hole in front panel marked A corresponds to similar hole drilled in skirt of chassis. Fig. 2-b—Layout diagram for cutting, drilling, and bending the chassis.



Front view of the 10-meter walkie-talkie transmitter and receiver. Antenna and handset are shown in operating position.

THIS 10-meter walkie-talkie is one of the most valuable pieces of equipment which we have for civil defense drills and regular ham QSO's. Operating on 28,560 kc from a 7,390-kc crystal we have worked in the Everett Emergency Net and have had many successful contacts with good reports. Its compactness and light weight (7¾ pounds less handset) make the unit ideal for use in locations inaccessible to mobile or larger portable installations. It is unbeatable for liaison to mobiles and fixed stations and as an intercom between rooms in net-control headquarters.

The construction of the unit is shown in the photographs and diagrams. The circuits of transmitter and receiver are shown in Fig. 1. All parts are standard and readily available. Measuring only 12 x 7 x 3 inches, the 5-tube walkie-talkie operates from self-contained batteries and works with a modified whip-type automobile antenna.

Transmitter section

The transmitter starts out with a 3Q4 with the control and screen grids operating as a triode Pierce crystal oscillator. The plate section of this tube operates as a 20-meter doubler.

The output stage is a 3Q4 doubling to 10 meters. We decided to operate the final as a modulated doubler after tests showed that operating the final straight through meant adding another tube as a doubler-amplifier, increased weight, added battery drain, and neutralizing problems. This stage performs very satisfactorily as a Heising-modulated doubler.

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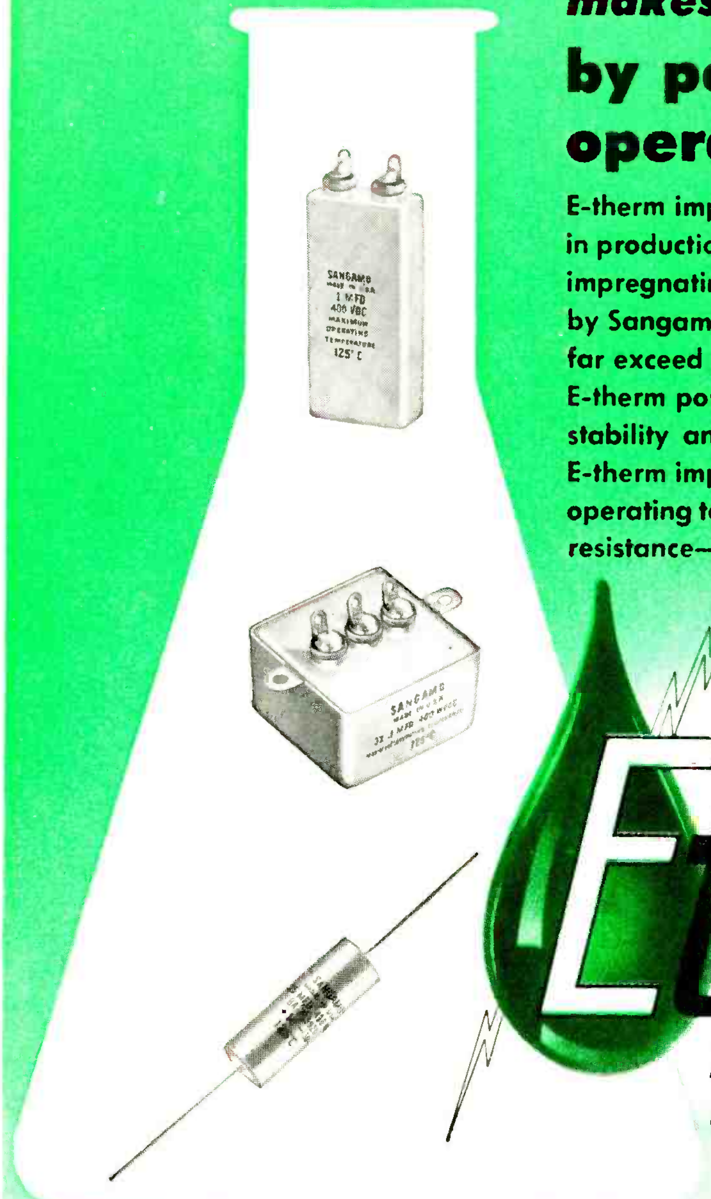

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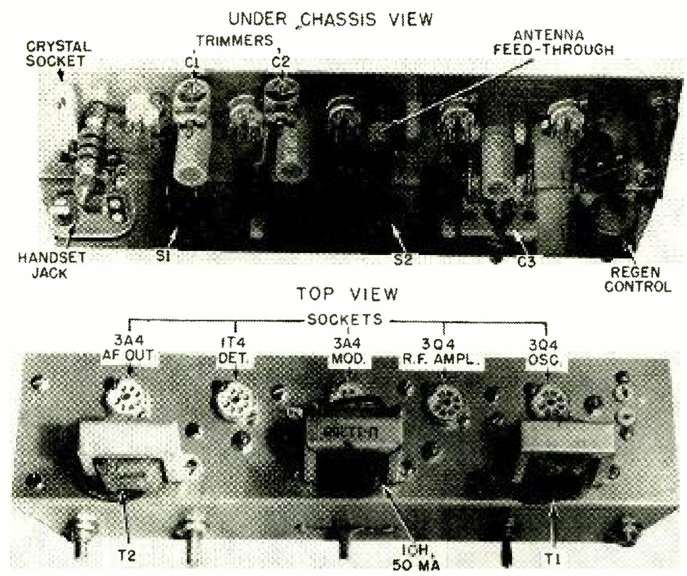

Photo A—Two views of unwired and unmounted chassis. All parts are placed for short leads and easy wiring. Midget components increase the portability.

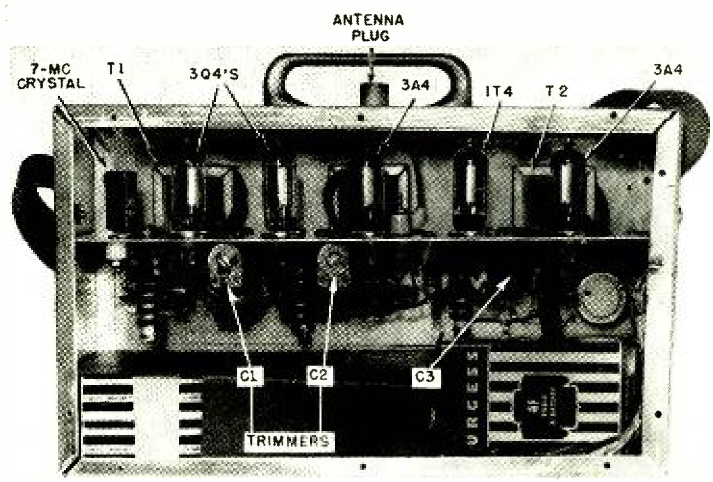

Photo B—Close-up view of the rear of the completed transmitter-receiver. Cabled leads run from chassis to the batteries mounted in the bottom of case.

The modulator is a 3A4 class-A amplifier driven by a carbon microphone in a standard telephone handset. The modulation inductance is a midget 10-henry, 50-ma filter choke. Audio input transformer T1 is a midget output transformer designed to match a 4,500-ohm plate to an 8-ohm voice coil. We selected it after experiments proved that it worked as well as more expensive mike-to-grid transformers. Excitation voltage for the microphone is taken from the transmitter filament line. Like the transmitter filaments, it does not draw current when the control switch is in the RECEIVE or STAND-BY positions.

The 20-meter tank coil L1 consists of 15 turns of No. 20 wire on a 1/2-inch ceramic form. The final tank L2 has 9 turns of No. 20 wire on a 1/2-inch ceramic form like that used for T1. The output link L3 is a 2-turn coil of No. 20 insulated wire wound over the cold end of L2. Turns on all coils are spaced one wire diameter.

Receiver circuit

The receiver consists of a 1T4 superregenerative detector and a 3A4 audio output stage. A 1T4 was chosen as the detector because of its low battery drain and its ability to superregenerate readily. Radiation from this detector circuit is much lower than from ultraudion and other more common superregenerative detectors. When operated with the regeneration controls backed way down, three or more of these units can be netted in the same building without mutual interference. However, it is possible to pick up radiation from the detectors on a good superhet within about 100 feet.

You should not have any trouble getting the detector to operate satisfactorily as a superregenerator. However, if you do run into trouble, a slight change in the value of the grid leak resistor or the grid capacitor should correct it. Superregeneration is controlled by the 200,000-ohm potentiometer which supplies B plus voltage to the plate and screen.

The 3A4 audio stage is conventional and supplies plenty of power to a low-impedance receiver in the handset. Signals can be heard with good volume while holding the handset at arm's length. A volume control is not needed.

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"I can assure you that it is a wonderful kit and good value" C. J Benadie. Newton Road, Beaconfield, Kimberley, South Africa; "I am very satisfied with the "Edu-Kit" Dominic Stracuzza, .111 Clarence St., London, Ont. Canada; "I received my Progressive "Edu-Kit" and I want to let you know that I am very pleased with it" F. B. Hartman, 290 Westminster St., Providence, R. I.; "This morning I was showing my Progressive Radio "Edu-Kit" to one of our representatives from our office in Richmond, and, already he wants me to purchase some for his hospitals" Veterans Administration, Physical Medicine Rehabilitation Service, Washington, D. C., "I received one of your Radio "Edu-Kits" and I am happy to report that my ten-year-old boy, with very little supervision, built a complete three-tube receiver - - one that works - in less than three hours" Bill Leonard, C.B.S. Radio, New York, N. Y,

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Output transformer T2 matches a 4,500-ohm plate to an 8-ohm load. A 4.5-volt C battery supplies bias for the 3A4's in the audio output and modulator stages.

Receiver tuning is conventional and very simple when you get the hang of it. To minimize radiation from the receiver, be sure to keep the regeneration control backed down to the minimum setting which provides satisfactory reception. Failure to observe this precaution will cause the receiver to radiate a signal which may interfere with reception on nearby receivers tuned to the same frequency.

The receiver grid coil L5 consists of 9 turns of No. 20 wire spaced one diameter on a ½-inch form. The cathode tap is placed 2½ turns up from the ground end. L4 is a 2-turn link of No. 20 insulated wire wound over the bottom end of L5. The 4-μh filament choke consists of 40 turns of No. 28 enameled wire close-wound on a ¼-inch form.

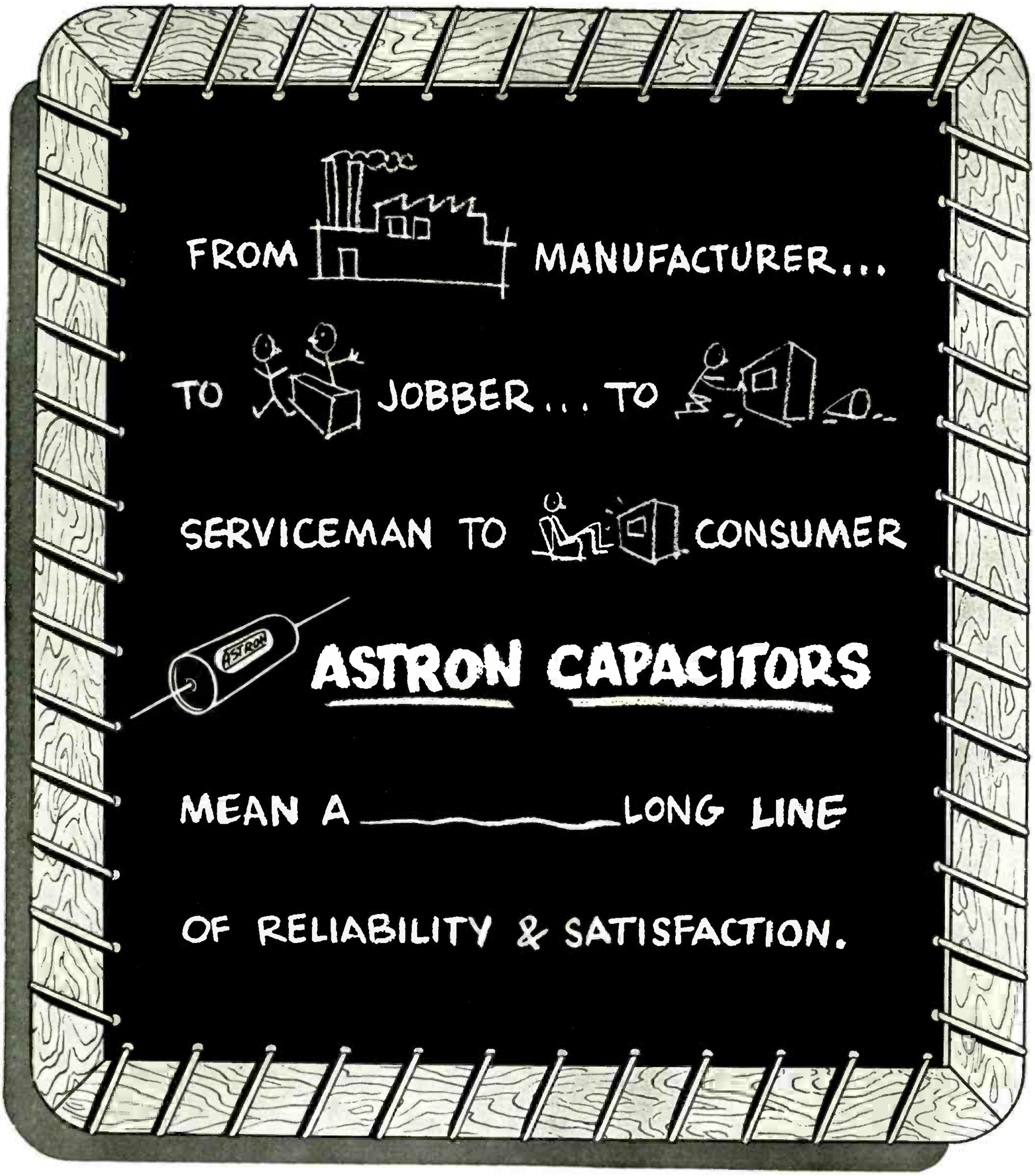
A 2-pole, 3-position lever switch S2 (Mallory 6143 or equivalent) selects the RECEIVE, STAND-BY, and TRANSMIT functions. One section switches the 1.5-volt battery between the filament lines of the receiver and transmitter and keeps the circuit open when in the STAND-BY position. The second section of S2 switches the antenna from the transmitter to receiver. Toggle switch S1 is the battery switch. It should be placed in the OFF position when you are through using the unit. If you don't, the drain through the 200,000-ohm regeneration control will soon exhaust the B battery.

Construction

The cabinet of the walkie-talkie is a 12 x 7 x 3-inch aluminum removable-top chassis with bottom cover plate. The chassis is a strip of $\frac{3}{32}$-inch aluminum approximately 12 x 1½ inches, bent and drilled as shown at *b* in Fig. 2. The holes and slot in the front lip of the chassis line up with similar openings cut into the front panel. The chassis and panel are held together by the controls fastened to them. Fig. 2-a shows position of chassis in cabinet. Top of chassis is 1 inch above chassis center line. The front-view photo shows the operating controls and the handset plugged into a 3-circuit jack. From left to right, the controls are: TUNING, REGENERATION, SEND-RECEIVE switch, and BATTERY switch.

Photo A shows two views of the chassis before it is wired and mounted on the panel. The top part of the photo shows the under side with the major parts mounted but unwired. The lower part of the photo shows the top-front view of the chassis. Photo B is a close-up of the rear of the unit after it is completed. The rear cover has been removed to show the inside of the finished project. Two ⅜-inch holes are drilled in the rear cover plate over the two trimmer capacitors so the transmitter can be tuned with the cover in place. Two ⅜-inch plug-buttons seal the holes against dust.

Two Burgess XX30 or equivalent 45-volt batteries connected in series are



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installed in the lower left-hand corner of the cabinet, and a Burgess 4F or similar 1.5-volt battery is mounted in the right-hand corner. Three No. 1 flashlight cells are connected in series for the bias battery. These are mounted in a plastic soap case with two small holes drilled for leads to the battery cable. The bias battery is in the center between the A and B batteries.

The shoulder strap is made from a 36-inch length of 1-inch belt webbing. It is attached to the sides of the case by ¼-inch bolts with 2-inch washers under the heads to ease the strain on the webbing.

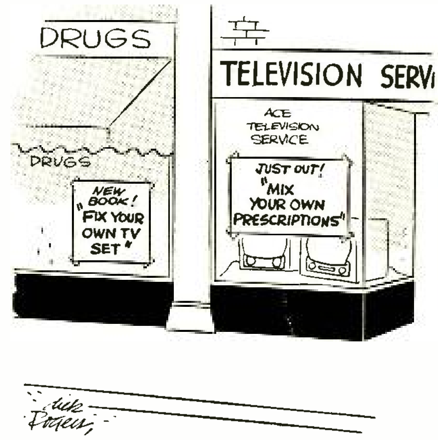
The plug-in antenna is made by inserting a long 6-32 screw into the bottom end of a telescopic automobile antenna and sweating it into place. The exposed threads are then filed off so the Amphenol 83-1SP plug can be pushed on and soldered in place. A piece of insulating tubing is slid down over the antenna into the plug to keep the antenna from shorting to its shell. Our whip extends to a full 6 feet but we find that about 5 feet gives good all-around results. Local contacts can be made with the antenna collapsed to 2 feet.

The socket for external batteries, shown in Fig. 1 but not the photos, was added so the set can be used with a battery eliminator or heavy-duty batteries too large for the case.

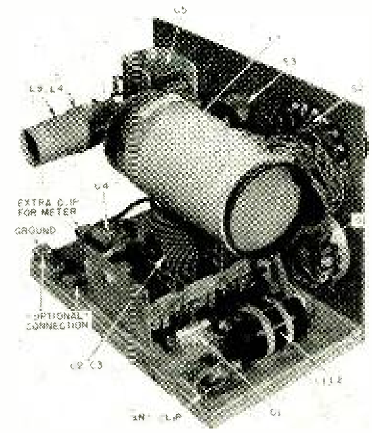
The transmitter is easy to tune up. The first doubler is tuned roughly to 14 mc and the second doubler to about 28 mc. Then a field-strength meter or a communications receiver with S-meter is used to set both trimmers for maximum output. When operating, the final amplifier delivers approximately ½ watt into the antenna.

Materials for walkie-talkie

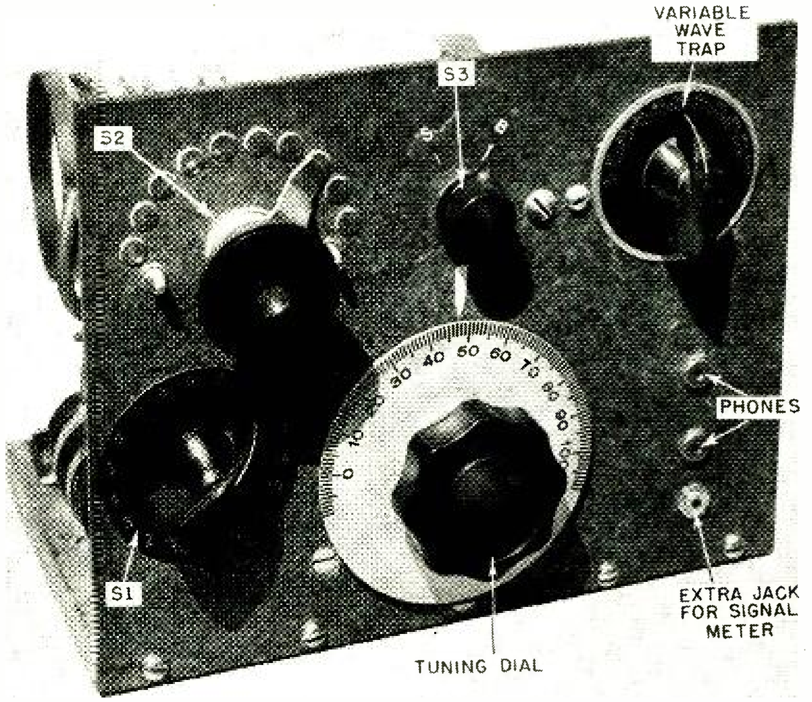
Resistors: 1—10,000, 1—75,000, 1—100,000, 1—150,000 ohms, ½ watt; 1—200,000-ohm potentiometer; 1—2.2 megohms, ½ watt.
Capacitors: (Ceramic) 1—10 μμf. (Mica) 1—30, 1—100, 1—500 μμf; 3—.001, 1—.002, 1—.003, 3—.01 μf. (Mica or paper) 1—0.1 μf, 400 volts or more. (Variable) 1—15 μμf, Millen 20015 or equivalent, 2—7-45 μμf ceramic trimmers, Centralab TS2A.
Miscellaneous: 3—2.5-mh r.f. chokes; 1—10-henry, 50-ma midget filter choke; 5—7-pin miniature sockets; 1—Coax plug, Amphenol 83-1SP; 1—coax receptacle, Amphenol 83-1R; 1—crystal socket, Millen 33102 or equivalent; 1—d.p.s.t. toggle switch; 1—2-circuit, 3-position lever switch, Mallory 6143 or equivalent; 1—3-circuit jack; 2—midget a.f. output transformers, 4,500 ohms to 8 ohms; 1—telephone handset, low-impedance carbon microphone and low-impedance receiver; 1—1T4, 2—3A4, 2—3Q4, batteries, crystal, chassis, antenna hardware, coil forms. END



DX CRYSTAL RADIO RECEIVER



By JOSEPH AMAROSE



CRYSTAL radio fans follow a pattern. They search everlastingly for a newer, better circuit that will excel their previous best effort. They want better volume, greater selectivity, higher sensitivity. Everlastingly, too, they must compromise, for no such optimum state can be achieved. Occasionally, an experimenter does find a circuit that is outstanding. Such is the hookup shown. No novelty is claimed, however; basically the circuit is old—only a few embellishments have been added. Nor must the reader expect that this receiver combines all the desired characteristics. What the writer (who has spent some 30 years testing and building the latest crystal "super-doopers") does promise is an unusual, versatile receiver that has consistently given fine results.

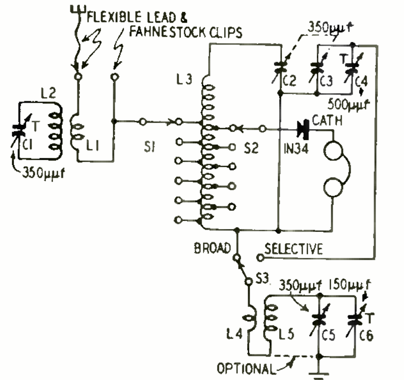
All last winter (in Virginia) this receiver tuned in stations from Canada to Cuba and from the Atlantic to the state of Utah, sometimes as early as 8 pm. Transmitters in Atlanta, Louisville, Chicago, Detroit, New York, New Orleans and Cleveland were most frequently logged. Even on the hottest summer nights, dx came in with impressive regularity.

No less impressive is the selectivity of this rig. All six of the Richmond locals are received clearly with no annoying hash or cross-talk. And three of these stations are only 40 kc apart! Worse still, one is a weak sister between two strong ones. Yet this set gets all with ease. With proper co-ordination of controls all locals (from 910 to 1480 kc) can be tuned in with just the one main tuning dial. Tested in Baltimore by M. M. Schuman, another old-timer (who built this set), the receiver tuned in all eight locals clearly there, plus the more distant WTOP in Washington, D. C.

Volume on the locals is high. Richmond's WRNL, 5,000-watt transmitter, *five miles away, operates a magnetic speaker loud enough to be heard clearly 15 feet from the reproducer*. It doesn't shake the rafters but every word of speech is intelligible at that distance.

How are these results achieved? First and foremost, for good dx, the antenna system should be of the best. A 125-foot aerial was used, 31 feet high, with the lead-in taken from the far end; this proved better than the usual "L" type. Total antenna wire to the set was 260 feet. Shorter aerials are O.K., *if high*.

The fixed antenna wave trap, L1, L2 and C1, is to be used only when two strong stations interfere. Set C1 so it confines the most troublesome station. For dx work, eliminate this trap entirely! Sensitivity is higher.



PARTS LIST

C1—350-μμf trimmer.
C2, C3—2-gang 350-μμf variable capacitors.
C4—500-μμf trimmer.
C5—350-μμf variable capacitor.
C6—150-μμf trimmer.
S1—17-point switch.
S2—10-point switch, or 10 switch points and lever.
S3—S.p.d.t. panel switch.
Other materials needed are coils as given in the table, a crystal, a pair of sensitive phones and the necessary panel, breadboard, hardware, etc.

The main tuning coil, L3, is an MRL (Modern Radio Laboratories, 1131 Valota Drive, Redwood City, Calif.) "low-loss" type. The constructor can make his own by winding 90 turns of No. 22 double-cotton-covered wire on a 2-inch plastic coil form 4 inches long (actual winding is 3 inches). Brush on a layer of very thin coil cement to make it stick to the coil and tap both antenna and secondary sides. Tap the antenna side every three turns from the 3rd to the 51st, and tap the secondary every five turns from the 5th to the 50th. Lift the turns with an ice pick to solder.

A standard 2-gang capacitor is used for C2 and C3, with a 500-μμf trimmer across the second section, for band-spreading on high frequency end. Adjust this trimmer, C4, for best volume on a 1000 kc station.

Switch 1 selects the proper antenna primary-coil tap. Switch 2 is used to match the impedance of the crystal. Tune in all locals, select the setting that gives best selectivity with good volume, and *leave set*. From ground end switch 3 provides a choice between peak sensitivity and high selectivity.

In the variable trap, L4, L5 and C5, a Carron S-645 coil is used. The primary, secondary and variable capacitor are series hooked. An "optional connection" is shown. If used, it makes a conventional wave trap of the section. Not used, another tunable circuit is provided, acting like a series-tuned loading coil and capacitor. With this arrangement, tuning is better.

The ground for this set was the pipe in a well. This makes the best possible ground connection; a signal meter showed almost twice as much signal strength as with other grounds. The urban dweller should use *cold water* pipes, with the wire attached close to the earth. Additional grounds also boost signal strength and are recommended.

Operating the set

The settings obviously will differ in each locality, depending upon the frequencies employed by the local transmitters. Individual experiment is necessary to determine optimum settings of controls. Generally, for dx work, eliminate the antenna wave trap, throw S3 to the BROAD position, and do not make the "optional connection." For best selectivity, use the antenna wave trap, move S3 to the SELECTIVE position, and hook up the OPTIONAL CONNECTION. With the connection closed, tune the trimmer C6 to loudest volume on a 1000-kc station. This completes all adjustments on this set.

In constructing the receiver, it is important to position both wave-trap coils as far as possible from the main tuning coil. The selectivity will be poor if their magnetic fields are allowed to affect each other.

A word about "signal meters." The serious dx fan will do well to consider using a sensitive microammeter across the phone posts, to determine peak signal strength. All the unusual results achieved by this receiver are due to the use of such a meter. Many months were spent making changes until the present circuit arrangement was arrived at; more time was spent in determining the best aerial and ground arrangements. All the optimum conditions were quickly revealed by the meter readings. By the cut-and-try aural method usually used, optimum conditions could not be very readily determined. These meters are still available at prices under $10 in surplus houses. A 200-microampere instrument is ideal. Especially useful is this device in picking out the most sensitive detector; some crystals give twice as much output as others, and a meter can spot your best one in an instant. For weak stations and dx work, this is most important. The value of such an instrument in helping to get distance cannot be overemphasized.

Finally, super-efficient as the aforementioned receiver might be, no extravagant claim is made for it. All the writer can say is, that, of the large crop of radios tested through the years, this one stands head and shoulders above the crowd. Made according to specifications, it should provide the hobbyist with no end of pleasure and entertainment.

COIL TABLE

L1—25 turns No. 30 enameled wire wound over L2.
L2—125 turns No. 30 enameled wire on 1-inch form.
(A low-impedance antenna coil will work well here. The constructor used a Carron S-645.)
L3—90 turns double-cotton-covered wire close-wound on 2-inch coil form.
L4—Low impedance primary of Carron S-645 broadcast antenna coil.
L5—Secondary of same coil.

END

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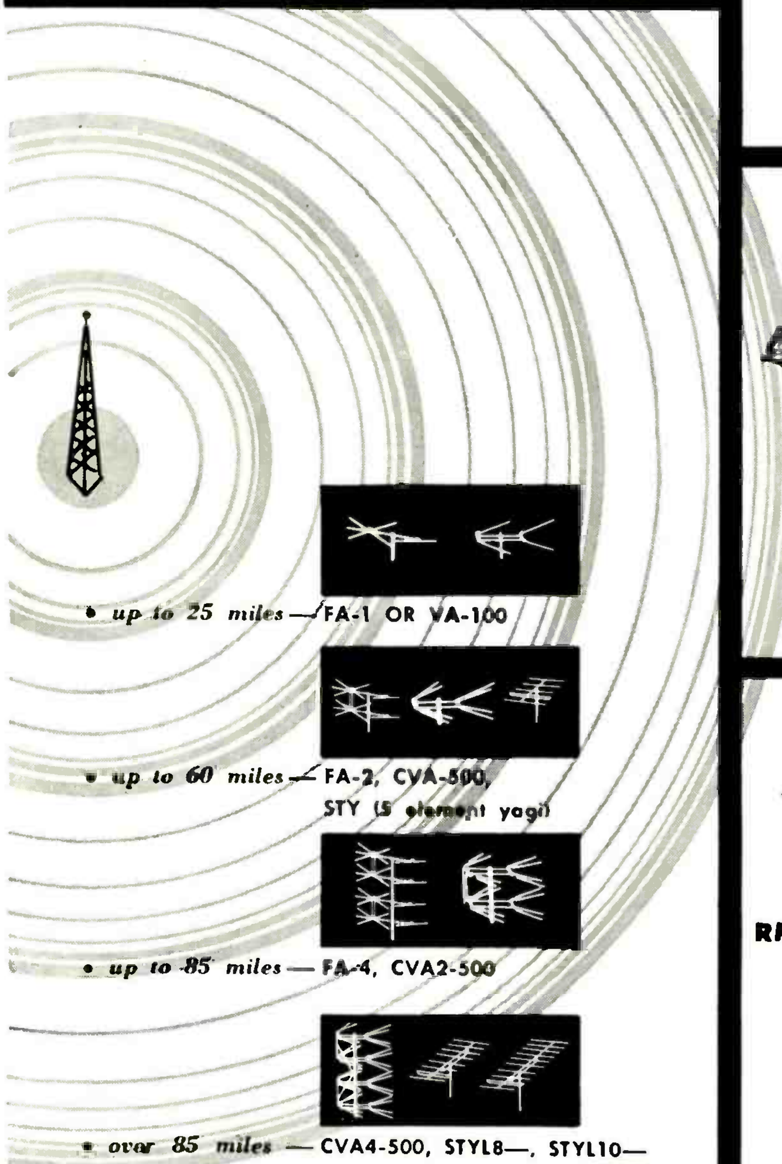

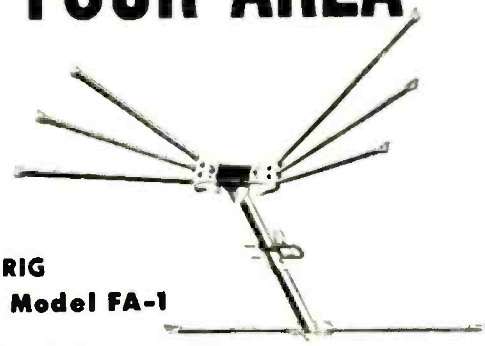

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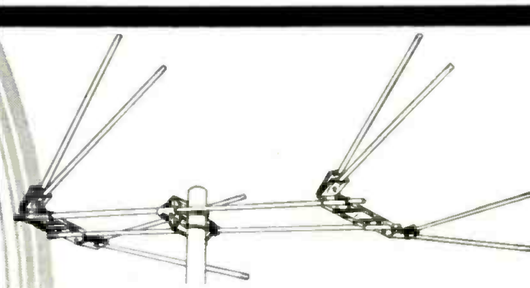

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NEW YORK HAS EXPOSÉ

The August 8 meeting of the Associated Radio-Television Servicemen of New York City (ARTSNY) was largely devoted to a discussion of the recent exposé of cut-rate service firms in the New York metropolitan area.

Although started under excellent auspices, including some unofficial assistance from the Association itself, it was pointed out that the project suffered somewhat through being handled by one of the more sensational local newspapers; with the result that proportion was sacrificed at times for dramatic effect. Emphasis was, however, placed on the 1- and 2-dollar service call, and the principal object of the investigation was to determine if a concern advertising such rates could operate legitimately.

Worst feature of the exposé was the "gimmick," that untypical and unnatural cause of TV maloperation that no service technician expects or is likely to look for. Worst example was a case where brilliancy was sharply reduced by turning down a screwdriver control. The service technician took one look at the set, replaced the tubes whose weakness would normally be responsible for the defect, adjusted the control, and charged for a service call plus the tubes replaced. The housewife's remark after he had gone: "Why, he wanted nearly ten dollars for doing practically nothing!" indicates the standard attitude toward a service technician who might have been audacious enough to try to collect the full price of a service call for turning up a control. One wonders if he would have charged the same or a higher fee in a normal case of reduced brilliancy, where the tubes actually would have needed replacement.

Another case involved the displacement of an ion trap. Although it was pointed out that this could have been a genuine defect (the householder told the service technician that the set hadn't worked since the room was cleaned that morning) it put the technician in the position of trying to charge for a service call after "doing practically nothing," or attempting to justify his call by selling a few tubes.

Best feature of the exposé was that local technicians were consulted before and during the investigation, and quoted in one of the concluding articles. Thus it was made quite clear to the reader who had followed the series that the operations of unethical service organizations were as harmful to the service technician as to the set owner, and that the service technicians were as interested as the public in eradicating unscrupulous practices and persons from the industry.

FULL-TIME MANAGER

The Certified Television and Electronics Association of Maryland announces the appointment of Donald H. Kresge as full-time business manager. Mr. Kresge has been a service technician, has operated several service organizations, and has worked as field engineer for the General Electric Co.

NEW GROUP IN VIRGINIA

Formed to combat the widely expressed distrust of TV and radio service practices, the Northern Virginia Electronics Association has drawn up a 5-point Code of Ethics:

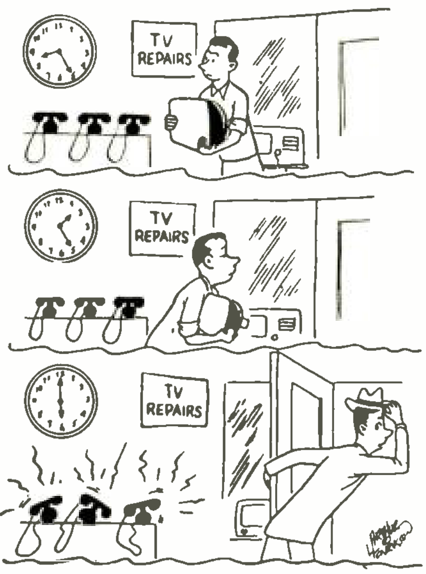
1. All TV installations and repairs to antennas will be in accordance with local building- and electrical-code requirements.
2. Materials used must be of a grade approved by the Association, electrical and building inspectors, and the Underwriters' Laboratories.
3. All installations and antenna repairs are to be guaranteed for a minimum of 90 days.
4. All installations must be neat and clean, rigidly anchored, and at a safe distance from power lines; any property damage during installation must be reported at once to the owner and arrangements made for repair or replacement.
5. Workmanship must be excellent and rates fair and reasonable.

Association members also pledge themselves not to "slander, abuse, or belittle" fellow members, not to make false or misleading statements to customers, to advertise truthfully, supply customers with itemized accounts of all work done and all parts furnished, and to fulfill all guarantees and contracts they may make to their customers.

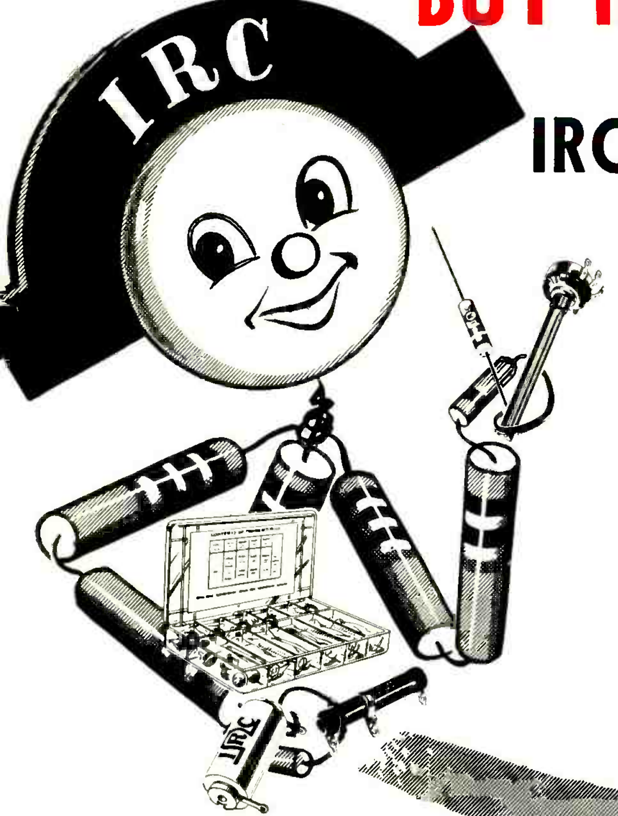
Charter members of the Association are six Arlington and one Falls Church (Va.) service dealers.

COLUMBUS ACTIVE

The Associated Radio-Television Service Dealers of Columbus, Ohio, included both a picnic and a Lake Erie trip in their summer recreational activities, according to the latest issue of the *A.R.T.S.D. News*. The same issue of the Columbus service dealers' monthly news sheet reports on the association's project to take care of the TV receivers at the Children's Hospital and the cerebral palsy institutions free of charge. END



HERE'S YOUR WISEST BUY IN REPLACEMENTS!



IRC Gives You Widest Variety —Greatest Dependability

You know the dependability of IRC resistors. But *do* you know their full replacement coverage? It's the *widest in the industry*—and that's worth knowing. For it means you can get the exact IRC part you need for any specific job—instead of running the risk of failures-in-service, so common with makeshift parts. Take a moment to look at IRC's replacement coverage. Then, for widest variety and greatest dependability, specify IRC.

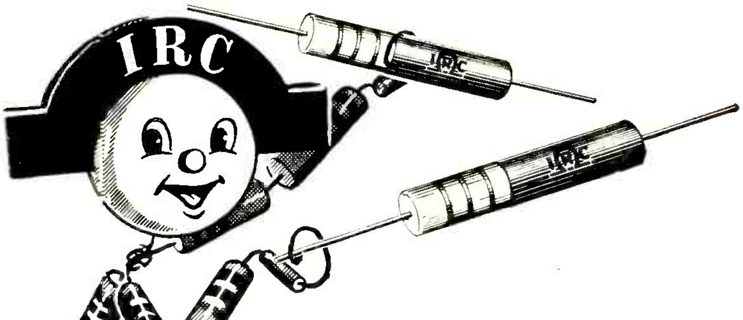
Controls for TV and Radio

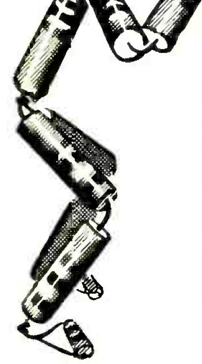
Whether you like the convenience and simplicity of *factory-assembled* Exact Duplicate TV Controls—or the wide coverage at lower stock cost of Universal TV Replacements—IRC gives you what you want. With either type you get full coverage of 336 different concentric duals handling nearly 500 Manufacturers' Parts Numbers specified in over 5,000 TV models. And for radio, IRC also offers the Type Q Radio Technician's Volume Control—which covers more than 90% of replacement needs.

Power Resistors

These heavy-duty Power Wire Wound Resistors need no de-rating; they carry *full wattage* in any stock range. Exclusive, moisture-proof coating dissipates heat more rapidly and assures better performance. *Low-temperature processing* in manufacture prevents damage to fine wires or shifting of windings. Lead-lug arrangement lets you cut off leads or lugs for easy installation in crowded chassis.

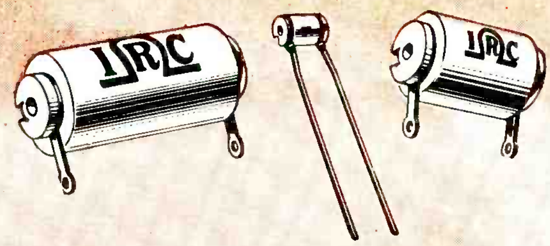
MAKE YOUR IRC DISTRIBUTOR YOUR ONE-STOP SOURCE





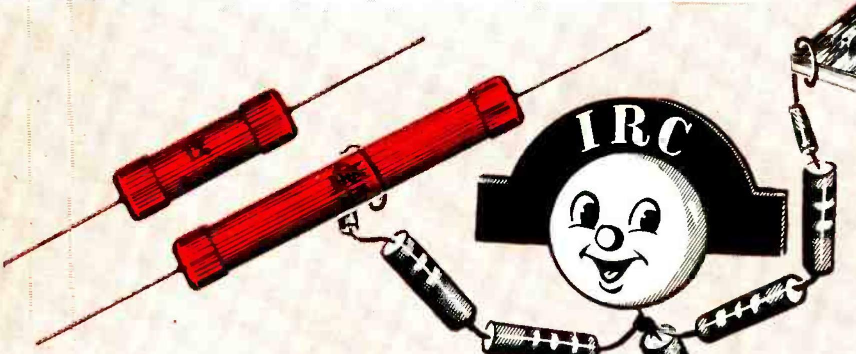
Insulated Resistors

IRC Advanced Type BT Fixed Composition Resistors beat rigid Army-Navy specifications and easily meet the stiff requirements of television. IRC Type BW Insulated Wire Wound Resistors are unusually stable, inexpensive units for low-range applications. Both BT's and BW's are compact, lightweight, fully insulated. You'll find more IRC BT's and BW's in radio and TV sets than any other brand.



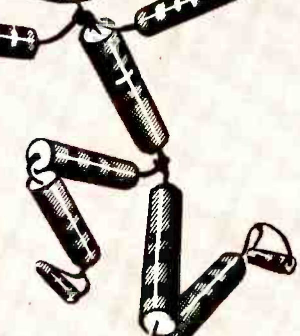
Precision Resistors

These all-new, greatly improved IRC Precision Wire Wound Resistors far surpass critical Army-Navy specifications. New winding forms hold more wire for greater resistance. New winding technique eliminates shorted turns and winding strains. New insulation compound gives higher stability and freedom from noise—greater humidity resistance and longer life. New terminations provide greater strength in connections.



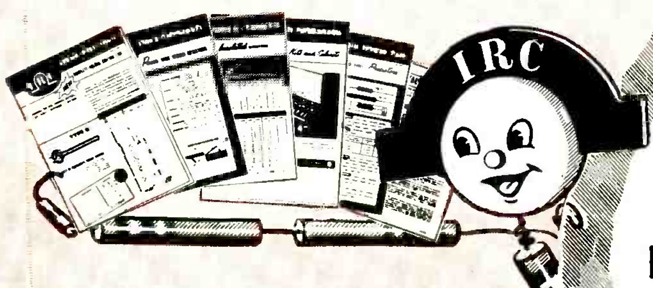
PRECISTORS

IRC Deposited Carbon PRECISTORS offer a combination of characteristics not found in other resistor types. Wide range of values, pin point accuracy, high stability, low voltage coefficient, excellent frequency and temperature characteristics, high voltage rating, low noise level and small size—all at low cost. You'll find PRECISTORS useful in critical TV circuits.



Practical Stock Assortments

At no extra cost, IRC's handy metal Kits and Cabinets put the parts you use most right at your finger tips. Stocked with BT and BW, resistors in the ranges most widely used in television—with Volume Controls and parts that cover more than 90% of Single Carbon Control Replacements—or with IRC Insulated Chokes, these handsome, compact kits save shopping time, eliminate clutter, improve your shop's appearance. There's even a flat, pocket-size kit for service calls or small bench stocks.



Get New Catalog Bulletins

Your name and address on a post card will bring you Catalog Bulletins on any of these parts you specify. Or, if you wish, you can examine any of the products shown above at your IRC Distributor. For more profitable servicing, get the full IRC replacement story today.

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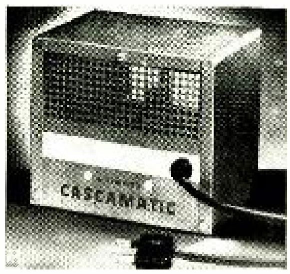
Wherever the Circuit Says

New Devices

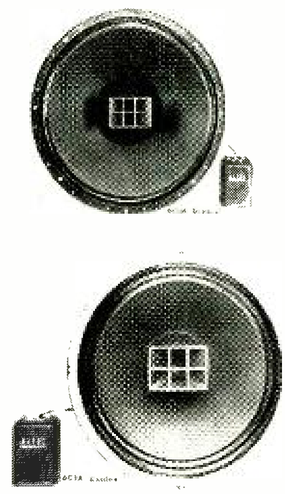
TV BOOSTER

Alliance Mfg. Co., Lake Park Blvd., Alliance, Ohio has announced a new automatic television booster, the *Cascamatic*. The booster mounts on the back of a TV receiver, is easy to install, and turns on and off with the set. Pretuned to all channels, it contains three tubes.



NEW LOUDSPEAKERS

Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif., has introduced two new loudspeakers. The 12-inch 601A and the 15-inch 602A have a frequency range from 30 to 22,000 cycles. Frequencies from 3,000 to 22,000 cycles are reproduced by a compact high-frequency unit, mounted in the center of the cone, through an exponential horn.

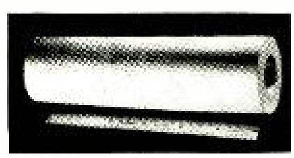


The two speakers are identical with the exception that 601A has a 12-inch cone and 602A a 15-inch one. As a result, the reproduction of frequencies below 50 cycles is somewhat better on the 602A although both speakers will reproduce fundamental tones down to 30 cycles.

DISCHARGE CAPACITOR

Centralab Division of Globe-Union, Inc., Milwaukee, Wis., is producing a new type ultra-high-speed discharge capacitor which has the characteristics of 30 feet of solid coaxial transmission cable. The tube is 2-inches in diameter, 6½ inches long. When used in the same manner as the coaxial cable, charged to 10,000 volts and discharged across a spark gap, the capacitor tube improves light intensity 900 times.

The tube is made of hi-K ceramic



(K-2000), silvered inside and out. It has a capacitance rating of at least .024 µfd (24,000 µµf) and when immersed in transformer oil is rated at a working voltage of 20,000 volts d.c. The unit has a decay time, peak to peak, of 2×10^{-7} second, a rise time, zero to peak, of 2×10^{-7} second, and 50% of peak limits occur in a period of 1.8×10^{-7} second. Leakage resistance is over 10,000 megohms, and dielectric strength is approximately 35 volts per mil.

NEW GENERATOR

Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill., has announced a new crosshatch pattern generator to make horizontal and vertical linearity, hold, height, width, and drive adjustments when transmitter test patterns are not available.

The Simpson model 485 provides a synchronized signal, modulated on the carrier frequencies of channels 2 through 6, which can be tuned and sent through the receiver under test. When the receiver has been properly adjusted, the signal will show equally spaced lines in vertical, horizontal, or crosshatch patterns on the picture tube.

All patterns are locked in place with synchronizing pulses exactly the same as the sync pulses in transmitted waveforms, making it unnecessary to double-check against an actual trans-

mitted test pattern. The output cable includes a variable termination network which can be adapted quickly to provide 75- or 300-ohm terminations for matching receiver inputs.

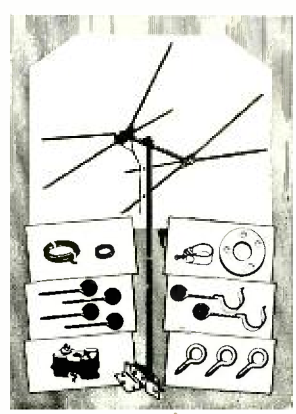
TUBE TESTER

Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y., has released its new model CRA television picture-tube test adapter.

Model CRA gives a quantitative measurement of cathode emission and tests for filament continuity and inter-element shorts when used with an Eico tube tester. It is supplied with standard 12-pin picture-tube socket; actal plug-in connector for the tube tester and an extra-long 4-foot cable that enables the picture tube to remain in the set while testing.

ANTENNA KITS

Channel Master Corp., Ellenville, N. Y., has a new master antenna kit which includes all components necessary for the average home television installation. In addition to the antenna, each kit contains a floor mount, screw eyes, guy ring and clamp, swaged mast, standoff insulators, lightning arrester, 300-ohm ribbon transmission line, and guy wire.



the highest quality instruments in kit form

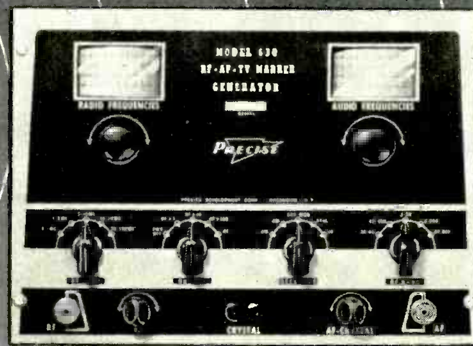
precise

above all else

still setting standards for competitive efforts • an engineered product

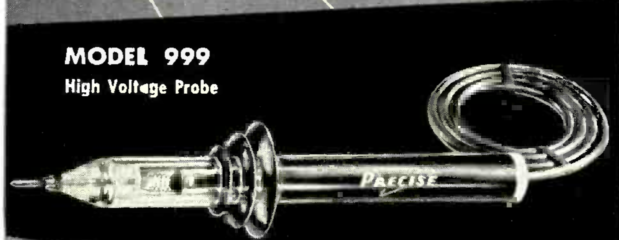
KITS • WIRED

MODEL 630 RF-AF-TV and Marker Generator.



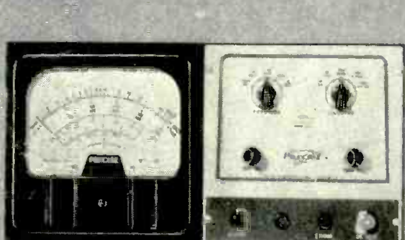
MODEL 635 Universal AF Sine, Square & Pulse Generator.

MODEL 999
High Voltage Probe



MODEL 909
Vacuum Tube Voltmeter

MODEL 912 R. F. Probe



MODEL 907 DELUXE Vacuum Tube Voltmeter

Save MORE THAN 50% ... *and own the finest!*

Model 630 RF-AF-TV and Marker Generator. For the first time in the history of the industry . . . SO MUCH FOR SO LITTLE. The very first kit to reach 110 mc on fundamentals, 330 mc on harmonics. The first kit to offer a complete factory pre-assembled and calibrated RF head.

RF FREQUENCIES: Band 1—300KC to 1MC Fundamentals • Band 2—1MC to 3MC Fundamentals • Band 3—3MC to 10MC Fundamentals • Band 4—10MC to 30MC Fundamentals • Band 5—30MC to 110MC Fundamentals • Band 5A—60MC to 220MC 2nd Harmonic • Band 5B—90MC to 330MC 3rd Harmonic

AF FREQUENCIES: Band 1—20 to 40 Cycles • Band 2—40 to 200 Cycles • Band 3—200 to 2K Cycles • Band 4—2K to 20K.

Pre-tuned RF Head; Audio 20-20,000 cycles; variable percent modulation; Cathode-follower output; stepping attenuator; external modulation; speech amplifier; crystal marker; crystal amplitude control; RF & AF stand-by; Wien Bridge AF Oscillator; Colpitts RF Oscillator; Drum Dials; Coaxial fittings; individually tuned coils; constant output impedance; filtered line; Vernier tuning on RF & AF; Separate RF section; complete shielding; 8 x 11 x 5″; wrinkle steel cabinet; etched panel; amphenol type connectors; 10 lbs.

Model 630K . . . **$33.95**
Model 630KA . . . $38.95 (pre-assembled head)
Model 630W . . . $53.95 (Factory wired)

Model 635 Universal AF Sine, Square & Pulse Generator.

Efficiently and effectively ascertains audio and video troubles. Sine waves; square waves, pulses; Wien Bridge Oscillator; variable impedance output; voltage regulation insures a veritably constant output; cathode follower output; square waves and pulses with minimum overshoot and roundoff through 30,000 cycles; sine waves through 200,000 cycles.......... **$33.50** Factory wired $52.50.

RANGES: 20-40 cycles • 40-200 cycles • 200-2000 cycles • 2000-20,000 cycles • 20,000-200,000 cycles.

Model 999 High Voltage Probe. 100,000,000,000,000,000,000,000,000,000,000, to 1 are the odds against a voltage breakdown occuring in this probe!

PRECISE Model 999 High Voltage Probe was designed for high voltage measurements with special emphasis on SAFETY, OPERATIONAL SIMPLICITY AND RUGGED CONSTRUCTION. FIRST in the industry to include any one or more of the following exclusive features: MULTIPLE INSULATION, MECHANICALLY SHOCKPROOF CONSTRUCTION: INTERCHANGEABLE TIPS: SWIVEL LEAD CONNECTION: INTERCHANGEABLE RESISTORS..........Wired Only . . . **$6.98**

Model 909 Vacuum Tube Voltmeter. Make a comparison . . . then, buy PRECISE. Ceramic precision resistors 1% or better; etched panel; steel cabinet; amphenol type DC connector; separate 5V. AC scale; special true zero alignment scale; burn out proof circuit; RUGGED oversize 4½″ meter . . . **$25.98** Factory wired $44.98

Model 912 R. F. Probe. LOWEST PRICED, finest factory wired and calibrated R.F. Probe in the industry, individually calibrated at 75 megacycles for accuracy, impedance and shunt capacity..........Wired Only . . . **$4.25**

Model 907 DELUXE Vacuum Tube Voltmeter.
Another PRECISE first! Vertical or Horizontal construction. GIGANTIC 7½″ meter movement; all the unusual values and features of Model 909 in a really DELUXE version . . . **$38.98**
Factory wired $57.98

Prices slightly higher in the West.
Prices and specifications subject to change without notice.

Write for your Precise Catalog Today! #52-RE

precise
above all else

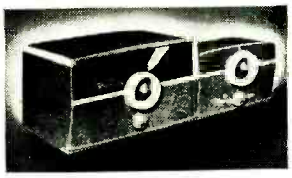
ALL EQUIPMENT HAS THE PRECISE GUARANTEE

Servicemen everywhere acclaim PRECISE ...TOPS IN THE FIELD

PRECISE DEVELOPMENT CORP. • Oceanside, N. Y.

UHF CONVERTER

Regency Division, I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis, Ind., has announced a new converter for adding u.h.f. station reception to any TV set. The cabinet is a companion in style to the Regency television signal booster.

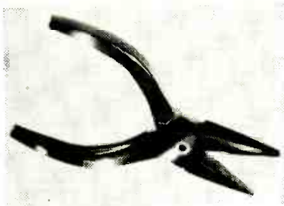


HAM-BAND FILTER

Grayburne Corp., 103 Lafayette St., New York 13, N. Y., has designed a TV interference filter to alleviate 21-mc ham-band interference. The model CPH *Clear-Pix Filter* has high rejection efficiency for the 21-mc band.

INSULATED PLIERS

General Cement Mfg. Co., Rockford, Ill., has developed an insulated pair of long-nose plastic pliers for TV technicians and others working around high voltages. The pliers are 6¼ inches in length, and are claimed to be absolutely shockproof. The tool is made of high-impact bakelite material.



VOLUME CONTROLS

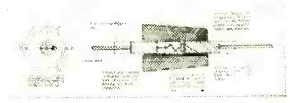
P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind., has announced the addition of a 2-watt wire-wound front control section to the line of selective-assembly dual concentric *Midgetrols*.

Known as the "WF" series, the sections are available in ten resistance values from 750 to 7,000 ohms in topped and untapped types. They may be employed in conjunction with any of the previously announced "UR" carbon rear control sections to fabricate a dual concentric volume control of exact replacement characteristics.

An inner shaft, phenolic spacer, and special coupling cup and shaft end are supplied with each "WF" control section. Instructions permit assembly without special tools or soldering.

TAPERED GERMANIUM DIODES

Radio Receptor Co., Inc., 251 W. 19th St., New York 11, N. Y. is using a new tapered design in its germanium diodes. The tapered hexagon-shaped body shows polarity at a glance—the taper shows the direction of current flow, permits mounting against a flat surface, and speeds up assembly operations. The diode consists of a



germanium wafer soldered to a nickel alloy cathode pin, and an electro-etched tungsten whisker welded to a nickel alloy anode pin, assembled into the glass-phenolic body. It may be clip-mounted by the terminal pins or soldered in by the pigtail leads.

Available JAN types are 1N69 general-purpose and v.h.f. rectifier unit, 1N70 high-voltage diode, and 1N81 medium-voltage diode with low back leakage near 10 volts. Commercial types are 1N48, 1N51, 1N52, 1N63, 1N64, 1N65, and 1N75.

TV LEAD-IN SHEATHS

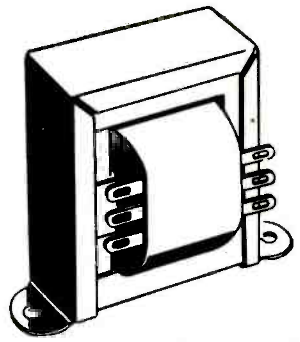
Don Good, Inc., 1014 Fair Oaks Ave., South Pasadena, Calif., announces four new protective coverings for 300-ohm transmission lines. *Lead-Sheath* is a protective tubing of pure polyethylene into which the lead-in is threaded to protect it from sunlight, salt spray, frost, snow, and icy conditions. *Lead-Sheath* is manufactured in a standard brown (No. 100) and silvery-gray (No. 120) colors. It is packaged on 750-foot reels, with shorter lengths available.

Sheath-Lead No. 803 is standard brown 300-ohm *Goodline Airlead* enclosed in a brown polyethylene tube. *Sheath-Lead* No. 823 is the clear *Goodline Airlead* shielded from ultraviolet light and the elements by silvery-gray *Lead-Sheath*.

Nos. 803 and 823 are packaged on 1,000-foot reels, with shorter lengths available.

70-VOLT TRANSFORMERS

Standard Transformer Corp., 3580 Elston Ave., Chicago, Ill., has added two new line-to-voice coil transformers to its line of components for 70-volt audio distribution systems. The A-8102 and A-8103 operate into 4-, 8-, or 16-ohm loads from 70.7-volt lines or from one or more of the speaker-distribution-line voltages in a series derived by successive multiplication or division of



70.7 volts by 1.414. When properly terminated in its rated impedance, power output ratings for the A-8102 are 8, 4, 2, 1, and 0.5 watts and 16, 8, 4, 2, 1, and 0.5 watts for the A-8103.

PRECISION OSCILLOSCOPE

The Instrument Division, Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N. J. announces the type 303-A wide-band, high-gain cathode-ray oscilloscope for the study of pulses and other highspeed phenomena. In addition to the conventional qualitative analysis, the 303-A can be used for precise quantitative measurement of both time and amplitude.

Nominal bandwidth is 10 mc, with a transient response of 0.033 μsec. The gradual fall-off of the Y-axis frequency response permits signals as high as 20 mc or more to be usefully displayed.

Sweep durations are variable from 0.1 second to 2 μsec. All sweeps may be expanded up to six times full-screen diameter, with full positioning available over the entire range. With expansion, maximum sweep speed is 10 inches per μsecond. Much higher sweep speeds may be obtained at some sacrifice in positioning and linearity; however time measurements may still be made accurately. Amplitude and timing calibration are provided by built-in voltage and frequency standards of high accuracy.

The deflection factor of the vertical amplifier is 0.1 volt peak-to-peak per inch, with 1.5 inches of undistorted deflection for unidirectional signals, and three inches for symmetrical signals.

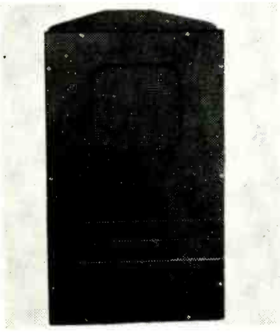
An illuminated calibrated scale with light level varied with a front-panel control is provided as standard equipment. A filter of a color appropriate for the screen type is provided with the individual instrument. Also supplied as standard equipment is a shielded coaxial-cable adapter with 52-ohm termination for connection of the input signal to the scope through a coaxial cable.

CORNER BAFFLE

The Permoflux Corporation, 4900 West Grand Ave., Chicago 39, Ill., has designed a new type of baffle designed to fit in the corner of a living room.

Due to the corner placement, the tone qualities are reinforced to give a sparkling performance from a low of 30 cycles to a high of 12 000 cycles per second.

Specifications, Model CB-8-M: Height 24, width 14 inches, depth at top 9½, at bottom 13¾ inches. Frequency response, 30 cycles to 12,000 cycles. Rich mahogany (Ordoba) leatherette: four-layer plywood construction. END



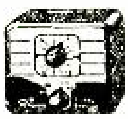
All specifications given on these pages are from manufacturers' data.

GREYLOCK SLASHES PRICES!

QUALITY • PRICE • SERVICE

All tubes listed below carry 6-month guarantee—excepting only burnouts and breakages. At these sensationally low prices, these tubes must be ordered in quantities of AT LEAST 10 ASSORTED TYPES. (Add 10% for orders under 10 tubes.) All individually boxed in attractive GREYLOCK Cartons.

0Z4M	.59	3S4	.59	6AT6	.49	6C4	.49	6SG7	.89	7A4	.69	12AX7	.59	25BQ6GT	.79
1A7GT	.79	3V4	.59	6AU6	.49	6C5GT	.49	6SH7	.79	7A8	.89	12AZ7	1.29	25L6GT	.59
1B3GT	.99	5U4G	.69	6AV6	.49	6C6	.49	6SJ7GT	.69	7B6	.59	12BA6	.49	25W4GT	.49
1H5GT	.69	5V4G	.99	6AX4GT	.69	6CB6	.49	6SK7GT	.49	7B7	.89	12BA7	.99	25Z5	.49
1L4	.49	5X4G	.59	6AX5GT	.79	6CD6G	1.49	6SL7GT	.69	7C6	.89	12BD6	.59	25Z6GT	.69
1LA4	.89	5Y3GT	.49	6BA6	.49	6E5	.79	6SN7GT	.59	7C7	.89	12BE6	.49	35B5	.59
1LC5	.79	5Y4G	.69	6BC5	.69	6F6GT	.59	6SQ7GT	.59	7L7	.99	12BH7	.99	35C5	.59
1LD5	.99	6AB4	.69	6BD5GT	1.09	6H6	.59	6SR7	.69	7N7	.79	12J5GT	.59	35L6GT	.69
1LN5	.89	6AC7M	1.09	6BD6	.59	6J5	.49	6T8	.79	7X7	.79	12Q7GT	.69	35W4	.49
1N5GT	.69	6AG5	.69	6BE6	.49	6J6	.89	6U4GT	.59	807	1.79	12SA7GT	.79	35Y4	.69
1R5	.59	6AG7M	1.19	6BF5	.69	6J7	.49	6U5	.69	12A8GT	.49	12SK7GT	.69	35Z5GT	.49
1S5	.49	6AH6	.99	6BG6G	1.29	6K6GT	.59	6U8	.89	12AL5	.79	12SN7GT	.79	41	.69
1T4	.59	6AK5	.89	6BH6	.69	6L6GT	1.19	6V3	1.59	12AT6	.49	12SQ7GT	.69	45	.69
1U4	.49	6AL5	.49	6BJ6	.79	6L6GA	1.19	6V6GT	.49	12AT7	.79	12S8GT	.79	50B5	.59
1U5	.49	6AQ5	.49	6BK7	.89	6S4	.49	6W4GT	.49	12AU6	.49	14A7	.99	50C5	.59
1X2	.99	6AQ6	.69	6BL7GT	1.09	6S8GT	.99	6W6GT	.79	12AU7	.59	14B6	.79	50L6GT	.59
3A4	.59	6AR5	.59	6BN6	1.09	6SA7GT	.69	6X4	.49	12AV6	.59	14Q7	.99	80	.59
3A5	.79	6AR6	2.49	6BQ6GT	.79	6SC7	.99	6X5GT	.49	12AV7	.69	19BG6G	1.29	117Z3	.49
3LF4	1.09	6AS5	.69	6BQ7	1.49	6SD7GT	.79	6Y6G	.79	12AX4GT	.69	19T8	.99	FM-1000	.89
3Q4	.49													7JP4	16.50



FAMOUS BRAND TV BOOSTER

Model DB-410

While present stocks last! **$14.95**

WEBSTER N-10 CARTRIDGES

Exact repl. for L72A, 82A ... **$1.95**

CRYSTAL PICKUPS

Complete

Webster N-7 ... $1.95
Astatic L71A ... $2.60
Astatic L82 ... $2.60

Clarostat Vol. Controls Reduced

Flat shaft, SPST switch, indiv. boxed. 5M, 10M, 100M, 250M. Your Choice, each ...... 35¢

Kit of 4 controls, 1 each of above **$1.25**

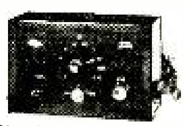
TV VARIABLE CONTROLS

Pix & Sound, 10M ohms, 1 Meg W/SPST switch ..$.79

Vert. & Horiz.

50M ohms, 1 Meg. $.69
Focus & Bright, 50M ohms, 2250 Ohms. $.59
Kit of 3 (1 ea.) ... $1.98
Kit of 6 (2 ea.) ... $3.89

McMURDO SILVER TV PREAMPLIFIER



Simple to hook up, instructions included. Special, while they last! ... **$9.95**

TELEVISION E-Z-I LIGHT

& ELECTRIC Self-Starting CLOCK, Walnut, square face .. **$6.95**

SPEAKER SPECIALS

All PM speakers have Alnico V slugs.

3" OM .68 oz ... $1.29
4" or 5" PM .68 oz 1.29
4"x6" PM 1 oz ... 1.39
6" PM 1 oz 1.59
5"x7" PM 1.47 oz 1.89
6"x9" PM 3.16 oz 3.49
8" PM 2.15 oz 3.69
10" PM 6.8 oz 5.95
12" PM 3.2 oz ... 4.95

AUTO SPEAKERS

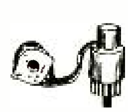
7¼" 4 ohm less output 2.19

7½" PM less output 4.95

Lindstrom 78 RPM PHONO MOTOR

With 9" Turntable **$1.49**

TV PICTURE TUBE REJUVENATOR



Simple to use, puts new life into old picture tubes **$2.79**

STANDARD BRAND TUBES

INDIVIDUALLY BOXED

Manufacturers of tubes do not permit mentioning their names because tubes are FAR BELOW FAIR TRADE. 6 Month guarantee, excepting burnouts and breakages.

0Z4G	.69	6C4	.59	34	.99
1A5GT	.69	6C5GT	.69	35/51	.79
1A7GT	.89	6CB6	.69	35B5	.79
1B3/8016	.99	6CD6G	2.39	35L6GT	.79
1E7	.59	6F6	.69	35W4	.49
1H4G	.59	6H6M	.69	35Y4	.69
1H5GT	.69	6J5GT	.59	35Z5GT	.49
1N5GT	.79	6J6	.99	36	.69
1Q5GT	.99	6J7GT	.89	37	.69
1R5	.79	6K6GT	.59	39/44	.69
1S4	.99	6N7M	.99	47	.99
1S5	.79	6R7GT	.99	50A5	.99
1T4	.79	6S4	.69	50C5	.69
1T5GT	.99	6SA7M	.69	50L6GT	.69
1U4	.79	6SG7M	.89	56	.59
1X2	.99	6SH7GT	.89	57	.59
3D6/1299	.59	6SJ7GT	.69	58	.59
3Q4	.89	6SK7GT	.69	76	.69
3Q5GT	.99	6SL7GT	.79	77	.69
3S4	.79	6SN7GT	.79	117Z6GT	1.09
3V4	.79	6SQ7GT	.59	1LA4	.99
5U4G	.69	6T8	.99	1LC5	.99
5V4G	.99	6V6GT	.69	1LG5	.99
5Y3GT	.49	6W4GT	.69	1LE3	1.19
5Z3	.79	6X5GT	.59	1LG5	1.19
6AB4	.79	6Y6G	.99	1LH4	1.19
6AC7	1.09	12A6	.69	1LN5	.99
6AG5	.79	12AT6	.69	3LF4	1.19
6AG7	1.29	12AT7	.99	7A8	.89
6AH6	1.29	12AU6	.69	7B7	.89
6AK5	1.29	12AU7	.89	7C6	.89
6AL5	.69	12AV6	.69	7C7	.89
6AQ5	.69	12AV7	1.19	7E5	.79
6AR5	.69	12BA6	.69	7E6	.79
6AR6	2.49	12BE6	.69	7E7	.79
6AT6	.59	12BH7	.99	7H7	.89
6AU5	1.29	12J5GT	.59	7N7	.89
6AU6	.69	12K8GT	.69	7L7	1.09
6AV6	.59	12SA7GT	.79	7Q7	.89
6AX5GT	.79	12SJ7GT	.69	7V7	1.29
6A3	.99	12SK7GT	.79	7Z4	.69
6A7	.99	12SN7GT	.89	14A4	.79
6BA6	.69	12SQ7M	.69	14C5	.99
6BC5	.79	12SQ7GT	.69	14F7	.89
6BG6G	1.69	19BG6G	2.39	14F8	1.19
6BL7GT	1.29	25BQ6	.99	14J7	.99
6BN6	1.29	25L6GT	.69	14Q7	.99
6BQ6GT	129	25W4	.79	14R7	.99

Dept. C-10

GREYLOCK'S FINEST "BONDED" CONDENSERS

Unit price in lots of ten or more assorted, shown. Additional 10% off for orders of 100 or more assorted.

Mfd	WVDC	Each
16	150	$.29
24	150	.35
30	150	.35
40	150	.39
20X20	150	.39
20X40	150	.39
30X30	150	.44
40X40	150	.45
50X30	150	.45
8	450	.29
8X8	450	.49
16	450	.39
30	450	.44
40	450	.49

TUBULAR ELECTROLYTIC KITS

Fine assortment, popular types for radio, TV service.

10 condensers ... $1.49
25 condensers $3.69

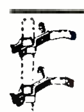
"DOOR-KNOB" CERAMIC

Hi-Voltage

500 Mmfd 20 Kv .. .59
500 Mmfd 10 Kv .29

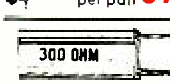
INSULATED RESISTORS

¼ & ½ Watt, Kit of 100 Asstd $2.25
½ Watt A-B & IRC, separated, in plastic container, 20 popular sizes **$4.85**



3" WALL MOUNTS

with hardware, per pair **39¢**



300-OHM TWIN LEAD

$12.95 per M ft.
$ 1.49 per C ft.

CAN TYPE CONDENSERS

Separate Leads. 450 V. Working.

Mfd	Size	Net
8	1⅜x3	.59
12	1⅜x3	.65
16	1⅜x3	.69
20	1⅜x3	.79
30	1⅜x3	.89
40	1⅜x3	1.05
8-8	1⅜x4	.75
8-16	1⅜x4	.89
16-16	1½x4	1.05
20-20	1½x4	1.19
8-8-8	1½x4	1.05

5% off, lots of 50 asstd.
10% off, lots of 100 asstd.

TUBULAR PAPER BYPASS CONDENSER KITS

100 Asstd, 400 WV $4.95
100 Asstd, 600 WV $5.95

DEFLECTION YOKES

63° RCA 205D1 .. $ .99
70° Type 206D1 .. 2.99
60° Type 201D1 .. 2.49

ION TRAPS

Permanent Magnets.

Single, 203D1 ... $.39
Double, 203D3 ... $.69

HORIZ. OUTPUT & HI-VOLT FLYBACK

TRANS., for 16", 17" Pix Tubes $2.99

EXTRA!

5% ADDITIONAL DISCOUNT ON ANY ASSORTMENT OF 100 TUBES OR MORE!

All Prices F.O.B. NYC. Please include postage and insurance with your remittance. 25% deposit on all C.O.D. orders. 50¢ Handling charge on orders under $5.00.

"A Trusted Name in Radio!"

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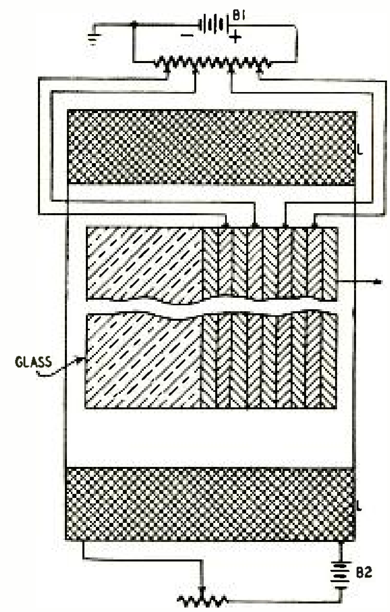
LIGHT AMPLIFIER

Patent No. 2,594,740
Lee deForest, Los Angeles, Calif., and William A. Rhodes, Phoenix, Ariz.

This device can amplify both light and invisible radiation. It consists of a glass or plastic base on which various thin layers are sprayed, deposited, or coated. Nine such layers are shown here at the right of the glass base.

The first layer is photoemissive. When light shines through the glass into the layer, electrons are emitted. They move through the second layer, a wire screen or grid connected to B1. The particles then continue through the grid into the



third layer, prepared for secondary emission. As many as 10 electrons may be emitted for each primary electron. The secondary particles are accelerated by the fourth layer, a wire grid also biased positively by B1. These four layers comprise one stage of the light amplifier.

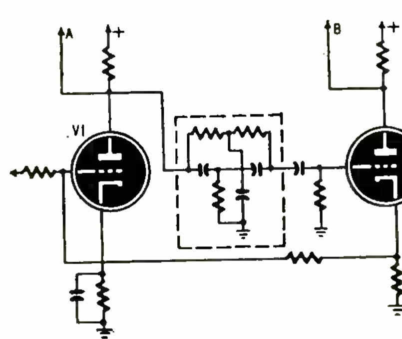
The figure shows a second stage of amplification following the first, accounting for 8 of the 9 thin laminae. The output is a greatly magnified electron beam which is fed into the last layer. This one is fluorescent. It glows when electrons strike it. The output light beam may be hundreds of times more intense than the input light beam.

A coil L surrounds the amplifier. Current from B2 generates a magnetic field within this coil. It forces all electrons to move in the same general direction (toward the output). Spreading is prevented and the output image remains sharply focused.

SIGNAL SELECTION

Patent No. 2,593,600
Winthrop S. Pike, Princeton, N. J.
(Assigned to Radio Corp. of America)

This circuit separates frequencies which make up a composite signal. Such a signal is often used between a TV transmitting station and a portable TV pickup. The composite includes a 60-cycle pilot tone for synchronization purposes as well as audio for telephone messages.



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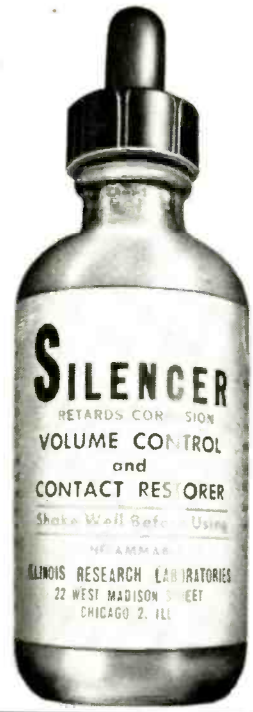

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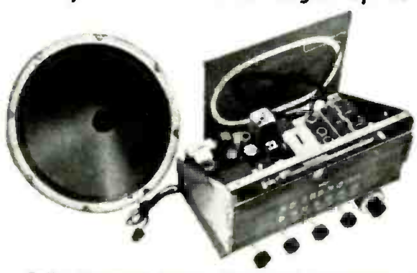

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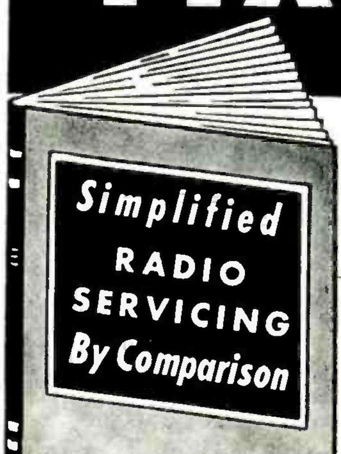

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A parallel-T network (shown in the dotted box) couples the two triodes. This network passes all frequencies except the one to which it is tuned, in this case 60 cycles. Thus the pilot tone does not appear at the grid of V2. The a.f. is amplified by V2 and may be taken off at B.

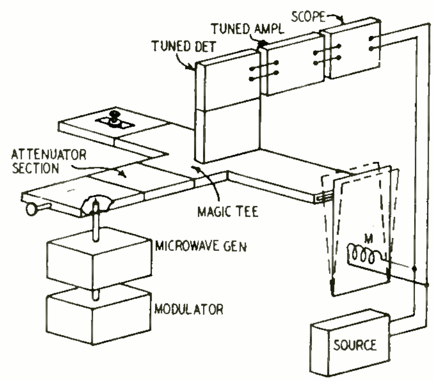
Note that a.f. is also taken off at the cathode of V2. It is fed back degeneratively to V1. This weakens the a.f., so very little audio appears at point A. The pilot tone is not fed back, so full output appears at A.

MEASURING DISPLACEMENT

Patent No. 2,596,531
Howard F. Clarke, Pullman, Wash.
(Assigned to United States of America as represented by the U. S. Atomic Energy Commission)

This instrument measures displacement (or vibration) accurately. The vibrating element is coupled only through an electromagnetic field. Therefore the element is not loaded down during a measurement.

A microwave generator feeds energy into a waveguide. The u.h.f. is modulated by a square-wave generator. The microwaves are attenuated and fed into a "magic-tee" bridge. This bridge balances when its right and left arms have the same impedances. In that case there is no output. The left arm contains a tuned element. It is adjusted for zero bridge output with the vibrating element in neutral position.



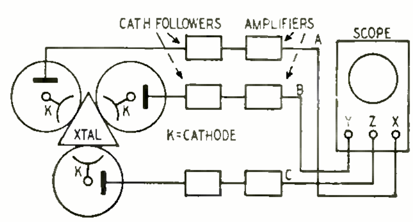
When the vibrating element is displaced in either direction, there is a change in the reflected energy in the right-hand arm. The bridge is unbalanced and output appears. The microwave energy is detected and amplified (at the square-wave frequency). This low-frequency signal is fed to an oscilloscope. For convenience, the displacement or vibration is effected by magnet M energized from the line. The line also sweeps the scope, so its pattern remains stationary.

IMPROVED SCINTILLATION COUNTER

Patent No. 2,590,867
Harmut P. Kallman, Bellaire, N. Y.
(Assigned to United States of America as represented by the Secretary of the Army)

This invention using stibene crystals cancels out noise in scintillation counters. These crystals give off flashes of light when bombarded with nuclear particles. A multiplier photocell converts the flashes to pulses of voltage. Thus we can tell the strength of radiation by counting the pulses. Unfortunately, we cannot distinguish between noise voltages in the multiplier cell and the voltage pulses produced by the flashes of light. By eliminating the noise we obtain a more accurate count.

The scintillation crystal is ground in the shape of a triangle. In a radioactive field, flashes will



SAVE $50. on this Brand New 1953 SUPER-POWER TV CHASSIS

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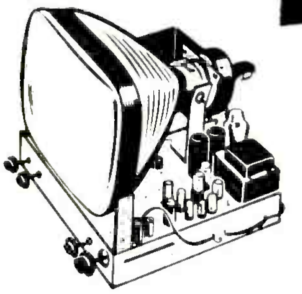
This new chassis incorporates all the new advances in TV that have been developed in the largest research laboratories and in various test homes.



The first time! 1953 New design Super-Cascode TV Chassis model 620. The ideal companion model for the famous 630 DX-Chassis.

NEW!
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NEW!
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NEW!
- Low-Noise bi-filter IF system to widen the band width and produce the ultimate in picture quality.

NEW!
- Local-fringe switch to increase sensitivity for ideal fringe area reception.

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COMPARE THESE INVALUABLE FEATURES!

- Super-cascode turret tuner: 12 channels: may be converted to UHF in 10 seconds.
- Fast action automatic gain control to eliminate outside interference & simplify tuning.
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- Increased hi-voltage for better daylight viewing.
- Increased sensitivity in fringe areas by using special new local-fringe switch.
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- Front & rear mounting brackets for all tubes.
- Finest quality, standard components used throughout.
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#620 Chassis & 20" tube & console cabinet, *a complete TV set*	194.50
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For 17", 19", 20" & 21" Picture Tubes—630 or other Chassis.
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With new Cascode tuner, 30-tubes, for 16" to 24" picture tube. Adaptable for color and UHF.

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CONVERT YOUR OLD TV SET TO 17", 20", 21" or 24" PICTURE TUBE.

Complete conversion kit to match your set! Wonderful new kit comes complete with all parts and diagrams necessary to easily convert any set to larger tube size. Kit includes:

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Be sure to send us make & model of your set for matching conversion kit.

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- 1—8 element conical antenna
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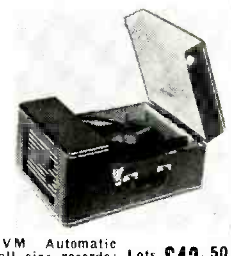

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540 to 1650 KC (560 to 182 meters)
6 tuned circuits
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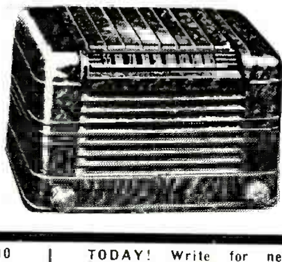
$15.95 ea. — Dealer Net: lots of 4: **$14.95** ea.



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LOWEST PRICE WE KNOW

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20/20—150 V.	39c	$3.50	$33.95
40/40—150 V.	45c	3.95	37.95
50/30—150 V.	45c	3.95	37.95
50/50—150 V.	49c	4.39	39.95
40/40/20—150 V.	69c	6.49	57.95
50/30/20—150 V.	69c	6.49	57.95
50/50 x 200 150 V.—25 V.	79c	7.49	67.95
25—25 V.	19c	1.50	13.50
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For Hi-Lo frequency antennas. Special close-out price: 39c ea.

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THE Rose COMPANY

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show at each face of the crystal. These fall on separate photomultiplier tubes. For convenience we show only a cathode and collector in each tube. The three pulse outputs follow separate paths; A, B, and C. Each circuit includes a cathode follower for isolation and an amplifier.

Pulses from A, B, and C are tied to the X, Y, and Z (horizontal, vertical, and blanking) terminals, respectively. The beam is set just below visibility. Pulses from C feed the amplifier so the beam becomes visible. When 3 pulses arrive together we see a diagonal trace. If only one or two arrive, we see either a dot or nothing at all.

It is not likely that random noise will occur in all three circuits simultaneously more than once every 16 minutes. Noise is effectively cut out and we are assured an accurate scintillation count.

D. C. MEASUREMENT

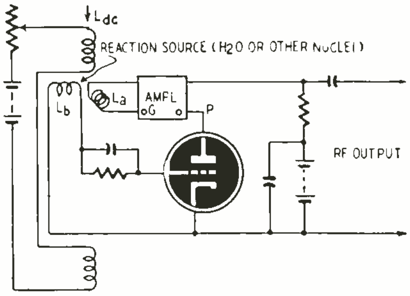
Patent No. 2,589,494

William D. Hershberger, Princeton, N. J.
(Assigned to Radio Corp. of America)

This invention is based on the principle of nuclear resonance. It makes possible the accurate measurement of direct current.

Nuclear particles are like gyroscopes. While spinning, they can absorb energy from surrounding magnetic fields and can also radiate. This inventor immersed the nuclei in two fields—one d.c., the other r.f. Nuclear absorption and radiation then occurs at the r.f. rate. This reaction is greatest at a critical ratio of frequency/d.c. field. The most important fact is that nuclear resonance is *ultra-sharp*. It acts like a tuned circuit having a Q of 70,000.

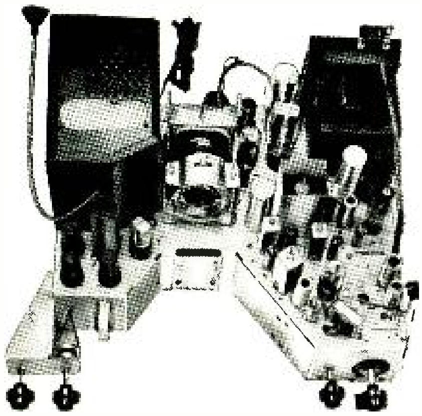
To make a measurement, we may vary either the d.c. field or the r.f. field. When reaction



occurs, we know that frequency/d.c. field is at the critical value. If the frequency is known, we can easily find the strength of the d.c. field. For hydrogen nuclei (common protons) the critical value is 4257.76 cycles per gauss.

The figure shows three coils: $L_{d.c.}$, L_a and L_b. $L_{d.c.}$ is placed vertically and is energized from a regulated d.c. source. L_a is fed by the output of a high-gain r.f. amplifier. L_b is connected to the input stage of this amplifier. Coils L_a and L_b are at right angles to each other, so they are not coupled magnetically. All three coils are placed near a test tube filled with water (which contains hydrogen). Energy absorbed by the hydrogen protons in the field of (L_a) is radiated and received by the field of L_b. Thus these coils are coupled only through *nuclear resonance*.

L_a and L_b are connected like the plate and grid coils of an oscillator. Energy from the first can be fed back to the second. Maximum feedback occurs only at the critical frequency, once the d.c. field is set. For any given value of current in $L_{d.c.}$ there is a definite output r.f. We can measure the frequency; then by referring to the critical ratio, we find the field about $L_{d.c.}$. If the coil is calibrated, the direct current may be known exactly. END



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THIS OFFER MAKES TV HISTORY . . . never ever so low a price, never ever such high quality . . . Quality and improvements in components that will enable the finished chassis to operate 10", 12½" and certain 16" picture tubes. . . . This STANDARD KIT consists of a complete set of parts, similar to those used in the famous RCA #630 29-tube chassis, including all tubes, speaker, resistors in correct 5%, 10%, 20% tolerances, the new Cascode tuner and the Brooks LIFE-SIZE Instructions (less CRT & wire)

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#630 SUPER DELUXE KIT

For the 31-tube CHASSIS that operates all 16" to 24" picture tubes . . . Tops for fringe areas . . . Peak performance for clarity, brilliance, stability and definition . . . This SUPER DELUXE TV KIT consists of a complete set of parts, including the basic components of the STANDARD KIT plus added features, more tubes, doubler components, AGC components, Cascode tuner, Cosine 70° deflection yoke, 12" speaker, etc., and the Brooks LIFE-SIZE Instructions. (less CRT & wire)

only . . . **$119.44**

#630 PARTS • IN SETS

VIDEO AND I.F. KIT, 19 items	$7.84
AGC KIT, complete with instructions	4.59
VARIABLE CONTROL KIT, 9 controls	5.83
CARBON RESISTOR KIT, 107 resistors	6.98
WIREWOUND RESISTOR KIT, 4 resistors	2.31
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TV WIRE & SOLDER KIT, for any Set	1.49

STANDARD PICTURE TUBES

DuMont or Sheldon With a Full Year Guarantee!

10"	— #10BP4A	(Round, Black)	$18.36
12½"	— 12LP4A	(Round, Black)	24.72
14"	— 14CP4A	(Rectangular, Black)	26.48
16"	— 16AP4A	(Round, Metal, Black)	28.97
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HORIZONTAL LINEARITY COIL,	201R3	.39
3rd & 4th PIX COILS, (2)	202L1 each	.39
FILAMENT CHOKES, (5)	204L1 each	.09
VIDEO PEAKING COIL,	203L1	.18
VIDEO PEAKING COIL,	203L2	.18
VIDEO PEAKING COILS, (2)	203L3 each	.18
VIDEO PEAKING COILS, (2)	203L4 each	.18
ION TRAP BEAM BENDER, double	203D3	.98
***ION TRAP BEAM BENDER,** single	203D1	.79

VARIABLE CONTROLS

PICTURE & SOUND, 10k ohms 1 meg. & switch	1.14
VERTICAL & HORIZ. 50k ohms 1 meg.	1.04
BRIGHTNESS CONTROL, 50k ohms	.44
HORIZ. CENTERING, wirewound 20 ohms	.57
HEIGHT CONTROL, 2.5 megohms	.48
VERTICAL LINEARITY, 5000 ohms	.44
VERTICAL CENTERING, wirewound, 20 ohms	.96
FOCUS CONTROL, wirewound, 1500 ohms	.98
HORIZONTAL DRIVE, 20k ohms	.44
***HORIZONTAL TRIMMER,** 40-103 mmf	.39

WIREWOUND RESISTORS

5000 ohms, 5 watts	.22
***5000 ohms,** 5 watts (2) each	.22
VOLTAGE DIVIDER, 1360/250 ohms	.74
VOLTAGE DIVIDER, 5300/2-500 ohms	.89
VOLTAGE DIVIDER, 6750/12/93 ohms	.72

MICA CONDENSERS—85°C Operation

270 mmf —	500 v.	(7) each	.12
390 mmf —	500 v.		.12
470 mmf —	500 v.		.12
680 mmf —	500 v.		.16
4700 mmf —	500 v.		.29
*220 mmf —	1500 v.		.29

ELECTROLYTIC CONDENSERS—85°C

40/10/80 mfd	450/450/150 v	1.37
40/40/10 mfd	450/450/450 v	1.49
80/50 mfd	450/50 v	1.49
40/10/10 mfd	450/450/350 v	1.37
20/80 mfd	450/350 v	1.49
250/1000 mfd	10/6 v	.98

TUBULAR CONDENSERS—85°C

.005	– 400v	(3) ea.	.07	.01	– 600v	(2) ea.	.12
.01	– 400v	(5) ea.	.09	.05	– 600v	(6) ea.	.15
.015	– 400v	(2) ea.	.11	*.05	– 600v		.15
.05	– 400v	(5) ea.	.12	.1	– 600v		.17
.1	– 400v	(2) ea.	.14	.001	– 1000v		.14
.25	– 400v	(2) ea.	.21	.004	– 1000v	(2) ea.	.14
.002	– 600v		.09	.035	– 1000v		.18
.0025	– 600v	(2) ea.	.09	.05	– 1000v		.18
.004	– 600v		.11	*.1	– 1000v		.22
.005	– 600v		.11	*.5	– 200v		.24

CERAMIC CONDENSERS

10 mmf 10% Tolerance	.12
51 mmf 10% Tolerance	.12
56 mmf 10% Tolerance	.12
82 mmf 10% Tolerance (2) each	.12
1200 mmf not less than rated capacity	.14
1500 mmf not less than rated capacity (21) ea.	.14
6800 mmf not less than rated capacity	.19
***AGC RESISTORS & MICA** set of 7	.74

PUNCHED CHASSIS PAN, cadmium plated	$4.87
630-KIT, screws, nuts, rivets, washers	1.69
HI VOLTAGE CAGE ASSEMBLY, complete	3.73
VOLTAGE DIVIDER SHIELD & COVER "	1.79
ELECTROLYTIC COND. SUB-CHASSIS	.94
SOUND DISCRIMINATOR SHIELD	.19
DEFLECTION YOKE BRACKET	.29
DEFLECTION YOKE MOUNTING HOOD	.59
FOCUS COIL BRACKETS set	.49
CATHODE TRAP COIL SHIELD	.39
CHASSIS MOUNTING BRACKETS set of 4	.44
BRIGHTNESS & HOLD CONTROL BRACKET	.59
WIDTH CONTROL BRACKET	.16
TUNER SHAFT BRACKET	.17
***FUSE** (.25 amp.) **& HOLDER**	.24
HV RECTIFIER, SOCKET ASSEMBLY, single	.79
***HV RECTIFIER, SOCKET ASSEMBLY,** double	1.37
TV 6' LINE CORD, with both plugs	.29
INTERLOCK SAFETY CONNECTOR (input)	.17
COMPLETE TERMINAL STRIP KIT, set of 30	.98
TUBE SHIELD & CLIP 2 sets	.22
***AGC BRACKET & SOCKET**	.39
MINIATURE WAFER SOCKETS (10) each	.07
MINIATURE MOLDED SOCKETS (2) each	.12
OCTAL WAFER SOCKETS (13) each	.07
CATHODE RAY TUBE SOCKET, 18" leads	.39
HV KINESCOPE LEAD, with clip	.39
AUDIO OUTPUT TRANSFORMER (6K6)	.69
8" PM SPEAKER, heavy alnico #5 magnet	3.97
***12" PM SPEAKER,** heavy alnico #5 magnet	6.94

H. V. FILTER CONDENSERS-(Cartwheels)

15kv	500 mmf	.67
*20kv	500 mmf (3) each	.79

CARBON RESISTORS

½ WATT, 5% TOLERANCE, 10, 3900, 4700, 5600, 10k(2), 18k, 680k(2), 820k **OHMS,** 1.2, 1.5 **MEG** each **.09**

½ WATT, 10% TOL., 3.3 39(3), 330 560, 680, 1800, 2700(2), 3300, 4700, 6800(4), 8200(4), 10k(4), 22k, 27k(2), 47k, 56k, 100k(3), 150k, 270k 470k(3) **OHMS,** 1(2), 2.2(2) 4.7, 6.8 **MEG**
*3.3, 47, 390k **OHMS** each **.07**

½ WATT, 20% TOL., 100(3), 150(5), 1000(8), 3300 22k(3), 150k, 220k(2), 330k, 470k(3) **OHMS,** 1(3), 10 **MEG**
***220k OHMS** each **.05**

1 WATT, 5% TOL., 2.2, 39k, 47k **OHMS** each **.14**

1 WATT, 10% TOL., 1800, 3300, 4700(2) 10k(2), 18k, 22k, 27k, 39k, **OHMS, 1 MEG**
*18k each **.12**
*4-470k **OHMS** (in series) in sleeves set **.58**

1 WATT, 20% TOL., 1000, 10k **OHMS**
***470k OHMS** each **.10**

2 WATT, 10% TOL., 100, 270 **OHMS** each **.18**

2 WATT, 20% TOL., 2200(2) **OHMS** each **.14**

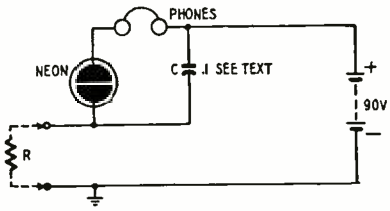
#630 TV TUBES—STANDARD MAKES

6AG5	R. F. Amplifier	1.27
6J6	R. F. Oscillator & Converter	1.39
6BA6	1st and 2nd Sound I.F. (2) each	.84
6AU6	3rd Sound I.F.	.84
6AL5	Sound Discriminator	.94
6AT6	1st A.F. Amplifier	.69
6K6GT	Audio Output	.77
6AG5	1st, 2nd, 3rd, 4th Pix I.F. (4) each	1.27
6AL5	Pix. Det. & DC restorer	.94
6AU6	1st Video Amplifier	.84
6K6GT	2nd Video Amplifier	.77
6SK7	1st Sync. Amplifier	.84
6SH7	Sync. Separator	1.04
6SN7	2nd Sync. Amp & Hor. & D's	1.04
6J5	Vert. sweep osc. dis	.69
6K6GT	Vertical sweep output	.77
6AL5	Hor. Sync. Discriminator	.94
6K6GT	Hor. Sweep Oscillator	.77
6AC7	Hor. Sweep Osc. Control	1.39
6BG6G	Horizontal Sweep Output	2.32
5V4G	Reaction scanning	1.14
1B3	High Voltage Rectifier	1.27
5U4G	Power Supply Rectifier (2) each	.69
***1B3**	High Voltage Rectifier	1.27
***6AU6**	Keyed AGC	.84
C.R. Tube	Optional	

HIGH-RESISTANCE TESTS

In some experimental work, it is necessary to measure very high resistances such as the leakage resistance of a capacitor or the insulation resistance of a length of cable or a tube socket. Such resistances are beyond the range of conventional ohmmeters but they can be easily measured by using the R-C oscillator technique where the unknown resistance is the R component.

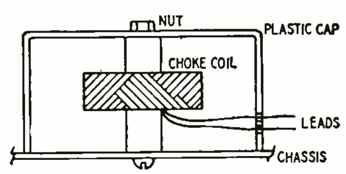
The diagram shows a neon-tube relaxation oscillator with the components



juggled so the resistance is at ground potential. C is chosen to give a low oscillation frequency. A value of 0.1 µf is suitable for resistances in the range of 10 to 100 megohms. Connect the unknown resistance to the terminals and count the clicks produced in a convenient interval of time; say one minute. From this, calculate the average time between clicks. Call this time t. The resistance is given by the formula $R = t/C$ where R is in megohms, t is in seconds, and C is in microfarads. This will not give the exact value of the resistance but it will be close enough for most purposes.—*Charles Erwin Cohn*

COVERS FOR R.F. CHOKES

Small pie-wound r.f. chokes and coils are very delicate and easily damaged. We must be always on the alert to avoid touching the winding with a hot soldering iron and to prevent stray bits of solder or metal filings from becoming imbedded between the turns and eventually causing a short or open circuit. Plastic bottle caps come in a



variety of shapes and sizes and it is not hard to find one that will make a good protective shell for that small choke or coil. Drill two small holes in the side of the cap for the leads, then mount the cap by running a bolt through a hole in its top and the core of the choke as shown in the drawing.—*B. W. Welz*

IMPROVING A.V.C. ACTION

In many receivers, the tubes controlled by a.v.c. have their screens fed through dropping resistors connected to the B plus line. This connection reduces the effectiveness of the a.v.c. system. When the a.v.c. voltage rises—becomes more negative—the screen current drops and screen voltage rises. The

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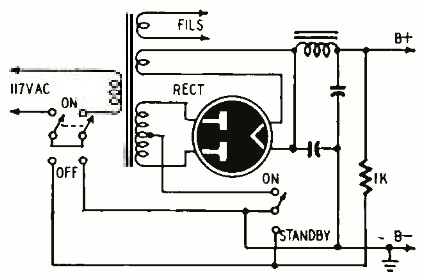
increased screen voltage tends to increase the gain of the stage and cancels a part of the gain reduction due to a.v.c. action.

It is better to feed the screens from a tap on a heavy voltage divider. The screen voltage remains constant and the improvement in a.v.c. action is quite noticeable. Only one-half the previous a.v.c voltage is needed for the same decrease in gain.—*Charles Erwin Cohn*

POWER SUPPLY SWITCHING

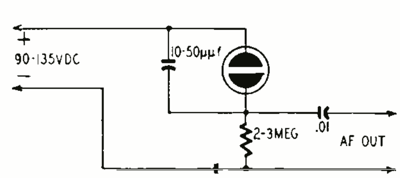
When developing or experimenting with receivers, amplifiers, and the like, we often desire to adjust or work on the circuit as soon as the power is turned off. If we do, we run the risk of damaging our multimeters or receiving a serious shock from the charge remaining on the filter capacitors. Therefore, it is desirable to rapidly discharge the filters as soon as the power is turned off. A heavy bleeder will do this but it consumes power while the supply is turned on.



The diagram shows a simple power supply with a.c. and stand-by switches arranged to discharge the filter capacitors when either is turned off. The 1,000-ohm resistor limits the current through the switch contacts as the capacitors are shorted out.—*J. Sareda*

SIMPLE A.F. OSCILLATOR

While working on a project late one evening, we found that we needed a neon tube for a relaxation type a.f. oscillator to complete the job. The stores were closed and we didn't have a neon lamp, so we substituted a fluorescent lamp starter. The starter was opened and the capacitor was removed from across the small neon tube. A capacitor of 10–50 μμf was connected across the tube and a resistance of three megohms was connected between one side of the lamp and a source of 90–135 volts d.c. (See diagram.) The audio signal is taken from across the resistor through a .01-μf blocking capacitor and may be fed to a key and headphones for code practice, to the modulation jacks of an r.f. oscillator, or to the input of an audio amplifier being tested. The pitch of the note can be changed by varying the capacitance or resistance in the circuit. —*G. J. Macheak*



PARTS LISTS

Bills of material for most of the pieces of equipment described in RADIO-ELECTRONICS construction articles are on hand at all radio parts jobbers and distributors who sell the magazine. See your dealer for a complete parts list of any of this apparatus you wish to construct.

PRECISION RESISTOR KINK

Ordinary composition carbon resistors can be used instead of expensive precision units in step attenuators, R-C oscillators, meter multipliers, etc. They will hold their resistance within 1% if you take two precautions: (1) Limit the voltage drop, and the power actually dissipated in each resistor to not more than 10% of its commercial ratings. (2) Use special care not to overheat the body of the resistor while soldering it in the circuit.

In 1943 I constructed step attenuators from standard ¼-watt resistors checked on a bridge to within 1% of the desired values. Four years later, the resistors were rechecked and found to be within the original tolerances. The attenuators were operated in grid circuits at levels of about 1 volt. Similar resistors used as plate loads failed in service.

In the original assembly, the resistor leads were sandpapered clean, then soldered with a very hot iron while the body was held under water. The underwater treatment is hardly necessary with 1- and 2-watt resistors. Just leave the leads long, clean them, then solder rapidly with a very hot iron. The amount of heat transferred to the body of the resistor depends on the length of time that the iron is applied. Make it fast. (Instead of the water bath, try the thermal shunt described on page 78 of the July 1951 issue. It is equally effective and more convenient to use. —*Editor*)

(If you cannot find a resistor within the desired tolerance range, select the closest value so little padding is necessary. The chances of hitting 10,000 ohms within 1% by selecting two 5,000-ohm units are slim indeed. If you start with 8,000 or 9,000 ohms, the chances of hitting 10,000 on the nose are much better because the permissible tolerance of the padding resistor is much greater. If a padder resistor changes the total resistance by 10%, a 1% change in padder resistance will change the total resistance only 0.1%.)

If the available resistor is smaller than the desired value, a padder resistance is inserted in series. Its resistance is the difference between the desired and available values.

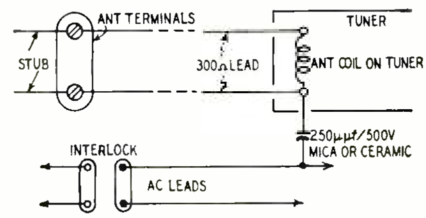
Parallel padding is used when the available resistance is too large. If the percentage change in the total resistance produced by the padder is 20% or less, you can use the following procedure for mentally computing the padder value:

1. Divide the desired resistance value by the required reduction in resistance.
2. Multiply the figure thus obtained by the desired resistance.

For example: We need 100,000 ohms. The closest available value is 105,000 ohms—just 5,000 ohms too high. In step 1,100,000 divided by 5,000 equals 20. In step 2, we multiply 20 by the desired resistance (100,000) and find that the padder resistor is 2,000,000 ohms or 2 megohms.—*L. Fleming*

POWER-LINE TV ANTENNA

The old trick of using the power line for an antenna will work with TV sets in good locations. I found that a power-line antenna actually works better than the built-in antennas in some sets. It will probably be very useful to the technician who does not have access to an outside antenna when he is servicing a set. (Warning: Power-line antennas can produce queer effects of their own. Don't get confused!)



I used a 250-μμf mica capacitor between one side of the 300-ohm antenna input terminals and one side of the a.c. line. I got good ghost-free pictures on channels 4 and 5, the only two low-channel stations in this area. Channel 7 was snowy, but by attaching a 300-ohm line stub of the right length to the antenna connectors I got a good picture on that channel.

I got best results with the circuit drawn above. Try the capacitor on each side of the antenna coil and reverse the a.c. line plug for best reception. —*B. W. Welz*

USING THERMAL RELAYS

Heat-operated switches (thermostats) such as the Fenwall Thermoswitch type 1565, have a number of useful applications in the home, ham shack, laboratory, and on the farm. They have normally-closed contacts which can be adjusted to open at any temperature from well below zero to 400° F. In the home, they can be used to control exhaust fans in the kitchen, basement, or attic. A few may be installed in the attic, basement, garage, barn, or any place where a fire is likely to start and burn unnoticed. They can be connected to an alarm system and set to go off when the temperature rises above normal.

Amateurs can use them to control cooling blowers or heat elements in precision oscillators. One can be taped to the side of a power transformer and set to open the circuit when the transformer gets hotter than normal.

Fruit growers can set them to turn on an alarm when the temperature drops to the point where frost is likely to form.

The thermostat can be used as the control unit of a time-delay circuit. The unit may be taped to the side of a light bulb or enclosed in a small oven with a heating element. The timed interval is started by turning on the light or heater and is ended when the temperature rises enough to open the switch contacts. The timed interval can be varied over wide limits by using bulbs or heaters of different wattages and different settings of the temperature control.—*O. C. Vidden* END

OSCILLOSCOPE CONVERSION

Ordinary oscilloscopes with free-running recurrent sweeps will not give clear pictures of transients or unstable recurrent waveforms even with full synchronization. Special scopes (synchroscopes) are needed for viewing waves of these types. These have "one-shot" sweeps that produce a trace *only* when a sync pulse is applied.

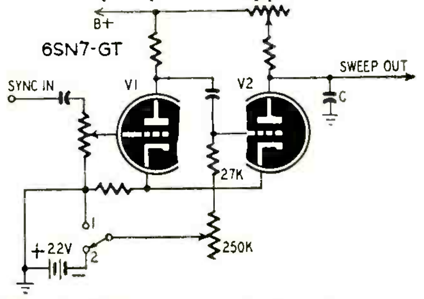


Fig. 1—Bias battery in fine-frequency control circuit gives "one-shot" sweep.

Any standard scope with a *multivibrator* sweep oscillator can be easily converted to operate as a synchroscope. For example, in many scopes, the arm of the fine frequency control—which biases the discharge tube—is normally grounded. Fig. 1 shows the circuit modified by connecting the arm to a s.p.d.t. switch. In position 1 the arm is grounded for normal recurrent sweep. In position 2 a fixed negative bias of 22.5 volts holds the tube below cutoff and prevents sweep capacitor C from discharging. The spot is held at the right-hand edge of the screen until a 3 or 4-volt *negative* pulse at the sync input triggers the circuit. Capacitor C discharges, returning the beam to the left, and recharges slowly to form the sweep trace. A single sweep is produced for each trigger pulse. The scope controls must be set so the charging time of capacitor C is long compared to the duration of the pulse to be viewed.—*H. J. Carter*

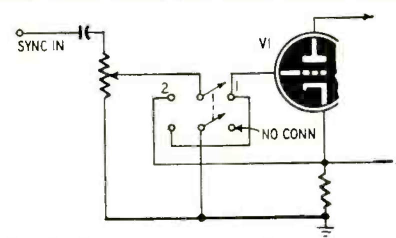


Fig. 2—Input selector for triggering sweep with positive or negative sync.

(A d.p.d.t. switch may be added as shown in Fig. 2 to provide for either positive or negative trigger pulses. In position 1 negative trigger pulses are applied to the grid; in position 2 the grid is grounded and positive pulses are applied to the cathode. Both switches and the battery terminals can be mounted on the oscilloscope panel. *—Editor*)

NOVEL OHMMETER CIRCUIT

Conventional ohmmeters have the following disadvantages when used for checking resistances in electronic and electrical equipment:

1. Scale graduations are wide

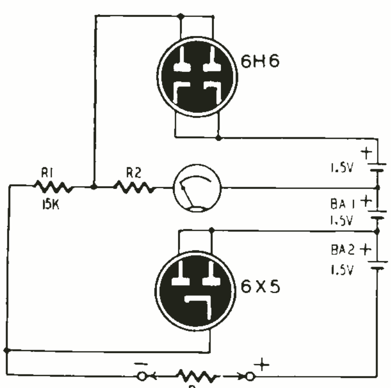
open at the center of the dial and accuracy is higher than usually required. At the ends, markings are crowded and difficult to read, and accuracy is often lower than the tolerance of conventional resistors.

2. Several ranges must be provided to insure high accuracy on the lower ranges.

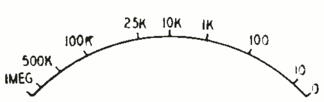
3. The operator must take care to remove all voltages and to discharge any heavy capacitors which may be in the circuit under test, or heavy currents may flow through the instrument and damage the meter movement or its calibrating resistors.

A novel ohmmeter which has a single range with expanded graduations at the low end of its scale and internal protection against damage by external voltages is described in patent No. 2,583,130 issued to Woodrow F. Wrolson and Harold Overdick. The circuit of the units is shown in the diagram at *a* and the drawing of a typical dial scale of the instrument is shown at *b*.

Resistors R1 and R2, the 100-μa meter, and batteries BA1 and BA2 are in series across the test terminals in the usual ohmmeter circuit. R2 is selected so its resistance plus the resistance of the meter equals the resistance of R1.



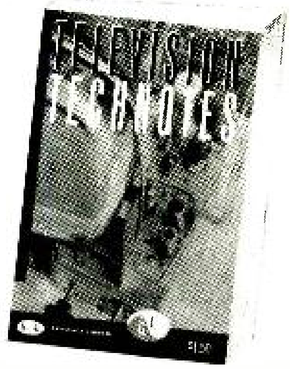
a

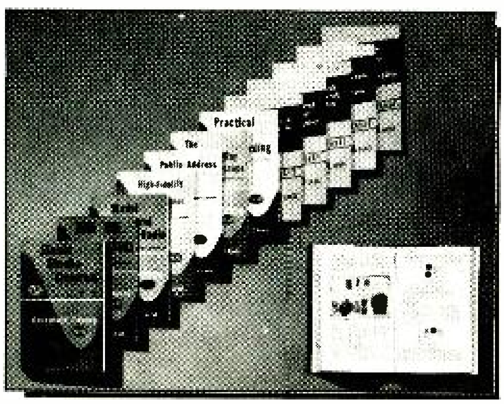


b

The 6X5 connected in series with BA1 across the meter and R1 and R2 spreads the dial markings at the low end of the dial so the 10-ohm point falls at about the same place as 1,000-ohm point on a conventional ohmmeter.

When R_x is a comparatively low value, the current flowing through it from BA1 and BA2 is high. A part of this current flows through the meter and the rest is bypassed through the 6X5. This reduces the current through the meter and causes the calibration to fall to the left of the point it would take if the 6X5 were left out of the circuit. As the resistance of R_x increases, the voltage drop across it increases and effectively subtracts from the voltage between plate and cathode of the 6X5. This causes the resistance of the tube to increase, lower-





ing the amount of current shunted around the meter. When R_x is large enough to produce a drop of 1½ volts, the plate-cathode voltage of the 6X5 is zero and full current passes through the meter. From this point on, the scale graduations conform to those of a conventional ohmmeter.

If the instrument is unintentionally conected to a power supply with the negative side connected to the negative test terminal, the 6X5 conducts and bypasses the current around the meter. The 6H6 protects the meter against accidental damage through the application of voltages of reverse polarity. With the two tubes protecting the meter against d.c. voltages of opposite polarities, the instrument is automatically protected against damage by alternating voltages.

RADIOTELEPHONE RELAY

Have you ever heard hams relaying radiotelephone transmissions from other stations or a net control station retransmitting the activities of a 2-meter net on a lower frequency? If you have, you've probably wondered how it was done. The figure shows a setup for automatically making simultaneous retransmissions.

T1 is the output transformer of the receiver being used to pick up the signal to be relayed. It should have a 500-ohm secondary and preferably a second secondary winding for feeding headphones. Receivers having a 500-ohm audio output include the Hallicrafters SX-25, SX-28, and SX-43, the Hammarlund Super-Pro, and Collins receivers of the 75 series. The HQ-129 and most National receivers have low-impedance output windings so the circuit will have to be modified or the output transformer replaced.

T2 is a line transformer to match a 500-ohm line to the grid of a voltage-amplifier tube. Your junk box may provide an old double-button mike transformer which makes a good substitute. The secondary of this transformer connects to the grid of the stage preceding the driver stage for the class-B modulators. If the rig uses NBFM or some form of efficiency modulation, i.e. grid, screen, cathode, or clamp modulation, connect the secondary of T2 to the grid circuit of the stage following the stage in which the audio gain control is located. If the speech-amplifier is push-pull at this point, the secondary winding connects between the two grids instead of between a grid and ground.

T3 is the line-to-voice coil transformer to match the 500-ohm audio line to the speaker. The s.p.d.t. switch cuts in the receiver's speaker for monitoring or normal use or cuts out the speaker and T3 and substitutes a 500-ohm load resistor when the speaker is not being used.

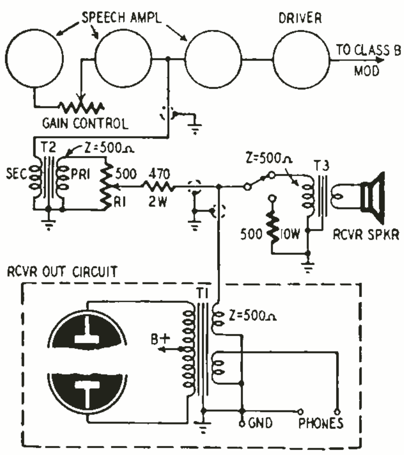
R1 is the audio gain control for the relay patching circuit. By carefully adjusting R1 and the receiver's volume control, you can insert the proper amount of signal into the speech equipment while keeping the speaker output at a comfortable level to minimize microphone feedback. You can set the level of the audio fed into the circuit by watching the modulator plate-current meter or by using some form of modulation indicator. Since the mixing circuit is independent of the speech-amplifier gain control, the operator of the relay station can insert comments or station announcements between pauses in the relayed transmission, or fade out the relayed transmissions to permit normal voice operation.

This simple arrangement can be used by amateur 2- or 6-meter civil emergency service nets operating in conjunction with established 10- or 75-meter nets to provide the latter with information originating at the net control station of the higher frequency net.

Here are two precautions which must be observed:

1. The frequencies of the high- and low-frequency transmitters must not be harmonically related, otherwise harmonics of the relay transmitter may block the high-frequency receiver or cause feedback.

2. Always obtain permission from the operator of the originating station before relaying his transmissions.—*George Ruffs, Jr., W2CJY*

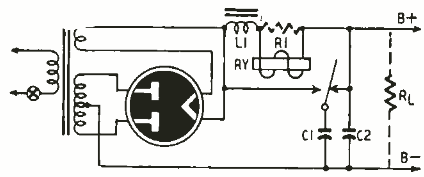


A circuit for the direct retransmission of communications network signals.

PROTECTIVE RELAY CIRCUIT

Various methods of reducing high voltage or preventing its application to circuit components until the tubes have reached operating temperature have been described. One system using an electronic thermal delay circuit was described on page 82 of the March, 1951, issue of RADIO-ELECTRONICS. A much simpler system, described in *Wireless World* (London, England) is designed for use on a power supply having a capacitor-input filter system. The relay contacts are wired so the input filter capacitor C1 is in parallel with C2 when the power is turned off. When the supply is first turned on, the current through the relay coil is not high enough to cause the armature to pull in. When the tube heaters have warmed up to the point where the drain is sufficient to prevent the B voltage from soaring, the armature pulls in and switches C1 to its normal input position.

Load resistance R_L is required to keep the initial voltage to a safe value. R_L, which includes the resistance of the choke plus the equivalent resistances of the tubes and transformers, may be adjusted to the desired value by short-circuiting the relay coil and checking the output voltage with a meter.



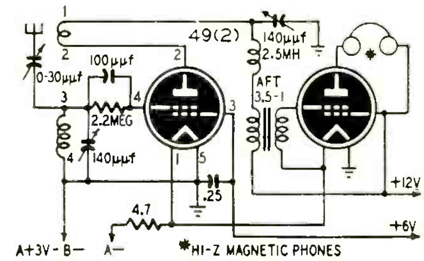
The relay should operate when the drain reaches approximately 75% of its maximum value. If the relay pulls in at a lower value, add R1 to shunt a portion of the current around the relay coil. The correct value for R1 can be found by substituting a potentiometer, setting it to zero resistance until the tubes have warmed up, then slowly increasing its resistance until the relay pulls in.

The resistance of the relay winding should be as small as possible for maximum output voltage and good regulation. For safety (especially where the positive side of the circuit is at a high voltage above ground) the relay coil can be connected in the transformer center-tap return. END

SPACE-CHARGE RECEIVER

? *Quite a few years ago, I constructed a two-tube receiver, called the Forty-Niner, from details given in one of your publications. This set used two type 49 tubes as a regenerative detector and audio amplifier. Its interesting feature was the 12-volt B supply. Will you kindly reprint this circuit in the Question Box?—W. H. W., Bronx, N. Y.*

A. Here is the circuit of the Forty-Niner. The 49's are now made "for renewal purposes" only and may be hard to find. If you have any difficulty in purchasing a pair, try some of the mail-order radio supply houses. Many of them still list this type as being available.



Four plug-in coils can be used for continuous tuning over the range of approximately 18 to 200 meters. The coils may be wound with No. 26 d.c.c. wire on 1¼-inch forms. Winding data is as follows:

Band	Grid coil	Tickler
20 meters	5 turns	4 turns
40 meters	10 turns	7 turns
80 meters	22 turns	11 turns
160 meters	45 turns	18 turns

The turns of the grid and tickler coils are close-wound. It may be necessary to experiment with the number of turns on the tickler and the spacing between the grid and tickler windings to obtain smoothest regeneration. The numbers on the ends of the coils refer to pin connections on a standard 4-prong tube base or coil form. Both coils should be wound in the same direction. If the set does not oscillate, reverse connections to the tickler winding.

TUBE SUBSTITUTION

? *I am planning to build a set of 12 frequency dividers like those described in "Electronics in Music" in the June, 1952, issue. I would like to know if I can use 6SL7-GT's in place of the 12AX7's. If so, what changes will be necessary.—R. L. H., Decatur, Ill.*

A. In many circuits, the 6SL7 and 12AX7 tubes are electrically interchangeable. However, in multivibrators and similar circuits, you may have to make minor adjustments in the values of the grid resistors and capacitors to insure the proper waveform and positive synchronization. We suggest that you build a breadboard model of one of the frequency dividers and compare the operation with both types of tubes. Substituting variable resistors for the fixed units will enable you to study the effects of resistance changes on the performance.

CRYSTAL-CONTROLLED CONVERTER

? *Please print a diagram of a crystal controlled converter to enable me to tune from 5 to 8 mc on my automobile receiver. I would like the circuit to include a stage of r.f. amplification.—F. R., Vicksburg, Miss.*

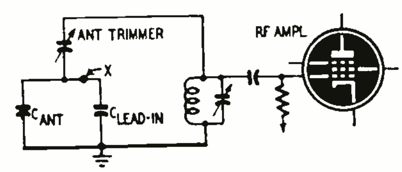
A. It is impossible to cover the band width you want with a broadcast receiver. When the oscillator of a shortwave converter is crystal controlled or cannot be controlled from the front panel, the tunable circuits of the receiver (the antenna, oscillator, and mixer grid circuits) are used as a tunable first i.f. of a double superheterodyne. The bandwidth of the shortwave band is equal to the bandwidth of the tunable i.f. amplifier. This is equal to F1 minus F2, where F1 is the highest frequency covered by the receiver on the band used for tuning and F2 is the lowest frequency in the band. Thus, if the receiver tunes from 550 to 1650 kc, the bandwidth of the shortwave range is 1,650 − 550, or 1,100 kc. With 5 mc as the lowest frequency in the shortwave band, the highest frequency that can be tuned without changing the oscillator frequency is 5,000 plus 1,100 or 6,100 kc.

Keeping in mind that the shortwave bandwidth equals the bandwidth of the first i.f., we find the desired oscillator frequency for any desired section of the shortwave band equals F3 − F4 or F5 − F6; where F3 is the lowest shortwave frequency, F4 is the lowest frequency in the tunable i.f., F5 is the highest frequency in the shortwave band, and F6 is the highest frequency in the tunable i.f.

MOBILE ANTENNA QUERY

? *Recently, I mounted a 10-meter whip antenna on my car as the first step in the installation of a complete 10-meter mobile station. The antenna was mounted on the rear bumper and connected to the broadcast receiver with RG-59/U coaxial cable. When I try to use the whip, the receiver sensitivity is far below that when the short cowl-mounted antenna is used. I cannot peak the signal from the whip with the antenna trimmer on the set. Can you tell me what causes this loss of signal? How can I get normal signal strength from the whip antenna?—E. S. K., Bronx, N. Y.*

A. The decrease in sensitivity is caused by the shunt capacitance of the



lead-in. The front end of an automobile radio is designed so the antenna trimmer can adjust the total stray capacitance across the tuned coil to the value which permits the circuit to track properly.

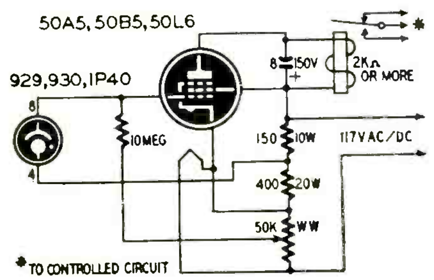
The diagram shows the antenna-to-ground capacitance C_{ant} and lead-in capacitance $C_{lead-in}$ in series with the antenna trimmer across the antenna coil. The capacitance range of the trimmer is selected to compensate for nominal values of antenna and lead-in capacitance resulting from using a standard automobile broadcast antenna and two or three feet of lead-in. Using a longer antenna and a dozen or so feet of coax increases the stray capacitance values to the point where the antenna trimmer cannot compensate for them. This makes it impossible to resonate the antenna circuit of the receiver and causes a loss of sensitivity.

You can compensate for the added stray capacitance by connecting a small ceramic or mica capacitor (about 200 μμf) in series with the lead-in at the receiver's antenna input terminal. This is equivalent to connecting the capacitor at point X in series with the lead-in capacitance. The added capacitor reduces the lead-in capacitance because it is effectively in series with it.

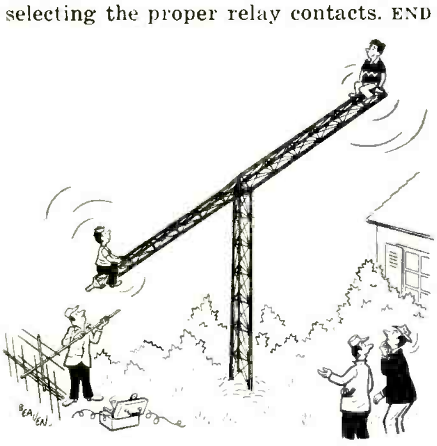
PHOTOELECTRIC RELAY

? *Please print a circuit of a photoelectric relay which can be arranged to open or close an external circuit when light is temporarily shut off from the phototube. I would like to have the simlest circuit that will provide reliable operation from 117-volt a.c. or d.c. lines.—W. W. W., Bronx, N. Y.*

A. This circuit can be used with a variety of tube types on a.c. or d.c. lines. The circuit is self-rectifying so it does not require a d.c. supply for the plate



and screen of the relay tube. The 50,000-ohm resistor controls the sensitivity. The s.p.d.t. relay makes it easy to make or break the external circuit simply by selecting the proper relay contacts. END



"I just turned my back for a minute, boss!"

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.

Dr. C. J. Breitwieser was promoted to director of engineering at P. R. MALLORY & Co., Indianapolis. Dr. Breitwieser was executive assistant to Dr. F. R. Hensel, vice-president in charge of engineering. In his new position he will direct the company's central research laboratories and general engineering staff and will assume responsibility for divisional engineering departments.


C. J. Breitwieser

Oden F. Jester joined STANDARD COIL PRODUCTS CO., INC., Chicago, as sales manager of the distributor division. Mr. Jester was vice-president of the Meissner-Thordarson-Radiart Division of Maguire Industries, and for a number of years was general sales manager of Utah Radio Products Co.


O. F. Jester

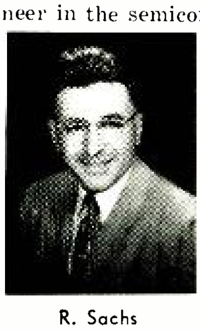
Dr Yuen T. Lo joined CHANNEL MASTER CORP., Ellenville, N. Y., as project engineer of the Antenna Development Laboratory. Dr. Lo has done extensive work in electronic research. In his new position he will carry on advanced development work in electronics and antennas.


Y. T. Lo

Dr Ben Kievet was promoted to manager of sales engineering for the Radio & Television Picture Tube Divisions of SYLVANIA ELECTRIC PRODUCTS, INC. He was formerly field engineer for the Equipment Tube Sales Department.


B. Kievet

Rudolph Sachs joined HYTRON RADIO & ELECTRONICS CO., a division of Columbia Broadcasting System, Danvers, Mass., as manager for semiconductor products. Sachs had considerable engineering experience with germanium and silicon diodes and transistors with Western Electric Co. and another pioneer in the semiconductor field.


R. Sachs


S. B. Schiffman

Stanley B. Schiffman was appointed manager of the Field Liaison Division of JOHN F. RIDER PUBLISHER, INC., New York City. Mr. Schiffman has been active in public relations, sales, and engineering in the electronics field.

Personnel Notes

. . . Daniel D. Halpin was appointed general sales manager of the Receiver Division of ALLEN B. DU MONT LABORATORIES. He succeeds Walter L. Stickel, who resigned to become national sales manager of Hoffman Radio, Los Angeles. Halpin was formerly with RCA.

. . . George E. Mobus joined MOSLEY ELECTRONICS, Overland, Mo., as head of the newly formed Advertising and Sales Promotion Department. He came to the company from the Bartz Advertising Agency, Peoria, Ill., which handles the Mosley account.

. . . Ken Burcaw, who had been sales manager of Cornell-Dubilier Electric Corp. and Radiart, formed his own sales organization, K. C. BURCAW & Co., with offices in Detroit, Mich., and East Palestine, Ohio.

. . . Lou Selsor, former sales manager of National Video, joined the distributor sales staff of JENSEN MANUFACTURING Co., Chicago. P. B. Williams, who had been in charge of Jensen transducer developments, was promoted to chief engineer, and Harry E. Allen, former senior engineer, was named manager of the Government Product Division.

. . . John Laura was appointed Western branch manager of RADIO MERCHANDISE SALES (RMS), New York City, manufacturer of TV antennas and electronic accessories. A veteran in the radio field, Mr. Laura is organizing the operation of the new RMS West Coast branch in Los Angeles.

. . . James McA. Krampf was promoted to sales manager of the HI-Q Division of AEROVOX CORP., Olean, N. Y. He was formerly assistant sales manager.

. . . V. S. Mameyeff, former manager of export activities for RAYTHEON MANUFACTURING CO., Waltham, Mass., was promoted to manager of the International Division. Raytheon also announced the transfer of George J. Zipf, former sales engineer for the New York district, to district manager of sales and service for the Chicago district.

. . . Robert Adelson, New York attorney, joined the legal staff of SYLVANIA ELECTRIC PRODUCTS, INC.

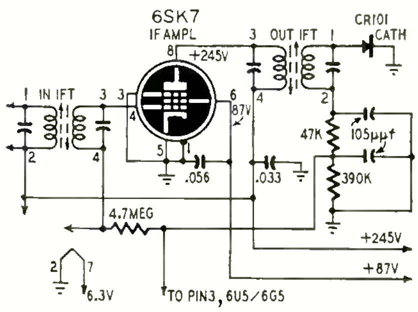
. . . J. B. Ferguson, formerly of Link Radio Corp., joined PLATT MANUFACTURING CORP., New York City, as chief engineer in charge of engineering.

. . . Howard S. Moncton was named administrative engineer of the Radio and Television Division of SYLVANIA ELECTRIC PRODUCTS, INC. Irwin Goldman, senior engineer, succeeds Moncton as assistant to the manager of the Physics Laboratories, Bayside, N. Y.

. . . Irving W. Romm, manager of the Special Order Division of the INSULINE CORP. OF AMERICA, Long Island City, N. Y., was honored by Insuline executives and co-workers on the occasion of his 25th anniversary with the company. END

RCA 4QV8C COMBINATIONS

Because of the scarcity of type 6SF7 tubes, it was necessary to substitute a 6SK7 and a germanium diode in the model 4QV8C and similar sets. The 6SF7 is a diode-r.f. pentode used as the detector and i.f. amplifier in chassis



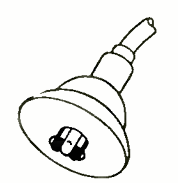
stamped RC 620A. The diagram shows the circuit of the 6SK7 and detector diode used in the RC 620D chassis.—*RCA Service Bulletin.*

TELE-TONE MODEL 249

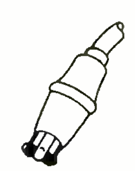
A number of these sets come in with the complaint that picture height has decreased to only 2 or 3 inches. This is usually caused by the 1.5-megohm resistor in series with the height control. It may change in value to as low as 500,000 ohms or it may open up. In either case, replace it with a 1.5-megohm, 1-watt unit.—*Martin Rosenberg*

CORONA AT SECOND ANODE

Certain types of rubber anode caps gradually become conductive due to a chemical decomposition of the rubber. This produces a leakage path across the insulated area of the glass around the anode button and often results in corona or arcing problems. Ordinarily, wiping the glass under the rubber cap does not remove the deposit that results from the decomposition of the rubber.



ORIGINAL ANODE CONNECTOR AND RUBBER CAP



ANODE CONNECTOR AFTER TRIMMING

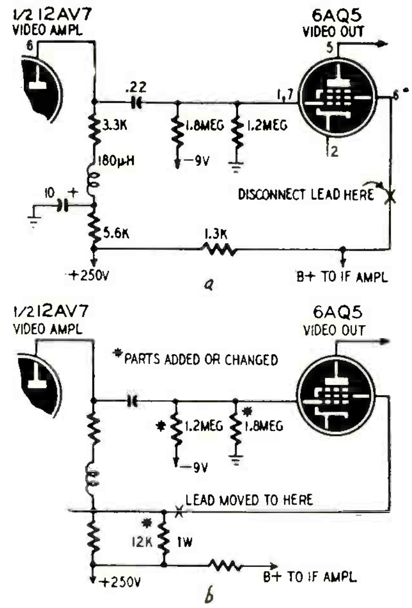
The suggested cure for this condition is to trim off the flange portion of the rubber cap to a point where no rubber touches the glass. This will leave only the sleeve portion of the cap which serves as a support for the lead into the connector.

Clean the glass around the anode button with water and a scouring compound such as Bon Ami. The area around the anode button should be scoured and then thoroughly dried and polished with a clean dry cloth so that no residue remains. If the above instructions are carried out, no further trouble of this nature should be experienced. The drawings show the anode connector before and after trimming. —*Crosley Service Bulletin*

PICTURE WASHOUT

In some late Philco dual-chassis receivers, the black parts of the picture turn gray if the contrast control is advanced beyond a point near the maximum gain position. This condition, called washout, is caused by overloading in some part of the video section of the set. If washout is accompanied by sync instability, the overloading is ahead of the sync take-off point. If sync stability is not affected, the overloading is taking place at some point in the circuit between the sync take-off and the input to the picture tube.

Three circuit changes are recommended as a cure for overloading in stages following the sync take-off. The diagram at *a* shows the original circuit and the modified circuit is shown at *b*. In the original circuit, the screen of the 6AQ5 video output stage was supplied from the B plus line to the i.f. amplifiers. To provide a higher screen voltage and thus prevent overloading, the 5,600-ohm resistor in the plate circuit of the first video amplifier is shunted by a 12,000-ohm unit and the output tube screen connection moved to the low-voltage side of these resistors. Operation of the output stage is further improved by interchanging the 1.2- and 1.8-megohm grid resistors. This change increases the grid bias, thus permitting the output stage to handle higher signal voltages without overloading.—*Philco Service Bulletin*



DU MONT RA-160

Complaints of vertical sync drift and erratic operation of the vertical oscillator in the RA-160 may be caused by overheating in the 6BL7-GT vertical oscillator and output tube when a shield is used over it. This shield should be removed when the set is installed. If vertical drift persists after the 6BL7 has been allowed to cool, replace the tube and leave the shield off. —*Du Mont Service News*

RCA KCS66 AND KCS68 CHASSIS

If the picture is weak and smeared, check the plate resistor of the video amplifier (6,000 ohms in the KCS66 and 6,700 ohms in the KCS68). These wire-wound resistors frequently open up or increase in value enough to cause this condition.

If the a.g.c. control cuts off the sound and picture when turned to the extreme counterclockwise position, check the 100-μμf bypass capacitor (C222) for leakage. This capacitor is in the screen circuit of the video amplifier.—*C. W. May* END

THE FUND NEARS $10,000

HELP-FREDDIE-WALK FUND

We at Radio-Electronics continue to receive encouraging reports from Herschel Thomason, radio technician of Magnolia, Arkansas, on the progress of his little four-year-old son, Freddie, who, as many of our readers know, was unfortunately born without arms or legs. Having just been fitted with a new pair of legs, he is adjusting himself to them rapidly, and even when the going gets tough, plucky Freddie refuses to be without them.

This is not the first pair of legs that Freddie has had—nor will it be the last. Like all youngsters, his rate of growth is rapid, and of course his legs must "grow" with him. We can all realize the tremendous sum of money involved in such an undertaking, and it was with this thought in mind that Radio-Electronics inaugurated the Help-Freddie-Walk Fund some three years ago. The Fund is now nearing the $10,000 mark, but its work is merely beginning; for literally thousands more dollars will be needed before we can be assured that we have done all that we can to help Freddie attain his rightful place in society.

But it is a task that cannot be handled by ten, twenty, or even one hundred of us. Its scope is so great that we have asked each and every reader to do what he can to back up the faith and diligence of Freddie's parents, who have never lost sight of the original goal—a "normal" life for their son. Thousands have responded, and each day's mail brings letters from new friends and old.

Won't you please send in your contributions whenever and as often as you can? No amount is too small to receive our acknowledgment and sincere thanks for the part you are playing in this worthy cause. *Make all checks, money orders, etc., payable to Herschel Thomason.* Address all letters to:

HELP-FREDDIE-WALK FUND
c/o Radio-Electronics Magazine
25 West Broadway
New York 7, New York

FAMILY CIRCLE CONTRIBUTIONS

Balance as of July 18, 1952	$ 558.50
Anonymous, Ocean City, N. J.	1.00
Mrs. Harry Blaver, Glendale, Calif.	2.00
FAMILY CIRCLE Contributions as of August 21, 1952	$ 561.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of July 18, 1952	$9,312.26
Anonymous, Elmwood Park, Ill.	2.00
Anonymous, Pala, Calif.	1.00
Anonymous, Portsmouth, Va.	10.00
Anonymous, St. Louis, Mo.	5.00

Anonymous, San Jose, Calif.	3.00
Esther Brody, Chicago, Ill.	2.00
Harry Folk, Phila., Pa.	2.00
Herbert Goldstein, New York, N. Y.	5.00
Rafael Gonzalez, Buenavista, Marianao Cuba	3.00
Ivan Harrison, Dallas, Texas	2.00
Abe Kabakoff, Cincinnati, Ohio	3.00
M. Klein, Glassport, Pa.	5.00
Lt. & Mrs. Fred H. Lund & Frederick, Seattle, Wash.	1.00
Lowe Pharmacy, Tallahassee, Fla.	5.00
Tom Plumley, Wake Island	2.00
Alexander Rys, Minneapolis, Minn.	1.00
Wilton Stone, Jr., Sanford, N. C.	2.00
Television Engineering Class T-16, Amer. Television Inst., Chicago, Ill.	8.00
W2PRI, Tonawanda, N. Y.	10.00
Allan Wallach, Winston-Salem, N. C.	5.00
Mrs. Thos. Watson, Erie, Pa.	1.00
William J. Zale, Antioch, Ill.	4.00
RADIO-ELECTRONICS Contributions as of August 21, 1952	$9,394.26
FAMILY CIRCLE Contributions	561.50
TOTAL Contributions as of August 21, 1952	$9,955.76

A radio-controlled life-raft of rubber, inflated with carbon-dioxide and housed in an aluminum-alloy cylinder which may be launched by plane or torpedo tube has been jointly developed by The United States Air Force Air Matériel Command and the Douglas Aircraft Company.

Using a remote-control radio system the launching plane or vessel will be able to start and stop the four-cylinder inboard engine and steer the raft to survivors on the sea. The raft has fuel for 300 miles of cruising, and is equipped with a two-way radio communication set, heating system, and automatic pilot.

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.

October 1918
ELECTRICAL EXPERIMENTER

The Automatic (Wireless) Soldier, by H. Gernsback
Tesla Has New Pointless Lightning Rod
New Developments in Telephotography, by LeRoy J. Leishman
Original "Valves" Used by Dr. J. A. Fleming
An Unusual Type of Electron Relay
New Developments in Radio Apparatus
Revolving Mirror and Spark Discharges, by Prof. Lindley Pyle, Washington University
The Einthoven Galvanometer, by Samuel D. Cohen

END

BURKE'S STORY: "WHY THE SMALL SHOP WILL STICK"

Dear Editor:

Thanks for your letter of July 29th. I regret to say, however, that is one article that I cannot go along with. Although I agree whole-heartedly that the small shop can and will survive and that the big shop is in for some very serious troubles, I am afraid that Mr. Burke's thinking on the small shop is of the type that has so long kept the radio-television industry on a slave status.

I believe that the biggest contribution big TV shops have made to our industry has been the elimination of daytime, nighttime, Christmas, Yom Kippur, any-old-time service philosophy. Anyone who permits a business to make a slave of him is a damn fool. All of this talk about people being entitled to service after hours is not in keeping with 1952 thinking. My own company has, since the war, closed shop at 5:00 each day and 12:30 on Saturdays. We have made studies to find whether this was hurting our business and we are happy to say that it has actually helped us since it separated us from the "punks" who are so inferior that the only time they can get business is after hours. This experience has been repeated by thousands of other companies both large and small across the entire country.

Even the medical profession and pharmacists no longer operate on the outdated idea that they must be chained to their shops and offices. No longer do doctors break their necks to dash out to make calls unless they are absolutely certain that it is a matter of life or death. If human life can await the convenience of the doctor, why not a TV set?

We challenge Burke to prove that he ever actually makes any money on the service of a TV set in a tavern which is loaded with bar-fly experts during evening hours.

When Burke speaks of getting the tremendous rate of $4.00 per call Sundays and overtime, he seems to think he is receiving top pay for qualified work. Apparently he has not had a haircut recently. Barbers in Chicago are now receiving $1.50 for a haircut which takes 15 minutes time, or on the basis of $6.00 per hour. Burke can drive a

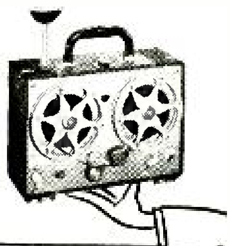
"This schematic calls for ½ 6N7 tube."

THE FIRST TRULY PORTABLE TAPE RECORDER

For All Remote and Field Recording

Tiny, Lightweight, Battery-Operated Spring-Motor

MAGNEMITE*



Every feature you want for field recording! No larger than a shoebox, the Magnemite* is a complete tape recorder-playback instrument, with self-contained inexpensive dry cells that last 100 hours without replacement. Why bother with old-style heavy, bulky, fluttery field recorders with their converters and storage batteries? Lose up to 50 lbs. of excess weight by using the Magnemite*

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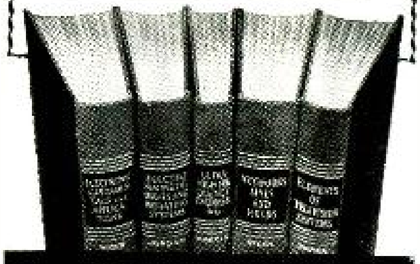

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truck without any TV headaches on Sunday for about $5.00 per hour. The $4.00 Burke charges is certainly peanuts if he is really qualified and equipped to do a job.

One reason that intelligent contractors have eliminated overtime calls was not (as Burke intimates) that they were trying to rob the people of something, but simply the fact that they *know* the cost of service at overtime pay and they knew that the public was not prepared to pay honest rates. You see, legitimate contractors do not expect their employees to work for Chinamen's wages such as Burke is willing to accept.

Although I personally operate a medium-size shop, and I am very favorably disposed towards small shops, I am afraid that unless thinking such as Burke's is eradicated, the TV-radio service industry will again become a refuge for small men with small minds, small abilities, and small opportunities.

FRANK J. MOCH,
Chicago, Ill. *President, NATESA*

COST OF SCHOOLING

Dear Editor:

In your July 1952 issue you published an article entitled "Selecting the Right Radio School." The information presented was certainly important because of the need for answers to numerous questions regarding an education in electronics. However, some of the data seemed to leave an absurdly false impression of those institutions in this country which offer liberal educations with standard degrees.

The author was right in many instances, but under the section "What type of school?", he stated as fact that a four-year education leading to an engineering degree costs from $7,000 to $10,000.

There are *many* schools where a four-year degree can be earned while living *very* comfortably for much less than $7,000. Some of the most expensive schools in the midwest cost (everything included) less than $1,200 per year, and most state colleges can be attended for considerably less than $1,000 per year.

The school I represent offers only a two year pre-engineering course. But, as a private college supported by tuition fees and donations only, our estimate of living expenses and tuition ranges from $725 to a maximum of $957 per year. This is average for this part of the country.

WILLIAM J. RICHARDS
Buena Vista College
Storm Lake, Iowa

(A number of graduates of Eastern schools doubted very much that a student could live on the above sums. Living costs differ widely throughout this country, and it is likely that Mr. Richards is speaking for the lowest-cost area, as Mr. Rietzke is for the high-cost East.—*Editor.*)

A SWITCHING PROBLEM

Dear Editor:

Perhaps some of your readers have come across this problem, and can help me find a solution.

The better FM and AM/FM tuners—such as the Browning and Radio Craftsmen—and many of the new audio preamplifiers are equipped with multiple inputs and a selector switch for feeding the audio system from various sources—TV, phonograph, or tape recorder. This is fine for transferring the signal inputs, but it means keeping *all* the equipment turned on all the time, or going through a complicated procedure of turning on (or off) the various pieces of equipment. This can be very inconvenient, especially where the units are in different parts of the room (as they are in the average home).

I know elaborate relay systems can be hooked up to control the various units automatically, but someone may have found a simpler solution.

STEFAN WAELDER

New York, N. Y.

CORRECTIONS

The photographic illustrations for the article "Mobile Interference" in the September issue were supplied through the courtesy of the United States Army Signal Corps, Fort Monmouth, N. J. The credit line which usually appears in such cases was inadvertently omitted.

The omission is more regrettable in view of the fact that special effort was expended to obtain the photos, which were from a Signal Corps manual, and we again wish to thank the Signal Corps for their cooperation.

In the item "Measuring Inductance" on page 75 of the August issue, the formula which appeared as:

$$X_L \text{ (in henries)} = \frac{R^2 - R_L^2}{377}$$

should read:

$$L \text{ (in henries)} = \frac{\sqrt{R^2 - R_L^2}}{377}$$

R in this case referred to the resistance of the adjustable resistor in the circuit, which was set to equal the *impedance* of the coil, and R_L to the ohmic resistance of the coil.

The captions of the Brush *Soundmirror* and the Webcor *Electronic Memory* on page 52 were transposed. The Webcor instrument is at the right, and the Soundmirror in the center (the name appears faintly in the photograph.)

It has been called to our attention that the choice of a horizontal output transformer photo to illustrate the article "Flyback Squeal," in the July issue, was singularly inappropriate. The transformer is the new RCA 230T1, a job designed to (among other things) reduce or eliminate this type of squeal. It is cushion-mounted, so that any attempt to pour cement between the core and frame would be the opposite of helpful. Tightening bolts is another technique that would not apply, since there are no through-bolts to tighten on the RCA 230T1.

We are happy to hear that the designers of this transformer are attacking the squeal problem right in the design, and we regret that it—rather than some older and more appropriate type—was used in such close juxtaposition to a drawing showing trouble points in a flyback transformer.

Two values were given for C8 in the parts list for the diathermy machine described on pages 58-60 of the September issue. The correct value is .0001 μf (100 μμf).

ARE YOU MOVING?

—Don't forget to send us the address label from your last copy of Radio-Electronics . . . plus your new address.

—If we receive these before the 10th of the month, you will continue getting the magazine without interruption.

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. All literature offers void after six months.

SYLVANIA BULLETIN

Sylvania Electric Products, Inc., has released a new bulletin describing the production facilities available at their Parts Division. The 20-page booklet tells of the company's manufacturing and engineering services in plastics, formed metal parts, wire, welds, mica, and electronic components. Automatic machinery for achieving close tolerances on all products is described and illustrated.

The bulletin is available from the Parts Division, Warren, Pa.

THYRITE RESISTORS

New miniature resistors whose electrical resistance decreases with increases in applied voltage are described in General Electric's bulletin GEA-4138C.

The resistors are composed of a silicon carbide ceramic resistance material called Thyrite, whose nonlinear resistance characteristic is stable and substantially independent of polarity and frequency.

Gratis from General Electric, Schenectady 5, N. Y.

CAPACITORS

Cornell-Dubilier's catalog TVR-7A is a 39-page guide arranged to enable the technician to locate the correct replacement capacitor. With the 9 types of twist-prong electrolytic capacitors added since last year, 134 new TV set models may be serviced.

Gratis to technicians through local Cornell-Dubilier distributors.

MOBILE ANTENNAS

Ward Products Corp. has released a catalog describing antennas and accessories for mobile use with descriptions and specifications for each model.

A second booklet, "How to Specify Mobile Antennas," describes the base, whip, and spring combination, stating the factors involved in buying them, and describing how these components are produced.

Gratis from Ward Products Corp., Division of the Gabriel Co. 1523 E. 45 St., Cleveland 3, Ohio.

FACILITIES BROCHURE

General Cement Mfg. Co. has issued a 16-page illustrated brochure, "The Story of G-C," to show the part played by the firm in supplying electronics components to the radio-television industry and other fields, and to acquaint customers with the size and extent of its manufacturing facilities.

Gratis from General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.

CONNECTOR BULLETIN

Cannon Electric has just issued a 32-page Audio-Type Connector Bulletin (No. PO-4-1952) adding new and improved connector types for microphone, public address, and low-level sound applications. This bulletin covers all pertinent engineering data on type series P, O, X, XK, X, BRS, BG, and UA.

These connectors meet RTMA $tandards. The *type BG* series is designed for communications and is used largely by the Signal Corps.

This bulletin is available upon request to the Cannon Electric Advertising Department, P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif.

SPRAGUE CATALOG

Sprague's new catalog, C-608, superseding C-607, describes the company's capacitors, resistors, interference filters, and test equipment for television and radio.

Gratis from Sprague Products Co., North Adams, Mass.

WALDOM CATALOGS

Two new catalogs released by Waldom Electronics, Inc., are the 1952 Waldom *Replacement Speaker Cone Manual No. 52* and the *Waldom Electronic Components and Croname Products Catalog No. 5C2.*

The first lists over 5,000 models of 105 set and speaker manufacturers, showing model number, speaker size, and replacement cone number, with a section showing how to replace a speaker cone.

The second catalog has descriptive listings and illustrations of knobs, dial plates, title plates, Croflex tuners, auxiliary drives, instrument dials, auto radio controls panel kits, tube sockets, terminal strips, and TV components.

Both are available on request from Waldom Electronics, Inc., 911 No. Larrabee St., Chicago 10, Ill.

NEEDLE REPLACEMENT GUIDE

Catalog and Replacement Guide No. 102 is a 34-page, 8½ x 11-inch booklet with six pages devoted to a descriptive listing of the Permo line of magnetic recording wire, tape, accessories, and phonograph needles. The balance of the booklet is a needle replacement guide listing the cartridge manufacturers' names and needle numbers, the Permo needle number, jobbers' parts numbers, tip material, prices. Needle and cartridge types are illustrated.

A copy can be obtained by sending a letterhead request to Permo, Inc., 6415 Ravenswood Ave., Chicago 26, Ill.

ELECTRONIC COMPONENTS

Switchcraft, Inc., has issued a new 16-page catalog which includes many additions to the present line of components as well as new items of special interest such as adapters, shielded jacks, microphone connectors, lever switches, and cable assemblies.

Copies sent on request to Switchcraft, Inc., 1328 N. Halsted St., Chicago, Ill.

END

TV AND YOU, by John B. Ledbetter. Published by the John B. Ledbetter Co., P.O. Box 1122, Cincinnati, Ohio. 6 x 9 inches, 72 pages. Price $1.00.

Aimed like many others at the TV owner, this book cannot be classed with any of them. Unlike the "Guide" type of work, it simply attempts to tell the owner how his set works, and why it gets out of adjustment. It does not attempt to explain electronic theory or TV transmission and reception. It does tell the owner what tubes are in his set, what effect the failure of each one of them might have, and shows numerous patterns to illustrate the point.

The set owner gets a much better break in the descriptions of adjustments than the reader of earlier works. Ledbetter is thoroughly familiar with his subject, and tells his readers what they may expect to find and where to look for it; for example, how various manufacturers differ in their methods of making the tuning adjustments accessible, what may happen when certain controls are turned too far in each direction, and how to select the midpoint between them for "best picture."

Apparently television (like the motor car) will ultimately produce a group of owners who—through costly experience or other means—are going to learn to make minor repairs and adjustments, calling the technician only when his skills are needed. This is an excellent textbook for that group.

It is more than possible that such owners will give the technician less business than others. There is certainly no doubt that the relationship between them and their repairmen will be much better than average, since—like the semi-skilled car owner—they will realize the complexities of their equipment, and know by experience that time and trouble are involved in its repair.

The author lays an excellent foundation for such good understanding in one of his opening paragraphs "Why Your Serviceman Must Charge" and on his last page under the headings "About Fix-It-Yourself Books" and "What Your Serviceman Is Doing to Help You." The latter item, incidentally, names and recommends the chief radio and TV technicians' associations.—*FS*

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY

Page 145

Radio - Electronics does not assume responsibility for any errors appearing in above index.

THE SATURDAY REVIEW HOME BOOK OF RECORDED MUSIC AND SOUND REPRODUCTION, by Edward Tatnall Canby, C. G. Burke, and Irving Kolodin. Published by Prentice-Hall, Inc., New York 11, N. Y. 6½ x 9½ inches, 308 pages. Price $4.50.

The first 108 pages of this book are devoted to a complete and highly competent history of mechanical music reproduction, from the earliest cylinder and disc records of the '80's to present-day high-fidelity tape recording. The techniques and problems of modern record-making are described in a way that is clear to the non-technical music-lover and satisfactory to the audio engineer. Canby's contribution alone makes the book well worth reading.

The historical section is followed by a rather strange essay called "The Eclectic Phonograph." The key to it is given in the author's "intention to eschew the technical lingo of the trade, the purpose behind this book being enlightenment, not obfuscation. There is also the danger that behind the polysyllabic obscurant phrase lurks the fat proportionate price. . . ." Behind the polysyllabic obscurantism of this essay lies disappointment for the reader who hopes to get some idea of what equipment to buy and put together for a good phonograph, and why. The writer, stimulated by "the exuberance of his own vocabulary" into a world where knobs may be complacent, recording curves may reflect the results of sales conferences, signals have to be simplified into "sonic prototypes" and FM stations cannot interfere with each other, gives little help to either the earnest music lover or the audio technician. Fortunately, in a summary which is almost entirely composed of matter not found in the main essay, he lists components for five phonographs of varying excellence. The ensembles appear to be well chosen, and this part of the article is useful.

The third section of the book is solely for music lovers. It is called "Learning to Listen and Listening to Learn" and seems to be well handled.—*FS* END

"We can't take that route—it has two tunnels with only 12-foot clearance."

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1. THE COMPANY

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The positions are for men who will serve as technical advisors to the companies and government agencies purchasing Hughes equipment. Your specific job would be to help insure the successful operation of our equipment in the field.

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Upon joining our organization, you will work in our Laboratories for several months until you are thoroughly familiar with the equipment you will later help the Services to understand and properly employ.

4. WHERE YOU WORK

After your period of training (at full pay), you may (1) remain with the company Laboratories in Southern California in an instruction or administrative capacity, (2) become the Hughes representative at a company where our equipment is being installed, or (3) be the Hughes representative at a military base in this country—or overseas (single men only). Compensation is made for traveling and for moving household effects, and married men keep their families with them at all times.

5. YOUR FUTURE

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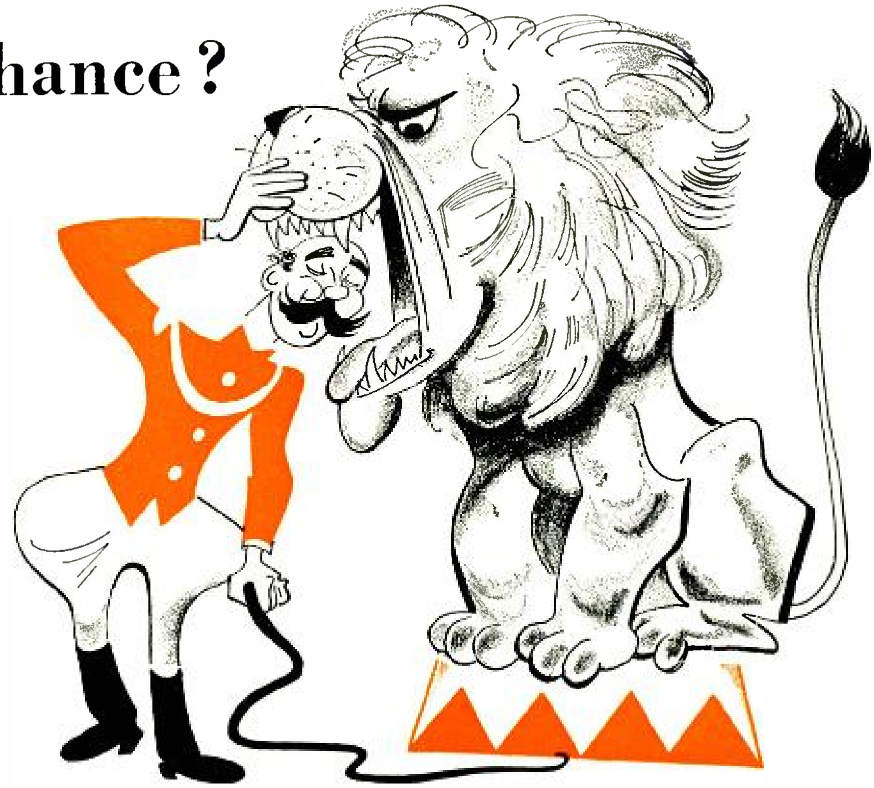

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Back of every Mallory capacitor is the knowledge and experience gained in 25 years of research and development work. Mallory produced the first dry electrolytic capacitor...pioneered in making smaller, longer-lasting capacitors with outstanding heat-resistant qualities. There's just no sense in taking chances on capacitor performance. Always be sure . . . always order Mallory capacitors for all your service work.

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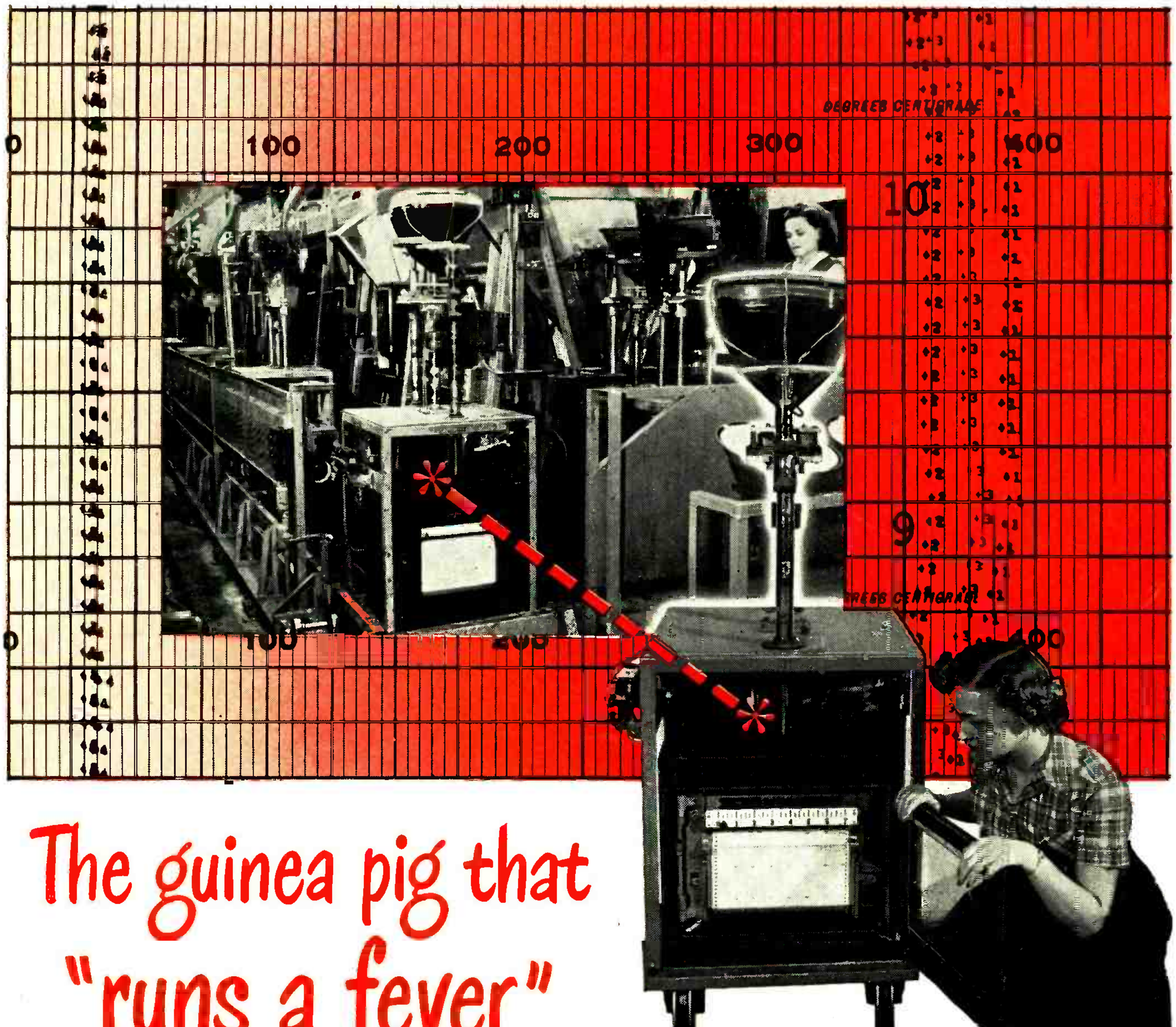

The guinea pig that "runs a fever"

to bring you better picture tubes

IN THE straight-line exhaust systems used at RCA picture-tube plants, each picture tube rides through a long oven on its own "exhaust cart." As the tube passes through this oven, the envelope is freed of gas by baking it at high temperatures.

These high temperatures must be carefully controlled for each picture tube type, and held to rigidly prescribed limits, in order to avoid setting up harmful strains in the glass, especially at the faceplate and wall of the tube.

Here is where the "electric guinea pig" comes in. The "guinea pig" actually consists of a sample tube, with five thermocouples attached to its outside surfaces. These thermocouples are connected to an instrument known as a recording pyrometer. At intervals during the day, this "guinea pig" travels through the oven, and emerges with a complete and accurate "fever chart" for the particular tube type in production. In this manner, temperature deviations are quickly spotted . . . and promptly corrected.

This is another example of the care exercised in the manufacture of RCA picture tubes. Through constant vigilance, RCA closely guards its own reputation for quality . . . *and yours as well.*

With RCA Receiving Tubes, as well as RCA Kinescopes, TOP-QUALITY CONTROL makes the difference.

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