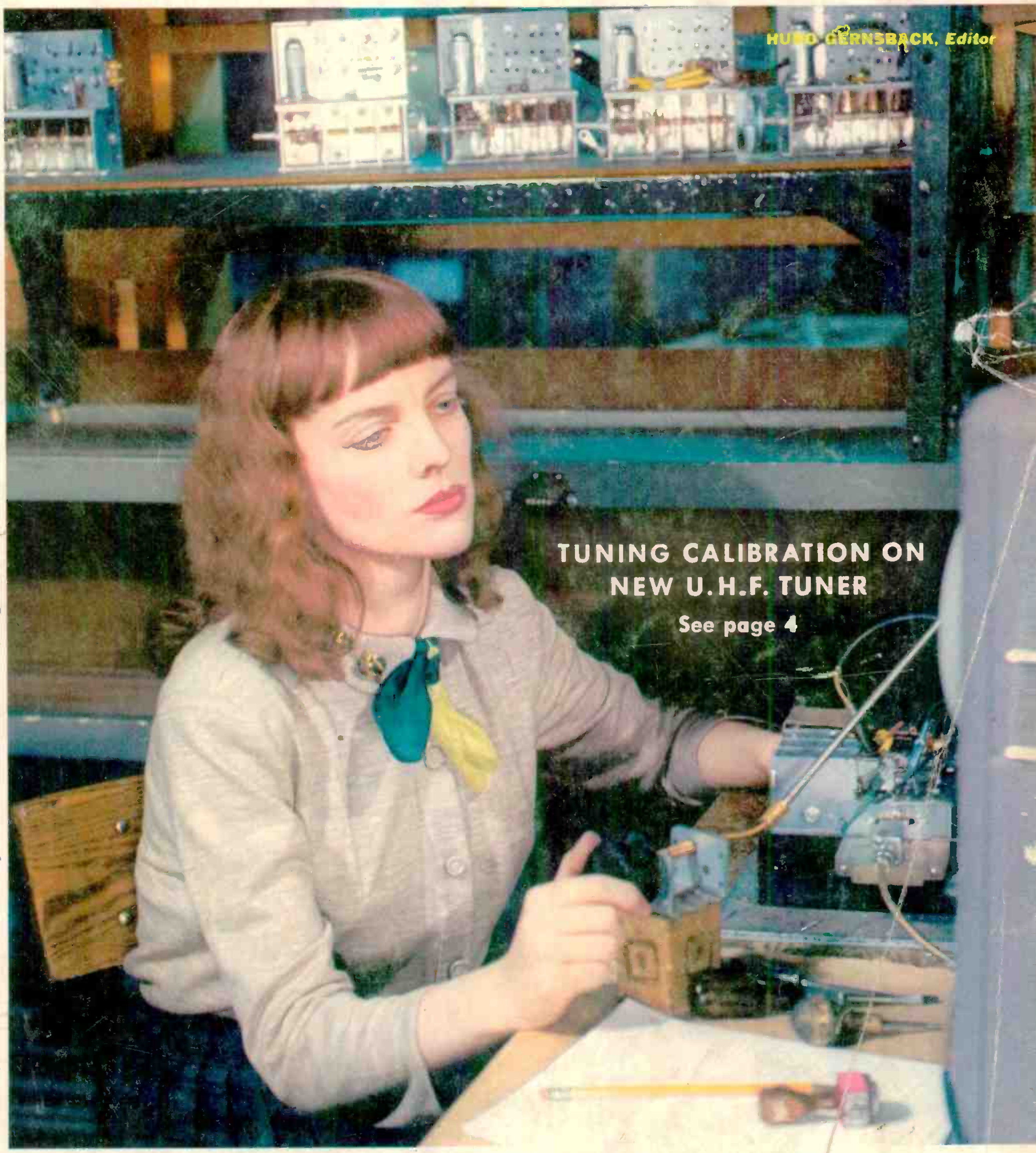
JUNE 1953

# RADIO-ELECTRONICS

LATEST IN TELEVISION • SERVICING • AUDIO

HUGO GERNSBACK, Editor



TUNING CALIBRATION ON NEW U.H.F. TUNER

See page 4

30¢
U. S. and CANADA

*In this issue:* **New TV Boosters from Old Tuners • Transistor Fundamentals • PA Hookup Problems**

NEW

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A Federal Communications Commission Commercial Operator's License puts you in line for a good job in Radio or Television Broadcasting, Police, Marine, Aviation, Two-way, Mobile or Micro-wave Relay Radio. Mail coupon below for 64-page book FREE. It will give you complete facts about my NEW Communications course.

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Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you? Even without Television the industry is bigger than ever before. 105 million home and auto radios, 2900 Radio Broadcasting Stations 108 TV Stations with 1800 more now authorized. Expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc. makes opportunities for Communications Technicians and FCC Licensed Operators. New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

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want. If you've had some training in Radio or Radar, or as a Licensed Operator, my course modernizes, increases the value of your knowledge.

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| **SHIP AND HARBOR RADIO**<br>Chief Operator<br>Assistant Operator<br>Radiotelephone Operator | **POLICE RADIO**<br>Transmitter Operator<br>Service Technician | **TELEVISION**<br>Pick-Up Operator<br>Voice Transmitter Operator<br>TV Technician<br>Remote Control Operator |

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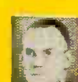
"I am a technician at WTOP in Washington and I like it very much. Most of my radio knowledge was from N.R.I."—John Britton, Hyattsville, Md.



"A former employee recommended N.R.I. training. Now employed as transmitter operator at WKBO."—Albert Herr, New Cumberland, Pa.

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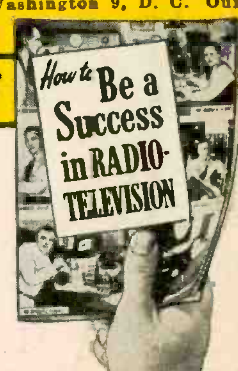


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# RADIO-ELECTRONICS

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



## CONTENTS

**JUNE, 1953**



ON THE COVER (See page 32) Barbara Reid makes tuning adjustments on the G.I. u.h.f. front end. Scene is the General Instrument factory in Elizabeth, N. J.
*Color original by Avery Slack*

MEMBER Audit Bureau of Circulations

Vol. XXIV, No. 6

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# What's your goal in

# TV—ELECTRONICS

## and how close to it *are* you?


**Free CREI booklet lists opportunities and shows how to grasp them**

DO YOU HAVE a career time-table? Do you know how much you should or could be earning two years from now? Five years? Many men are plodders without a plan. They wander through life never doing what they want to do, never receiving enough pay, never achieving true career satisfaction. Because they never knew ahead of time where they should or could be at a given date, they never planned ahead. When an opening arises, somebody else is promoted. When January 1st rolls around, they're just where they were a year before. Their *error*, failure to plan, can be the lesson which shows you the secret of future success. In this expanding, bustling TV-Electronics world, there is a whole lifetime of happiness and high earnings waiting for you, if you name your goals, and take steps to reach them. Thousands of ambitious young men have found success in TV-Electronics through the aid of the CREI booklet, "Your Future in the New World of Electronics." The newest edition tells of electronics' golden opportunities. 152 TV stations are now on the air with 2,000 more coming. There are over 23,000,000 TV sets and over 100 million radios in use.

This is the era of Communication: aeronautical, marine, police and fire, industrial, land transportation communications; this is the era of defense orders and a manufacturing industry which last year alone sold 3.8 billion dollars worth of electronic equipment, and is expected to do no less than 10 billion dollars worth excluding military orders. All these developments mean positions; in development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting and servicing. Who will get these positions? You—if you have a career time-table; if you can foresee your future in electronics; if you are willing to advance your knowledge; if you spend 2 minutes to write for your copy of "Your Future In the New World of Electronics," and follow the plan it describes.

This is the booklet that shows you how CREI home study leads the way to greater earnings. However, being an accredited technical school, CREI promises you no short-cuts. You must translate your willingness to learn into salable technical knowledge via study. CREI knows what it means to grow along with a booming industry. This year CREI is celebrating its 26th Anniversary, having started in 1927 in the early days of radio. Since then CREI has provided thousands of professional radiomen with technical educations. During World War II, CREI trained thousands for the Armed Services. Leading firms use CREI courses for group training in electronics at company expense; among them are United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Sears Roebuck & Co. Bendix Products Division, All-American Cables and Radio, Inc., RCA-Victor Division and Machlett Laboratories. CREI courses, prepared by recognized experts, are constantly revised to keep them up-to-date. Student work is under the personal supervision of a CREI Staff Instructor who knows and teaches what industry needs.

You choose your own hours when you study at home. Upon completion you join the many CREI graduates who have found their diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold many top positions in America's leading firms.

At your service is the CREI Placement Bureau which helps find positions for students and graduates. Although CREI does not guarantee jobs, the bureau now has many more requests for personal than can be filled. Talk to men in the field and check up on CREI's high standing in electronics instruction. Determine for yourself right now that your earnings are going to rise with your knowledge—and that you will rise with this booming industry. All this CREI offers you, provided you sincerely want to learn. Fill out the coupon and mail it today. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future—is up to you.

> CREI resident instruction (day or night) is offered in Washington, D.C. New Classes start once a month. VETERANS: If you were discharged after June 27, 1950—check the coupon for full information about the new G.I. Bill of Rights.

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**ALFENOL,** new alloy of approximately 16% aluminum and 84% iron, may help to produce lighter and better transformers and other "iron-core" components. The new metal has high permeability and low retentivity, is magnetizable by very low currents and holds very little of its magnetism after the current is turned off.

**NINETEEN NEW TV STATIONS** on the air between March 14 and April 25 brought the U. S. total to 167—59 since the end of the freeze. The five new stations in the v.h.f. bands: KDZA-TV, Pueblo, Col., 3; KFDX-TV, Wichita Falls, Texas, 3; KTTS-TV, Springfield, Mo., 10; KFDA-TV, Amarillo, Texas, 10; KTYL-TV Mesa, Ariz., 12; and KCJB-TV, Minot, N. D., 13.

The thirteen new u.h.f. stations: KRTV, Little Rock, Ark., 17; WPAG-TV, Ann Arbor, Mich., 20; WCOV-TV, Montgomery, Ala., 20; WFTL-TV, Ft. Lauderdale, Fla., 23; WCOS-TV, Columbia, S. C., 25; WAFB-TV, Baton Rouge, La., 28; WEEV-TV, Reading, Pa., 33; WICC-TV, Bridgeport, Conn., 43; WKST-TV, New Castle, Pa., 45; WLEV-TV, Bethlehem, Pa., 51; WHP-TV, Harrisburg, Pa., 55; WKNX-TV, Saginaw, Mich., 57; and WLOK-TV, Lima, Ohio, 73.

**EDUCATIONAL TV FAILURE** would be "a second American tragedy in broadcasting," according to a speech by ex-FCC Chairman Paul A. Walker at Boston University. Mr. Walker said the educators must meet the challenge of "this new medium of a new day" and unite with citizens in "an aggressive battle" for educational channels. He called attention to "the lost opportunity in aural broadcasting."

Dr. W. R. G. Baker, vice president of G-E and general manager of the company's Electronics Division, said in a speech at Philadelphia that those who claim educational television would provide state thought control "are themselves using one of propaganda's oldest weapons, the catchphrase which damns without sound reason behind it."

Actually, he pointed out, "any mother sitting at home would be able to monitor what is being shown her children at school."

Referring to a report by a New York State temporary commission on educational television which rejected a proposal for establishment of a 10-station educational television network, Dr. Baker cited criticism which described the commission's report as an "incredibly clumsy and shocking document."

On the question of competition with commercial television stations, Dr. Baker pointed out that "owning a commercial station obviously is not a license to chain people in front of their television sets and hypnotize them from turning to any other channel."

"If education can be made interesting enough to compete with entertainment . . . some educational programs might even end up as sponsored programs on commercial stations," Dr. Baker concluded.

**SELF-REPRODUCING MACHINES** are already in the planning stage. Dr. Claude E. Shannon of Bell Telephone Laboratories told an audience at Case Institute of Technology in Cleveland that an abstract model of such a machine has been set up by John Von Neumann, one of the world's leading mathematicians. According to Dr. Shannon, the machine will collect parts from its environment and assemble them into another machine identical with itself. The new machine will then repeat the process, so that by the time each machine wears out, it has already built a new one to take its place.

**THREE SCIENTISTS** at the University of California have developed an electronic vacuum pump without moving parts. Gases to be removed are first ionized by bombarding them with electrons from an incandescent cathode. A super-powerful electromagnet drawing 5,000 amperes then propels the ionized gases to a cold condensing plate. The new pump can be used alone, or as an auxiliary to existing pumping equipment.

**THE CORONATION** of Queen Elizabeth II on June 2 has created a tremendous demand for television receivers and radios throughout Great Britain, but rigid Government restrictions on installment sales have shut out many would-be buyers. One large manufacturer has apparently solved the problem of legally meeting the requirement of one third the selling price on delivery and the balance in 18 months. Customers were offered the opportunity of paying the first third in advance installments up to the end of May, with delivery guaranteed in time for the Coronation.

Would this type of sales promotion work in the United States? We doubt it. When similar credit restrictions were in force here last year many people who could not afford the required down payment were able to get sets immediately through heavy price-cutting and fantastic trade-in allowances on anything from a 1925-model Atwater Kent to a burned-out toaster.

**CONFLICTING STATEMENTS** on the dependability of transistor hearing aids have been made by Zenith and Sonotone, two of the largest producers in this field. In announcing that Zenith has suspended production of the new-type aids, president E. F. McDonald Jr. said that despite their superior performance in laboratory models, transistors had failed after only a few weeks service in every aid sold by his company except one. He attributed the failures to body humidity, and stated that Zenith would continue tests with hermetically sealed types.

Irving I. Schactel, president of Sonotone, disagreed with Mr. McDonald, and claimed that thousands of transistor hearing aids sold by Sonotone are giving better service than any previous type made by his company.

(PLEASE TURN TO PAGE 12)

# Get yourself on the beam to the BIG MONEY in

# RADIO AND TV

That's the way to become an expert Radio or Television service man. Study the bedrock theories and principles. These are vitally important. Nothing can take their place—not even the most elaborate kits.

Listen to what radioman R. G. Hamlin of Bay City, Michigan, says, "There's no royal road to learning. I am convinced more than ever after examining the lessons of friends who were lured by the alleged short-cut methods of competitors . . . 'understandability' and 'rememberability' are of utmost importance and I.C.S. lessons qualify on both counts."

I.C.S. offers you two new courses in radio and television servicing—one for beginners, the other for experienced amateurs.

The beginner's course, Radio and Television Servicing with training Equipment, is extremely thorough. You get extra texts featuring experiments and job assignments. You get equipment second to none. Matched parts for an excellent 5-tube superheterodyne receiver. Your own professional-quality multitester. A complete single generator kit. High-grade servicemen's tools. "Rider's Perpetual Trouble-Shooter's Manual." The principles of Television including the most up-to-date developments (VHF and Color TV, for example).

The second course quickly reviews the essentials then goes step by step into advanced phases of Radio and Television, including modern methods of installation and repair. Course contains valuable supplementary material. For example, you get a special book giving characteristics of all tubes used in Radio and Television receivers.

Learn by doing! That's the world-famous I.C.S. method. Thoroughly practical. Completely modern. Success proved. The coupon below brings you full details—on Radio and Television Servicing or any of the more than 400 I.C.S. Courses. Mark and mail it *today!*

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- ☐ Magazine and Book Illustrating
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- ☐ Show Card and Sign Lettering
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**AUTOMOTIVE**
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- ☐ Auto-Elec. Technician
- ☐ Auto Body Rebuilding and Refinishing
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**AVIATION**
- ☐ Aeronautical Engineering Jr.
- ☐ Aircraft Engine Mechanic
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**BUILDING**
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- ☐ Arch. Drafting
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- ☐ Estimating
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- ☐ Heating
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- ☐ Retail Business Management
- ☐ Managing Small Business
- ☐ Sales Management
- ☐ Salesmanship
- ☐ Traffic Management

**CHEMISTRY**
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- ☐ Sheet Metal Drafting
- ☐ Mine Surveying and Drafting

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- ☐ Mathematics
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- ☐ Good English

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- ☐ Cotton Manufacture
- ☐ Rayon Manufacture
- ☐ Woolen Manufacture
- ☐ Loom Fixing
- ☐ Finishing and Dyeing
- ☐ Textile Designing

***YEAR OF THE SIX MILLIONTH STUDENT***

Name__________ Age_____ Home Address__________

City__________ Zone_____ State__________ Working Hours_____ A.M. to_____ P.M.

Occupation__________

Special tuition rates to members of the Armed Forces. Canadian residents send coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

No statement was made by the General Electric Company, who throughout the whole I.R.E. show last spring operated a transistor transmitter in a glass coffee-maker full of boiling water.

**WHEN A CAMERAMAN** follows the horses, it's merely an occupational disease; but when the horses follow the cameraman, it's an invention. Eric A. Black, of Red Bank, N. J. has just received U. S. Patent No. 2,633,054 on an aerial cableway for racetracks. A car suspended from the cableway carries a TV or movie camera and crew. Travelling just ahead of the horses at all times, it not only lets viewers see the race in complete detail, but provides track officials with an unquestionable, permanent record where fouls are claimed.

**GANO DUNN,** internationally famous engineer, financier, and educator, died April 10 in New York City at the age of 82. The first man in the United States to receive a degree in electrical engineering, Mr. Dunn's career spanned almost the entire history of electrical power transmission, communications, and engineering education in this country.

Mr. Dunn was president of J. G. White Engineering Corp., a director of RCA and NBC, chairman of trustees and former president of Cooper Union in New York City, and a director or trustee of many other industrial, financial, and educational institutions. He was a Fellow of the Institute of Radio Engineers, honorary secretary for the United States of the I.E.E. of Great Britain, a member of the American Academy of Arts and Sciences, the American Society of Civil Engineers, and had received many honorary degrees in this country and abroad.

**DR. RONALD W. GURNEY,** noted British-born electronic physicist whose pioneer research on semiconductors was one of the factors which led to the development of the transistor, died suddenly on April 14th in New York City. Dr. Gurney had made his home in the United States since 1941, conducting research in ballistics during World War II at the Army's Aberdeen Proving Grounds, and later as research professor at the University of Maryland.

**NEW LOW-COST COMPOUNDS** of aluminum, antimony, and other common metals may revolutionize transistor manufacture by replacing germanium as the basic material. The new semiconductors have already proved themselves as rectifiers, and further tests are being carried on at the National Bureau of Standards, Bell Telephone Laboratories, and Battelle Memorial Institute in Columbus, Ohio.

The aluminum-antimony compound may even outperform germanium at high operating temperatures, and as for cost—aluminum and antimony sell for less than 50 cents a pound. A pound of germanium costs $350! END

## BAROMETER of the PARTS INDUSTRY

During April, 64 of the leading 400 manufacturers of Radio-Television-Electronic parts and equipment made changes in their lines. Actually there was a decrease in "change activity" as compared to March.

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

| | No. of Manufacturers | |
|---|---|---|
| | March | April |
| Increased prices | 23 | 22 |
| Decreased prices | 18 | 8 |

| | No. of Products | |
|---|---|---|
| | March | April |
| Increased prices | 350 | 967 |
| Decreased prices | 179 | 466 |

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

| Product Group | Increased Prices | | Decreased Prices | | New Products | | Discontinued Products | |
|---|---|---|---|---|---|---|---|---|
| | No. of Mfrs. | No. of Products | No. of Mfrs. | No. of Products | No. of Mfrs. | No. of Products | No. of Mfrs. | No. of Products |
| Antennas & Access. | 4 | 30** | 1 | 2** | 14 | 129** | 9 | 147* |
| Capacitors | 1 | 31** | 3 | 404* | 4 | 778* | 2 | 57** |
| Controls & Resistors | 0 | 0** | 0 | 0** | 1 | 1** | 1 | 1** |
| Sound & Audio Prod. | 2 | 98* | 0 | 0 | 11 | 65* | 12 | 84* |
| Test Equipment | 5 | 35* | 0 | 0** | 6 | 19* | 5 | 9* |
| Transformers | 1 | 8* | 0 | 0** | 2 | 8** | 0 | 0** |
| Tubes | 6 | 85** | 3 | 14* | 9 | 57* | 4 | 21* |
| Wire & Cable | 3 | 680* | 1 | 46* | 1 | 1** | 2 | 7* |

* Increase over March
** Decrease from March

**COMMENT:** Showing only a slight decrease in the number of manufacturers reporting changes since last month, over-all product activity continues to be heavy. While tube, antenna, and sound manufacturers once again dominate this "change activity" scene, we note that several capacitor and wire manufacturers have made considerable revisions in their lines.

*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

I.D.E.A., Indianapolis, has prepared a colorful broadside which it mailed to distributors of its *Regency* v.h.f. boosters. A letter describing the company's Card-of-the-Month campaign accompanied the broadside. Each card will contain a pertinent suggestion on new methods of realizing greater profits on Regency boosters.

Earl H. Kirk shows *Regency* sales aid.

**Tel-A-Ray Enterprises, Inc.,** Henderson, Ky., has prepared a u.h.f. antenna selector indicating the various types of Tel-A-Ray u.h.f. antennas for good reception at different distances.

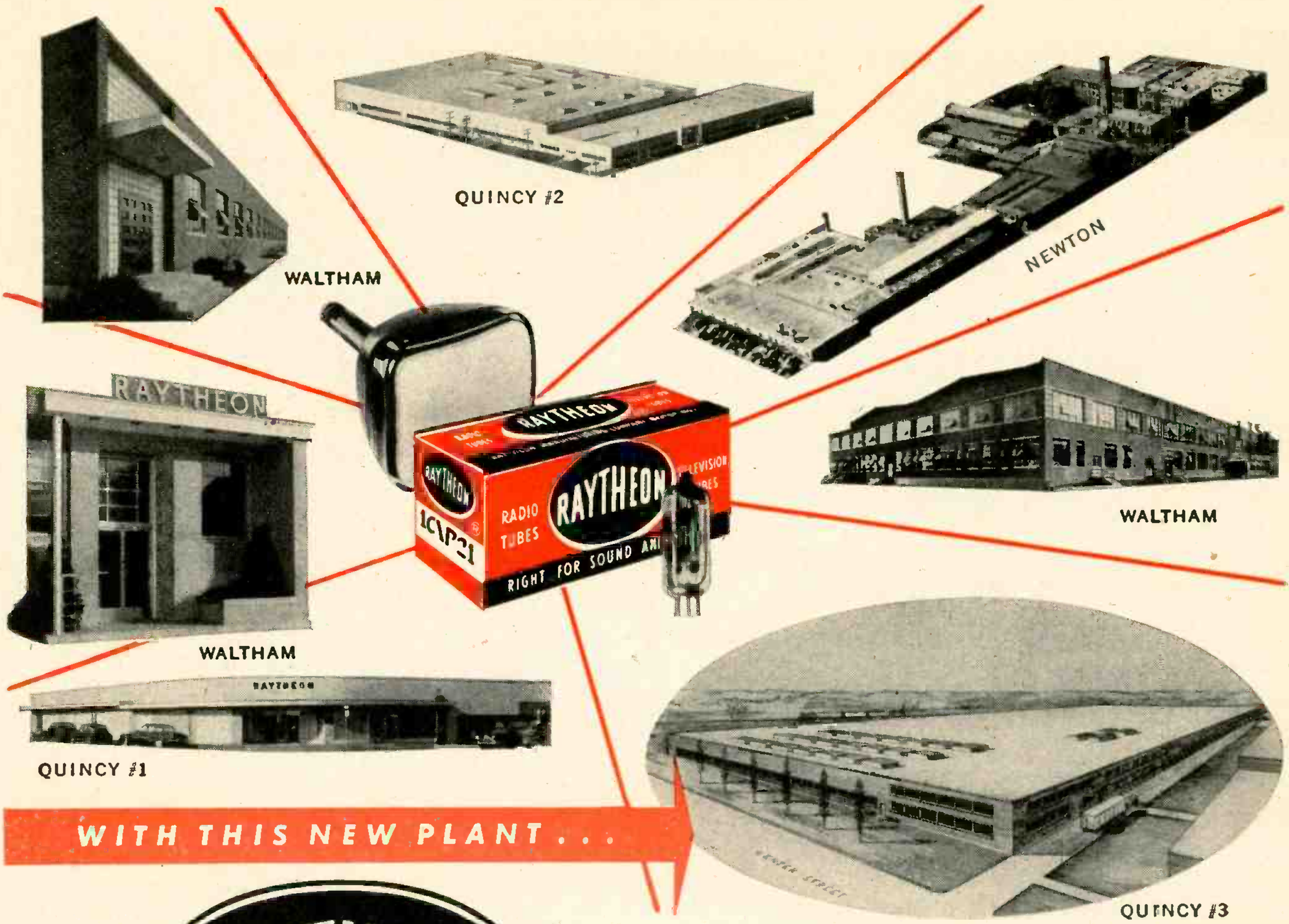
**Sylvania Electric Products** is offering radio-TV service technicians a personalized home calendar for 1954. The calendar, which serves as a Christmas greeting and features recipes and home care hints, may be imprinted with the service technician's name, address, and phone number.

**Walter L. Schott Co.,** Los Angeles, has built its new distributor promotion around the theme, "When you buy, sell, or install Walsco, it's like money in the bank." In addition to 150,000 mailing pieces made available to distributors, three-minute recordings and miniature banks are also being used.

**Channel Master Corp.,** Ellenville, N. Y., designed a new package for its Katy-B television booster which doubles as a two-color pop-up counter display.


**Electro-Voice, Inc.,** Buchanan, Mich., launched a new program to help service technicians cash in on the huge phono-cartridge replacement market.

(PLEASE TURN TO PAGE 18)




## the RAYTHEON resources

### DEVOTED EXCLUSIVELY TO ELECTRON TUBES

consist of
- more than 1,000,000 sq. ft. of manufacturing area
- more than 10,000 skilled tube craftsmen
- backed by 30 years of tube engineering, development and production experience

Raytheon's newest plant at Quincy, Massachusetts is expressly designed to economically manufacture 24 inch and larger Raytheon Picture Tubes. It will employ the very last word in modern engineering and manufacturing techniques. It will be devoted exclusively to the making of tubes worthy of the Raytheon reputation for quality and dependability. With *Raytheon* Radio and Television Tubes you are *Right* . . . for *Sound* and *Sight.*

RAYTHEON®

*Excellence in Electronics*

**RAYTHEON MANUFACTURING COMPANY**
Receiving Tube Division
Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

RAYTHEON MAKES ALL THESE:
RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES


5"
RCA WO-88A
$169.50
Suggested User Price
You can believe what you see
with an RCA oscilloscope
The RCA WO-88A 5-inch and WO-56A 7-inch oscilloscopes have the facilities you need for precise qualitative analysis and accurate quantitative measurements . . . thanks to advanced engineering design.
For instance, one of the outstanding features of these instruments is their remarkably true square wave response . . . obtained by adequate band width, negligible phase shift, fast rise time, frequency-compensated attenuators, and a complete absence of peaking circuits.
Equally important are the peak-to-peak voltage-measurement features—obtained through the use of voltage-calibrated attenuators, front-panel calibrating-voltage terminals, calibrated graph screens, and good amplifier linearity.
Other quality features common to both designs include . . . push-pull direct-coupled amplifiers . . . extra fast retrace . . . shielded CRT gun . . . plus and minus sync . . . line-frequency sweep with phasing . . . and a set of matched probes and cables including a high impedance probe having an input resistance of 10 megohms and an input capacitance of less than 10 uuf!
Before selecting a 'scope for your special needs, be sure to get the full details on the WO-88A and WO-56A from your RCA Test Equipment Distributor . . . or write RCA, Commercial Engineering, Section 49FX, Harrison, New Jersey.
7"
RCA WO-56A
$237.50
Suggested User Price
RCA
RADIO CORPORATION of AMERICA
TEST EQUIPMENT
HARRISON, N.J.

The program, "Your Profit Key to '53," offers an all-metal six-unit cartridge


dispenser, a Professional Phonographic Service decal and a Set Model Phono-Cartridge Replacement Guide with every purchase of six Electro-Voice cartridges through E-V distributors.

**Permoflux Corp.**, Chicago, designed a new point-of-sale display carton as a promotional aid for the Permoflux telephone pickup attachment which picks


up both sides of a telephone conversation without electrical connection to the phone. The new display is printed in three colors and holds six pickup units.

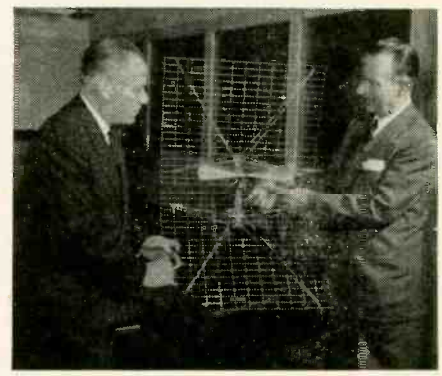
**John F. Rider, Publisher, Inc.**, New York City, is offering purchasers of its book "High Fidelity Simplified" an opportunity to buy a special Columbia LP high-fidelity test record. The offer expires September 1st.

**The RCA Victor Tube Department**, Harrison, N. J., is pointing its spring-summer advertising campaign toward the establishment of local RCA battery dealers as radio battery and service headquarters for portable-radio owners. National radio, TV, and magazine advertising will be used as well as in-store display material and a variety of sales aids including a battery tester and display unit.

RCA's new battery-tester sales aid.

## New Plants and Expansions

**United Motors Service Division** of General Motors Corp., Detroit, is planning an expanded distribution of radio and TV service parts and additions to



Executives view Delco u.h.f. antenna.

these lines, according to W. N. Potter, general manager of the division. TV antennas and picture tubes will be marketed under the Delco name and sold through electronics parts distributors. Formerly, Delco radio parts were sold almost exclusively through automobile parts distributors.

**International Resistance Co.**, Philadelphia, has begun production in its new plant in Asheville, N. C. Various types of volume controls for radios, TV sets, phonographs, test equipment, and military and other devices will be made in the new $200,000 plant.

**Quam-Nichols** expects to be in full production in its new 75,000-square-foot plant on Chicago's South Side by mid-July. The new plant has more than double the productive capacity of the old plant.

**Westinghouse Electric Corp.** recently held the official public opening of its new Electronic Tube Division plants in Bath and Elmira, N. Y.

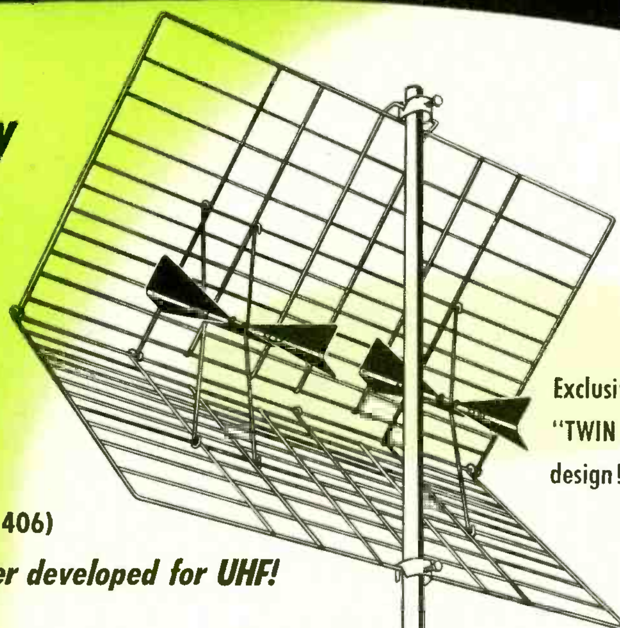
**Permo, Inc.**, Chicago, now maintains a large warehouse of Fidelitone and Permo-Point products in Los Angeles, according to Gail S. Carter, vice-president.

**Krylon, Inc.**, has moved its executive and sales offices to 1422 Chestnut St., Philadelphia 2. Plant, warehouse, and general offices remain at 2038 Washington Ave., Philadelphia 46. END


GENERAL ELECTRIC
GENERAL ELECTRIC COMPANY

# Two heads are better than one!

## And that's *exactly* why CHANNEL MASTER'S amazing new TWIN CORNER REFLECTOR (Model No. 406)



Exclusive "TWIN DIPOLE" design!

*is the most sensitive fringe-area antenna ever developed for UHF!*

### TWO DIPOLES—HIGHER GAIN

The two dipoles of the Twin Corner Reflector provide TWICE as much gain as standard-type Corner Reflectors!

This two-dipole construction is an original Channel Master idea which successfully combines two separate Corner Reflectors into *ONE ANTENNA STRUCTURE* — requiring ONE simple installation.

This 2-in-1 combination gives you:

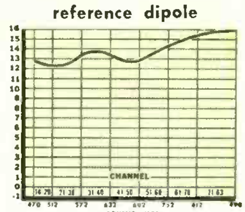
. . . the economy of one antenna.
. . . the convenience of one antenna.
. . . BUT the combined performance of TWO separate high gain antennas.

Model No. 406 furnishes far better picture quality — at far greater distances — on every UHF channel.

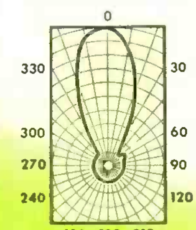
**Eliminates UHF's "Twin Terrors."** 100% vibration-proof construction prevents picture flicker. "Free space" terminals prevent dirt and rain water from shorting out the picture.

## up to 16 DB gain

gain above tuned reference dipole




horizontal polar pattern (relative voltage)




Channel 20

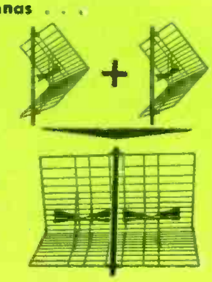
*Extremely narrow "Yagi-type" forward lobe; no side lobes; very high front-to-back ratio*

## 2 antennas in 1

The Twin Corner Reflector furnishes the performance of 2 antennas because it really is 2 separate antennas . . .

stacked side by side . . .

into 1 simple structure . . . with just a single down-lead to the set.

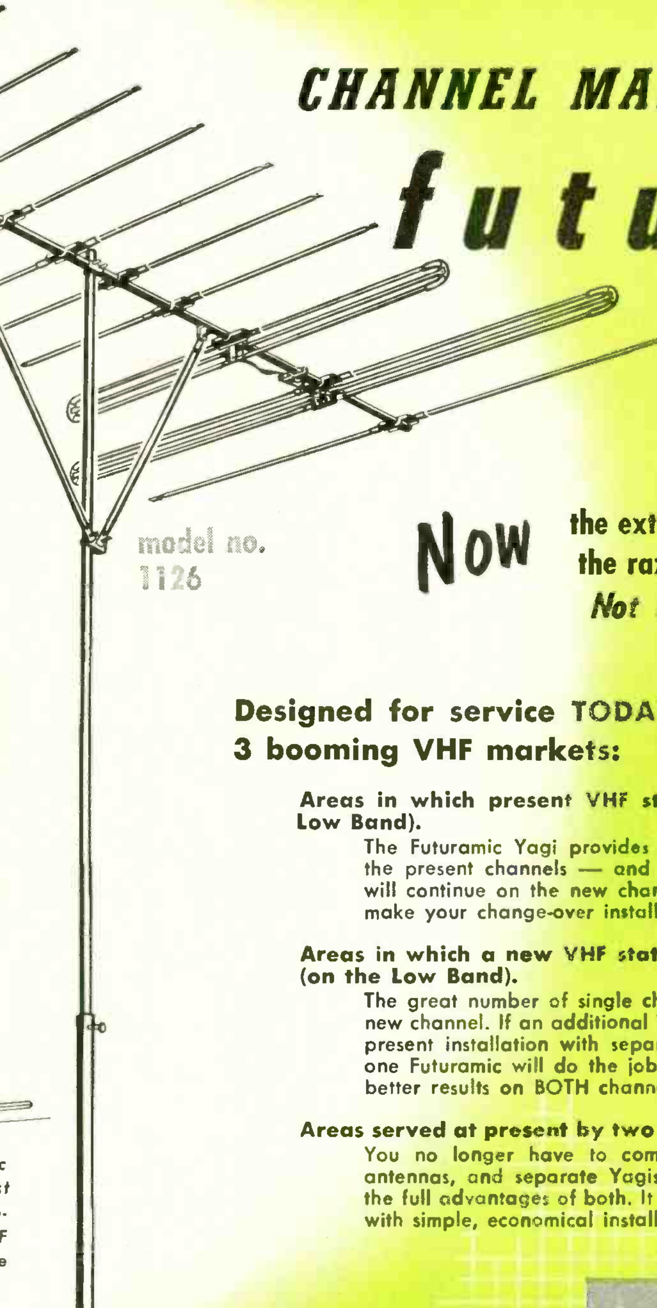


*CHANNEL MASTER engineering pays off on UHF!*

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.

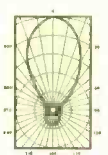
# At Last! a YAGI for the ENTIRE LOW BAND!

## CHANNEL MASTER'S Newest futuramic

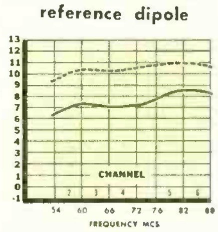


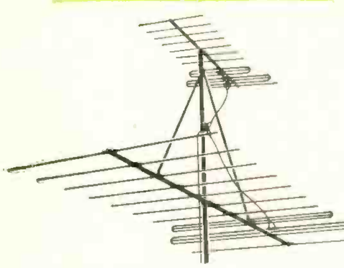

**Completely covers every low band channel– 2 through 6**

horizontal polar pattern
(relative voltage)



gain above tuned
reference dipole



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

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

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

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

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

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

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

| model no. | channels covered | list price |
|---|---|---|
| 1173 | 7 — 13 | $20.15 |
| 1124 | 2, 3, and 4 | $40.77 |
| 1125 | 2, 3, 4, and 5 | |
| 1136 | 3, 4, 5, and 6 | |
| 1146 | 4, 5, and 6 | |
| 1126 | 2, 3, 4, 5, and 6 | |

**CHANNEL MASTER engineering pays off on VHF!**

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

# Be Sure of Your Installations...Next Year Use *Aptitude-Tested* MIKE CABLE *Now!*

FOR 50 YEARS *Wiremaker for Industry*

Now, you can be sure of your installations with Belden Microphone Cables. They are *Aptitude-Tested* and rated to give you safe and complete knowledge of their characteristics. Furthermore, Belden Mike Cables are built for maximum service. Put them to work for you now—and be sure... specify Belden.

Belden Manufacturing Co., 4623 W. Van Buren Street
Chicago 44, Illinois

**To You, Belden's Golden Anniversary Means**

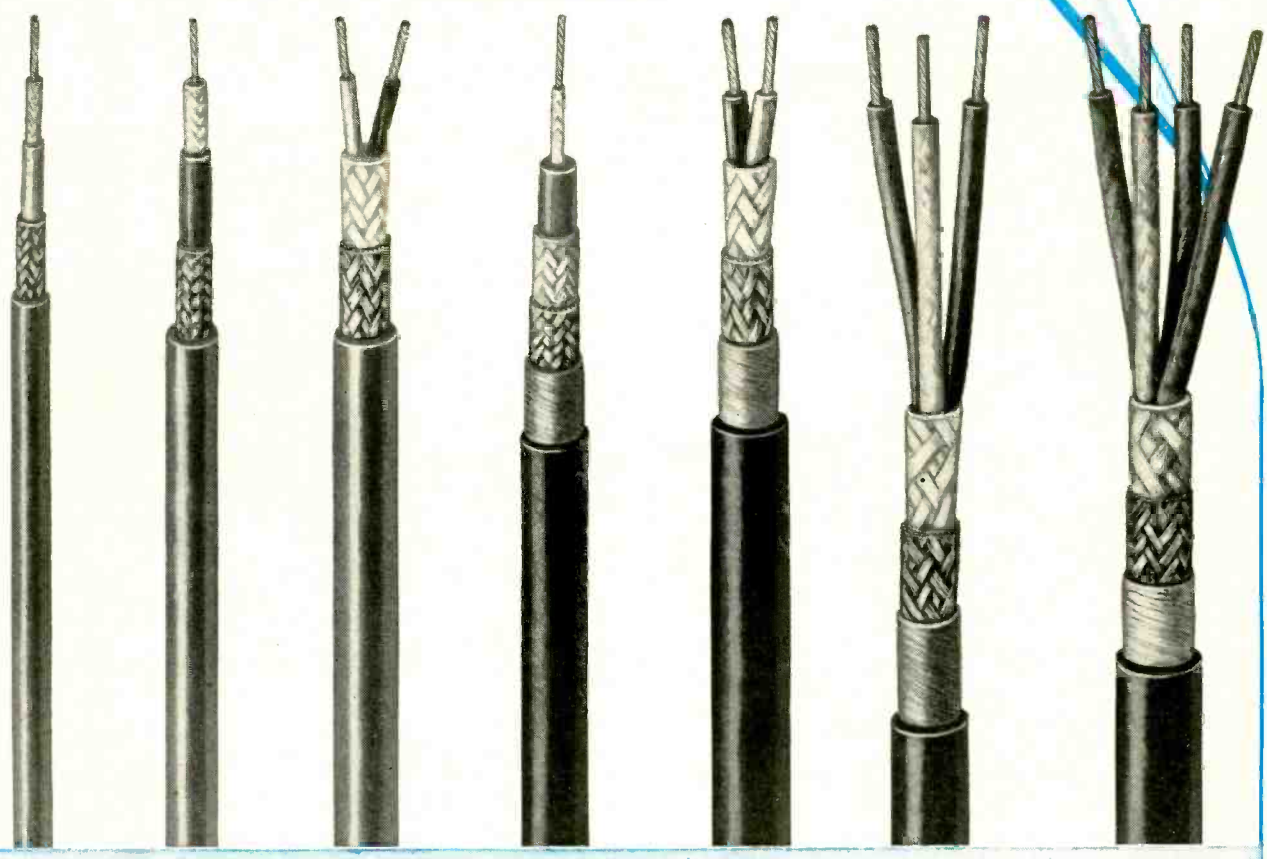
—product performance that can come only from a "know-how" that has grown through actual service since the inception of Radio.

—an ability to co-operate in pioneering new wires to meet or anticipate industry's growing needs.

In the years that follow

This Belden Program Is—

— TO BE CONTINUED



| No. 8411 | No. 8401 | No. 8422 | No. 8410 | No. 8412 | No. 8423 | No. 8424 |
|---|---|---|---|---|---|---|
| Nominal Capacitance 37 mmf per ft. Use particularly for lapel microphone. | Nominal Capacitance 25 mmf per ft. For crystal, ribbon, carbon microphones. | Nominal Capacitance 32 mmf per ft. Use specially for carbon microphones. | Nominal Capacitance 33 mmf per ft. For crystal, ribbon, carbon microphones. | Nominal Capacitance 68 mmf per ft. Use specially for carbon microphones. | Nominal Capacitance 54 mmf per ft. Use particularly for carbon microphones. | Use for interconnecting power cable for all electronic uses. Also microphone cable. |

**Belden** *Radio* **WIRE**

The *Aptitude-Tested* **LINE**

# $10,000.00 IN PRIZES

## ENTER RAYTHEON'S TRANSISTOR APPLICATION CONTEST!


Here's the chance-of-a-lifetime to win a big cash prize while gaining valuable "know-how" on the latest electronic development — transistors. Raytheon is offering 17 *cash prizes* to the seventeen contestants who produce the most ingenious applications of the Raytheon CK722 Junction TRANSISTOR.

**Here's all you have to do!** Simply build equipment that uses one or more Raytheon CK722 Transistors which you have purchased from your local Raytheon Tube Distributor. Then send a photograph of the unit you have built, a completed official entry blank and a 500 word minimum, 1000 word maximum constructional article on the equipment to Raytheon, P. O. Box 6, Newton 58, Mass. All entries will be carefully judged and prizes will be awarded on the basis of ingenuity of application. Duplicate equipment to be judged on basis of descriptive material. Decision of the judges is final and all entries and their ideas become the exclusive property of Raytheon.

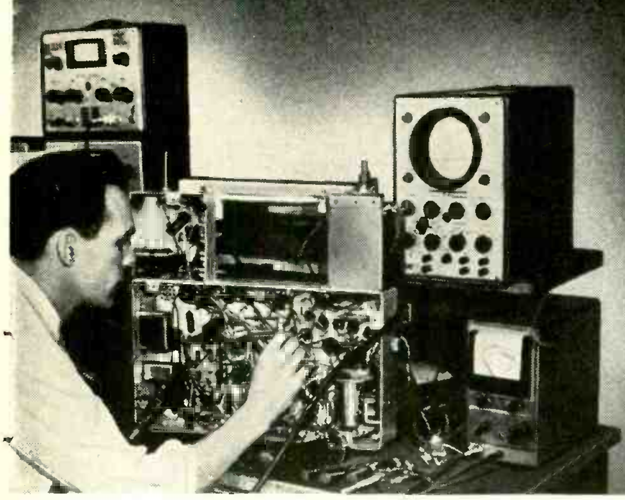
**Here's how to enter!** Go to your nearest Raytheon Special Purpose Tube Distributor. Get your official entry blank which *must* accompany each entry and which contains complete contest rules or get the official entry blank by writing directly to Raytheon, P. O. Box 6, Newton 58, Mass. Enter today — the contest closes on Midnight August 31, 1953.

RAYTHEON®
*Excellence in Electronics*

**RAYTHEON MANUFACTURING CO.**
*Receiving Tube Division*
POST OFFICE BOX 6, NEWTON 58, MASSACHUSETTS

# For opportunities within your reach

# See what the RCA TV Servicing Course offers you



## Good-pay jobs. A business of your own.

Opportunities for good-pay jobs in Television are within your reach when you study TV Servicing by the RCA Institutes Home Study Method. Or perhaps you would like to start a TV Service business of your own.

If you are not satisfied with the way your future now stacks up, see how easily you can change the course of your career. RCA Institutes Home Study Course in TV Servicing is helping thousands of other people to better jobs. It can help you. Right now thousands of opportunities are going begging. There is a critical shortage of trained TV servicemen. This is *your* big opportunity.

## Easy-to-understand, illustrated lessons

The entire course is divided into ten units of several individual lessons. You study them at home in your spare time. Lesson-by-lesson you learn the theory and step-by-step procedures of installing TV antennas, of servicing and trouble-shooting TV receivers. Hundreds of pictures and diagrams help you understand the how-it-works information and the how-to-do-it techniques. You will be amazed how easily you absorb the knowledge of each lesson, how quickly you train yourself to become an experienced technician.

## Experienced engineers and faculty prepared the course, grade your lessons

The RCA Institutes course was written and planned by instructors with years of specialized experience in training men by home-study and resident-school methods. The course embodies RCA's background of television experience plus knowledge gained in training several thousand technicians. A study of the course parallels an apprentice's training. Your lessons are carefully examined and accurately graded by friendly teachers who are interested in helping you to succeed.

## One of the leading and oldest Radio-Television training schools

Founded in 1909, RCA Institutes, Inc. has been in continuous operation for the past 44 years. Its wide experience and extensive educational facilities give students, just like you, unsurpassed technical training in the highly specialized field of radio-television-electronics.

RCA Institutes is licensed by the University of the State of New York . . . an affiliate member of the American Society for Engineering Education . . . approved by the Veterans Administration . . . approved by leading Radio-Television Service Organizations.

## It costs so little to gain so much

RCA Institutes makes it easy for you to take advantage of the big opportunities in TV Servicing. The cost of the TV Servicing Home Study Course has been cut to a minimum. You pay for the course on a pay-as-you-learn unit lesson basis. No other home study course in TV Servicing offers so much for so little cost to you.

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

**RCA INSTITUTES, INC.**

***A SERVICE OF RADIO CORPORATION of AMERICA***

***350 WEST FOURTH STREET, NEW YORK 14, N.Y.***

**SEND FOR FREE BOOKLET**—Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.

**MAIL COUPON NOW!**

RCA INSTITUTES, INC., Home Study Dept. RE-653
350 West Fourth Street, New York 14, N.Y.

Without obligation on my part, please send me copy of booklet "RCA Institutes Home Study Course in Television Servicing." (No salesman will call.)

Name ____________________ (please print)

Address ____________________

City ____________ Zone ______ State ____________

# CLOSED-CIRCUIT TELEVISION

*. . . A new booming field for video . . .*

By HUGO GERNSBACK

CLOSED-CIRCUIT television has been with us for a number of years. We have mentioned the subject on this page several times in the past and we will attempt to give as complete a list of the new uses of television as is feasible in this limited space.

General Sarnoff, Chairman of the Board of the Radio Corporation of America, recently stated: "The dimensions of industrial television may surpass the growth in broadcast television we are now witnessing."

By far the most publicized use of closed-circuit television is that for educational purposes in colleges, universities, and other institutions of learning. This new field is bound to grow by leaps and bounds, and while it will never supplant the classroom, there is a great future ahead for it.

Sarnoff is also of the opinion that television in the office, factory, and home will rank soon with voice communication between rooms in the same house and offices in the same building. He is of the opinion that when the cost of camera attachments becomes low enough to permit their use in homes, *the television receiver will become the control center of the home.* By turning a switch, the receiver, instead of showing broadcast programs, will be used to view the children asleep or at play in the yard or in the nursery, to view the cooking in the kitchen, and to see callers before the door is opened.

Industrial television has already achieved many wonders. Seventeen years ago, the writer predicted one of the important improvements in the art, namely stereoscopic television, now popularly called 3-D (three-dimensional viewing)*. Quietly, without fanfare, it has already arrived. The Allen B. Du Mont Laboratories, Inc., are making a stereoscopic television camera which is used at the Argonne National Laboratories in atomic research work. The stereoscopic camera is focussed on a mechanical manipulator used to work with radioactive "hot" materials. At a safe distance away, a chemist views a stereoscopic image on a receiving screen through spectacles fitted with polarized glasses as he co-ordinates the mechanical manipulator. The receiver which he watches has two identical pictures side by side on the same screen. This, with his polarized glasses, gives stereoscopic vision at a distance.

An accountant with pencil poised now can watch freight yards from his office with a camera mounted in a railway yard. Thus, he can check off the serial numbers on the freight cars as the train passes by the camera.

Railroads now also use television to guide switching of incoming and outgoing trains.

An electronic eye can now see into a furnace and observe fuel combustion and do away with smoke pollution.

In London, England, airports can now check on taxiing planes and planes aloft by means of television.

At the New York Savings Bank, customers' signatures and balance cards are viewed by a television camera. The result is flashed to the teller's cage and he instantly sees the customer's balance. He thus can verify the customer's signature and tell whether a check might overdraw the account. This system greatly speeds banking transactions.

The British use underwater television cameras routinely in locating sunken ships. The camera is remotely controlled. It can be swung through a variety of angles for horizontal and vertical shots, or shots of any given angle.

During the 1952 Radio Exhibition at London, a radio-controlled crane was operated by an engineer using television. He saw only the crane on a screen; all operations were performed by remote-control.

Operations performed by surgeons via television are becoming commonplace. A new idea however for lecturing purposes by the medical profession now makes it possible to bring home anatomical details by throwing a greatly enlarged television image on the screen. A recent English demonstration showed only a live human eye, the pupil of which was enlarged to such an extent that it was bigger than the lecturer. Standing before the screen he used a long lecturing stick to show the eye's pathological points to the assembled physicians.

Supervisors of factories can now view almost any operation in any plant for which they are responsible. Thus, for instance, if he wishes to see plant No. 2, fifth floor, center of the Stamping Department, all the supervisor has to do is flip a switch. If he wishes to see Plant No. 8, two miles away, and wants to watch a certain operation on the assembly line, he simply flips another switch. In this manner the supervisor or operating manager can visit any part of a huge factory, and can cover more ground in fifteen minutes than he previously could in 3 hours.

It is also possible now for salesmen in widely scattered areas to see a new product demonstrated and familiarize themselves with all its important points.

John Gallagher, Industrial Television Sales Development Coordinator of Du Mont, recently spoke at length on closed-circuit television. Among other things, he stated that such a system can now be used to guard banks, industrial plants, and department stores, to supervise commercial operations at a distance, to protect documents and signatures, to control traffic in tunnels and crowded highways, and to read all types of meters and gauges on boilers on industrial installations.

It will also soon be possible for publishers to see final proofs and check corrections via closed-circuit television. One of the time-consuming nuisances in publishing today is that proofs must either be transported from the distant printer to the publisher. Or the editor or editorial worker must go to the printing plant. By closed-circuit television, it will be possible to read proofs from a television screen and verify corrections, with vast saving of time.

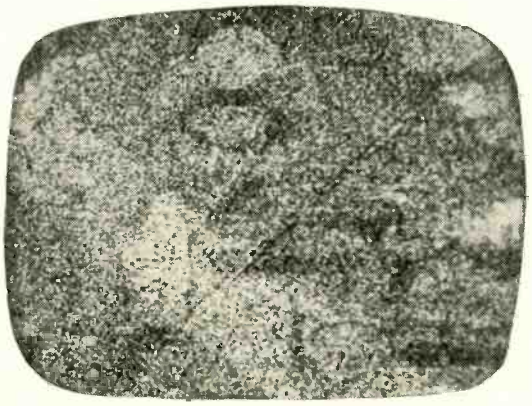
Closed-circuit video will really start booming when color television becomes of age. This is particularly true in surgery and many manufacturing processes where color control is of vast importance, such as textiles, foods, and color printing, to mention a few. Color television now being in the last stages of development, it is certain that in the next ten years industrial television will rise to unimagined heights.

* Oct. 1936 issue SHORT WAVE CRAFT.

# NEW BOOSTERS from OLD TUNERS

***Convert junk-box front ends to cascodes—and into cash***

By JOSEPH MARSHALL



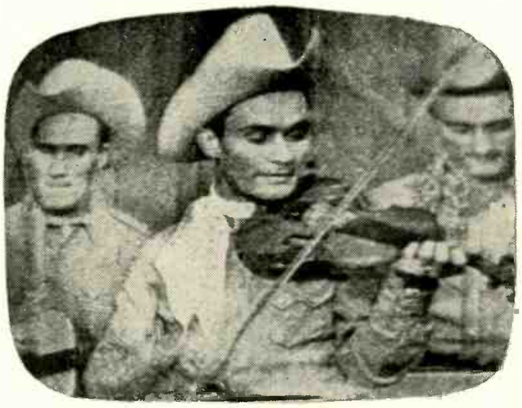


**Fig. 1—Before and after. Unretouched photos of the picture received without (left) and with (right) a home-built cascode booster made from a 98¢ tuner.**

THE cascode circuit is unquestionably the biggest improvement in high-frequency amplifier design of the past decade. Incorporating it in the front-ends of TV receivers has vastly improved their performance in near-fringe areas; but it has also brought problems in the far-fringe areas. The new tuners work very well where the signal strength is great enough to give good contrast without a booster, since the "snow" of the cascode circuit is small enough not to be annoying. But trouble ensues when a booster must be added, for unless the noise figure of the booster is at least as good as that of the cascode front-end, a stronger picture is obtained only at the expense of more snow.

Most pre-cascode boosters have an inferior noise figure. It takes a booster with a cascode input stage to improve the over-all picture quality. Technical magazines have had articles describing many types of single-channel boosters; but there have been no descriptions of cheap home-built boosters for all-channel performance, for the simple reason that the headaches involved in winding and switching the multiplicity of coils are enough to try the patience of a whole factory engineering staff, let alone a lone experimenter or amateur. But in the past year the near-obsolescence of pre-cascode tuners has thrown many varieties of front-ends on the market at bargain prices—some as low as $1.00 and most of them under $10.00. Many of these can be rebuilt easily into excellent all-channel cascode boosters, with performance at least as good as high-priced commercial versions. The author has constructed several in the past few months.

The two unretouched photos in Fig. 1—taken within a few seconds of each other—show the improvement on channel 2 effected by the addition of one of these boosters at a distance of 140 airline miles from the transmitter. Although the receiver did not have a cascode r.f. stage, the improvement with the new-style tuner is nearly as dramatic. The booster responsible for this performance was made in a total of three hours out of a tuner of unknown make purchased from Burstein-Applebee for 98¢. We have also made very successful boosters out of Du Mont *Inputuner* front-ends. Although we have not actually converted one, old models of the Standard Coil tuner should also make very satisfactory boosters.

Most conversions are simple and do not take more than a few hours of work. The re-wiring is practically all confined to the tube sockets; the tuned circuits are not disturbed. In most cases the only additional parts needed are a pair of 100-ohm resistors and possibly two new tubes. The circuit is not at all critical and if reasonable care is taken in construction no trouble should follow. Adjustments are also simple, since the original alignment is not disturbed much.

## Choosing the tuner

Some of the old tuners had push-pull-triode r.f. amplifiers and tuned-line resonant circuits. Although it is possible to convert these, I have not tried it, and I do not recommend the attempt except to those who have had considerable experience fooling around with v.h.f.-amplifier circuits. The best types are those with a pentode r.f. stage and a 6J6 mixer-oscillator. All the Du Mont *Inputuners* are convertible into extremely good boosters, whether they have pentode or grounded-grid-triode r.f. stages. In fact, any tuner that has parallel-tuned antenna and output circuits, and two 7-pin miniature sockets fairly close together, will work in this circuit.

## The circuit

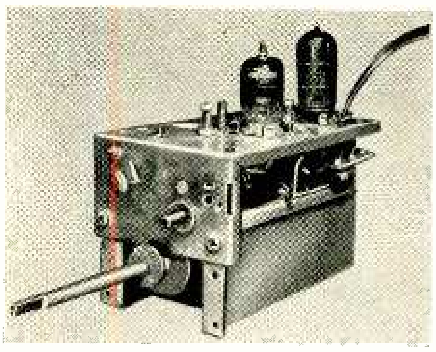
The circuit of Fig. 2 uses a 6AK5 (though a 6CB6 will probably work as well) and a 6J6 in a direct-coupled cascode circuit. The new twin-triodes (6BK7-A, 6BQ7-A, and 6BZ7) would also work here; but unfortunately they call for replacing the 7-pin sockets with larger 9-pin sockets and this involves real labor. This two-tube circuit works even better, and requires no physical modification of the tuner chassis. The circuit is actually very simple, despite the presence of coils in unfamiliar places.

The cascode circuit combines a grounded-cathode-triode input section and a grounded-grid-triode output section. For several reasons this combination produces an incredibly good combination of low noise and high gain. Its high input impedance permits the use of an impedance-stepup transformer in the antenna circuit. This gives a better input-signal to tube-noise ratio, and the gain becomes very much higher, approaching—and in some cases surpassing—the gain of a pentode. The grounded-grid 6J6 loads the first section very heavily, reducing the gain of the 6AK5 to unity or a little better, eliminating the instability and oscillating tendency of a triode. Though the 6AK5 has very little gain, it transfers the favorable signal-to-noise ratio of the first section to the grounded-grid second stage. The combination has the high stability of a grounded-grid triode and the favorable noise figure of a grounded-cathode triode. The over-all noise figure is equivalent to that of the input tube alone, and the over-all gain is as good as or better than that of a pentode.

### Interstage coupling

Several methods of coupling between the two stages are possible. The simplest—and in many ways the most effective—is the direct coupling made possible by putting the second section in series with the first one. The interstage impedance to ground is very high and the number of tuned circuits is reduced to a minimum. This is the method used in this booster. The schematic is given in Fig. 2.

There are two variable tuned circuits, one at the antenna input and the other in the output of the second stage. These tuned circuits are the antenna (L1)



Two-tube *Inputuners* are easy to convert. See circuit changes in Fig. 5.

and amplifier-plate (L4) coils of the original tuner, and need little or no modification. Before going into that, however, it might be well to explain the function of the two *unfamiliar* coils L2 and L3 which appear in the circuit diagram.

The purpose of L2 is to neutralize the grid-plate capacitance of the 6AK5. This is normally only about 2 or 3 μμf, but this is increased by the Miller effect and by circuit capacitance. This capacitance offers very little impedance to the high TV-signal frequencies, and has two bad effects. On one hand, part of the input signal bypasses the grid of the first section completely, going through the interelectrode capacitance directly to the second section; on the other hand, part of the output signal at the plate of the first section feeds back through this capacitance to the input grid. Since the first section in a cascode circuit has little if any voltage gain, the feedback effect does not cause oscillation—at least not when the input is loaded with an antenna. But it does result in some loss of signal. On the other hand, the *feed-through* around the first section reduces the noise figure of the amplifier because the low input impedance of the grounded-grid second section loads the antenna input more heavily than the grounded-cathode first section. In any event, we get slightly more gain and a noticeably better noise figure—especially on the high-band channels—by preventing this feedback and feed-through in the first section of the amplifier.

We achieve both of these aims by adding an inductance (L2) to form a parallel-resonant circuit with the plate-grid and circuit capacitance at the signal frequency. As we know, such a parallel circuit forms a rejection trap, preventing signals from going through it in either direction. We also have to add a blocking capacitor (C1) to prevent grounding the plate voltage. Although at first glance the result looks like a series resonant circuit, it is actually the parallel-tuned circuit shown in Fig. 3-a. (The reactance of the 250-μμf blocking capacitor at TV-channel frequencies is so small that L2 is effectively connected directly to the 6AK5 plate.) The inductance of L2 is not critical. Where there is room, it can be 5 to 10 turns of No. 22 *Formvar* wire, wound on a ¼-inch slug-tuned form. Where space is at a premium (as in the Standard Coil tuner) it can be a self-supporting coil of 15 to 20 turns of the same wire, wound on a ⅛-inch drill stem. It is best to resonate this on a high-band channel or the weakest station received.

Now let's look at L3. It neutralizes the plate-to-ground capacitance of the first tube. In a triode-connected 6AK5 this capacitance is around 2 or 3 μμf. The capacitance is increased if the tube is shielded, and no shield should be used on this section. It is also increased by wiring capacitance. With one thing and another, we end up with nearly 10 μμf plate-to-ground capacitance. In the ordinary r.f. amplifier, where the load is a tuned circuit between plate and ground, this capacitance is put to work as part of the resonant circuit. But in the cascode circuit, the load is *in series* between the plate and the output of the next tube. So the plate-ground capacitance—instead of being part of the load—bypasses the signal *before* the load, and unless it is neutralized a good portion of the signal will be bypassed to ground instead of going into the load and being amplified in the process. Once again we neutralize by installing an inductance. L3 forms a

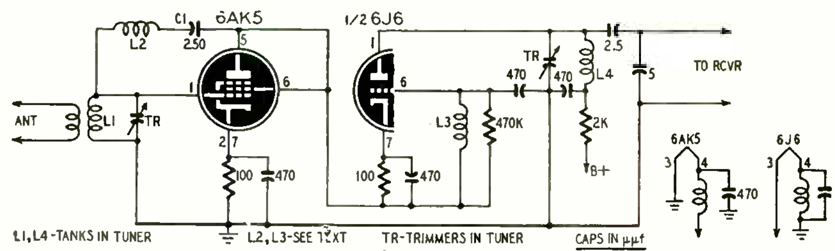



Fig. 2—Circuit of the cascode booster. L2 and L3 are neutralizing coils.

parallel-tuned circuit with the plate-ground capacitance at the signal frequency and therefore obstructs the passage of the signal to ground. Once again we must block this circuit to d.c. by putting a capacitor in series. We kill two birds with one stone by returning the ground end of L3 to the second grid. The 470-μμf capacitor thus serves two purposes. Although here, too, the circuit looks like a series-resonant circuit at first glance, it is also actually a parallel-resonant circuit. See Fig. 3-b. Incidentally L3 and C2 also form a series-resonant circuit at a frequency much lower than the signal frequency. This can be tuned to form an interference-rejection trap by changing the value of C2. For instance, if the receiver has an i.f. in the 40–50 mc range, this coil can be made to do double duty by choosing a value of C2 which forms a series-resonant circuit with L3 at 40–50 mc.

Ordinarily we think of neutralization as an expedient to prevent oscillation. In the case of the cascode circuit, however, we use neutralization not for that purpose (for the circuit is extremely stable as is) but to keep the signal within the amplifying channel and prevent its loss through bypassing to ground. For this reason, L3 has a much greater effect on the gain than L2. Fortunately, L3 is not very critical and can be a duplicate of L2, adjusted for maximum gain on the high band or on the weakest station.

Otherwise, and in spite of these neutralizing coils, the cascode circuit is very simple. Putting in the wrong-size neutralizing coil will not ordinarily make the circuit inoperative; it simply will not give all the gain and the ideal noise-figure that can be obtained with the right values.

The two tubes are actually in series between the antenna input at the grid of the first tube and the booster output at the plate of the second section. About half the supply voltage appears at the plate of the 6AK5. The full supply voltage is applied to the plate of the 6J6, but the effective plate-to-cathode voltage is only half the supply voltage, because the grid is returned to the bottom of the cathode-bias resistor, as in ordinary circuits.

### Circuit tuning

Now to get back to the tuned circuits. We need two of them, one at the antenna input and the other at the output of the second tube. All tuners can supply these circuits with more or less modification. The input circuit is usually no trouble at all, except in the case of some Du Mont tuners, whose case is considered separately later on. Most tuners provide a link-coupled input coil between the antenna terminals and the grid of the r.f. stage. If your tuner has one, leave it as is. If the tuner does not have link coupling, you will have to provide it. One way is to purchase a replacement input transformer for a Du Mont *Inputuner* and use it as indicated in the section on Du Mont tuners. A simpler method is to use the capacitative transformation provided by the "R-9'er" input circuit. This is diagrammed in Fig. 4 and would replace the input circuit in Fig. 2.

The tuned output circuit is more of a problem. The simplest solution is to use the "R-9'er" capacitative transformer again, and this is the method diagrammed in Fig. 2. Tuners like the Standard Coil type which have transformer coupling between the r.f. stage and the converter, offer an alternative. In these, the oscillator winding on each channel can be either removed or open-circuited. The converter-grid winding can be reduced to 3 or 4 turns and used as an output link. This involves considerable work and offers only doubtful improvement in performance. So the capacitative output transformer is the most practical. It can be used with either 300-ohm or 72-ohm cable. The output impedance can be varied by increasing or decreasing the value of the 5-μμf capacitor in Fig. 3. But the two fixed values given will work adequately as is.

There is only one really critical factor in converting a tuner into a booster. That is to keep the inductance of the leads to the tuned circuits unchanged. In tuners with a pentode r.f. stage, the antenna coil presents no problem at all. The r.f.-amplifier socket is already oriented for the best lead length from grid to coil or switch, and since this circuit is retained without change, the antenna tuned circuit is not disturbed at all. However, we must shift the output tank from the plate of the first tube to the plate of the second tube. To keep this connection as short as it is now, it will probably be necessary to drill out the mounting rivets on the converter socket, and turn this socket so that the plate terminal is as close as possible to the coil terminal. If the resulting lead is a little longer than the original, make it of heavy wire or brass strap to reduce the inductance. In any case, dress this lead well away from the chassis—especially if it is a strap.

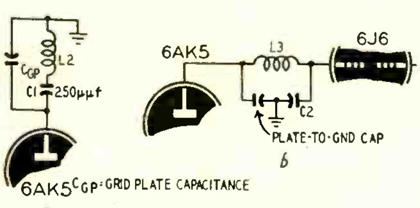



**Fig. 3—Equivalent parallel-resonant rejection traps formed by the neutralizing coils and associated circuit capacitances.**

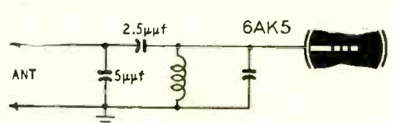



**Fig. 4—Circuit of the "*R*-9'er" capacitive impedance-matching transformer.**

If the r.f. amplifier in the tuner was a pentode, usually the only changes needed in this circuit are to remove the tank circuit, tie the screen to the plate (removing the screen-bypass capacitor and voltage-supply lead), and connect the plate to the second-section cathode through the cathode resistor. In most tuners, however, the mixer circuit will have to be rewired completely, except for the heater circuit. Although certain values of bypass capacitance are suggested in Fig. 2, these are not critical. The best thing is to use the original capacitors in the tuner. The same is true of heater chokes, and that is why no values are given for them.

The converted circuit should not require much if any re-alignment. Any changes caused by rewiring can be compensated for with the trimmers already in the circuit. Since the individual coils in any tuner have already been adjusted for each channel at the factory, the alignment at one point—usually the weakest station—will suffice for all channels. The only other adjustment is peaking the neutralizing coils. This should also be done on the weakest channel, or on one of the high channels. If the coils are wound over iron cores, the slugs can be adjusted to peak them. If the coils are self-supporting, they can be adjusted by spreading or compressing the turns. The neutralization will be fully effective over only part of the range; but this is ordinarily enough to provide good gain on all channels.

## Du Mont tuners

Du Mont tuners can make the best boosters but offer some special conversion problems. Those with 3-section spiral tuners have a pentode r.f. stage, but use an untuned antenna input, with two-section bandpass tuning between r.f. amplifier and converter. Others use a 6J6 ground-grid input stage. In any event the best way to convert them is to take them apart completely and rewire from beginning to end. Both sockets may require re-orientation to provide short leads to tuned circuits.

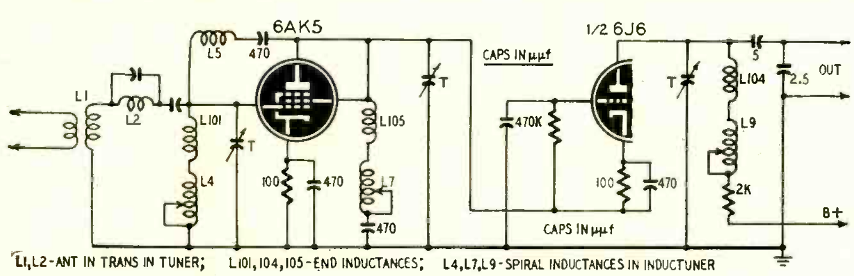



**Fig. 5—Converting a Du Mont *Inputuner* to a highly effective cascode booster. L101, L105, L104 are coil numbers used in Du Mont schematic for RA-103 *Teleset.***

The bandpass circuit is not used in the converted booster (Fig. 5). A more normal circuit with a tuned antenna stage is employed instead. The end inductances will be shifted around. The one wound with flat strap is used in the r.f. stage (L2); the one on the rear section (converter-oscillator), is moved to the front section. The untuned antenna-input transformer is retained and rewired as indicated in Fig. 5.

The middle section of the *Inductuner* is used as a continuously variable neutralizing coil (L7). (This accounts for the superior performance of boosters made from Du Mont tuners.) The end winding (L105) can be the one formerly used as the end inductance for the oscillator tank. Do all the wiring on the chassis with the *Inductuner* removed. Solder the end inductances in place on the chassis, so that only the connections to the *Inductuner* have to be made when this is fastened in place again. These can be soldered through the various openings in the chassis shield divisions. Now you can align the three tuned circuits on the highest channel by adjusting the brass slugs in the coils, and then on the weakest channel by adjusting the trimmers.

## Standard Coil tuners

Standard Coil tuners are very well suited for conversion to boosters. The r.f. stage can remain almost intact. Merely remove the screen wiring and connect the screen to the plate. The r.f. plate tank must be moved to the plate of the second section. It should be possible to do this without changing the socket; but even re-orienting the socket poses no problem. The Standard tuner does not provide for continuous tuning of the neutralizing coil. At first thought the use of the oscillator winding suggests itself. However, it must be remembered that this coil is on the same form as the plate tank and coupled to it. The result would be an absorption trap, at least partly, rather than a rejection trap. The best thing to do is merely to open the leads to the unused oscillator coils at the strip terminals. The Standard tuner is neutralized at only one point—with coils which have to be added—but it should give excellent performance as a booster on all channels.

## Conclusion

There are many obsolete tuners of various types now available at very low cost—some for free out of the junk-box—which can be converted into cascode boosters. If normal precautions are taken, the resulting boosters can equal or surpass in performance commercial versions of the same circuit selling for $25 and up. Such boosters will bring higher gain without added snow to receivers already equipped with a cascode r.f. stage. In remote-fringe areas where one booster is not enough, the addition of a cascode booster may make all the difference between a snowy picture and one with local-station quality. END

# Design Data ON VIDEO AMPLIFIERS

By ALAN G. SORENSEN

## *Part IV—Peaking-coil design*

WINDING your own peaking coils introduces a number of problems. There are formulas for winding a coil to a given inductance, but there are so many variables that calculation is very complex. Cut-and-try is needed to get the desired results. An inductance bridge or Q-meter is the ideal tool for the peaking-coil constructor to use, but you can just check the high-frequency response curve and go by it.

It is easier to get accurate inductance values if you wind the coils on one of the small permeability-tuned forms such as the Millen 6900 series, the National XR-50 type, or Cambridge Thermionic type LS. These make high-Q, efficient coils, and the inductance can be adjusted easily by turning the slug in or out of the coil. When the slug is "all in" (near the center of the coil) the inductance is nearly double the value when the slug is all the way out. Thus a point can be found where the desired inductance is equal to the computed value.

In most cases a single-layer coil may be used (Fig. 1-a). However, when the desired inductance is over about 100 microhenries, it will be necessary to use a multilayer winding. A point of caution here. The distributed capacitance of a peaking coil must be kept at a minimum. It would be best to use a bank-type winding, as shown in Fig. 1-b. In this way adjacent turns represent parts of the coil that are close together while the ends of the winding are far apart physically, as well as electrically. The formulas below are used for calculating inductance:

$$L = \frac{(rN)^2}{9r + 10\,l}$$

$$N = \frac{\sqrt{L(9r + 10\,l)}}{r}$$

$$L = \frac{0.8(rN)^2}{6r + 9\,l + 10d}$$

where L = inductance in microhenries; N = number of turns; r = radius in inches; $l$ = length of coil in inches; and d = depth of coil in inches.

The first two equations may be used for small single-layer air-core coils, and will be accurate to about 1%, if the coil is not too short. The length $l$ must be greater than 0.8 r. The third equation is for multilayer coils. With an iron core in close proximity to the coil, as it is in this case, the minimum inductance will be somewhat greater than this computed value. All dimensions are in inches, and N is the number of turns. The answer is in microhenries.

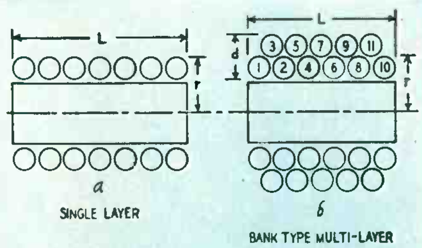



**Fig. 1—Cross-section views of single-layer (a) and bank-wound (b) coils, with dimensions used in computations.**

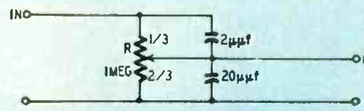



**Fig. 2—Shunt capacitances associated with a typical volume-control potentiometer at an intermediate setting. The upper capacitance increases as the arm approaches the high end and bypasses more h.f. energy around the resistance.**

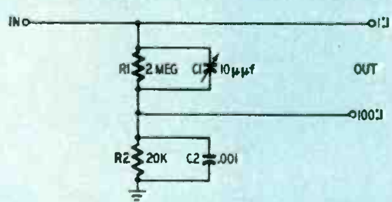



**Fig. 3—Two-step attenuator used in many oscilloscope input circuits. The trimmer is adjusted to equalize the capacitance and resistance voltage-division ratios.**

About the easiest way to wind one of these coils is to first set the slug to its mid-point. Next, wind on several more turns of wire than will probably be needed. Connect the unit to an inductance bridge and remove turns until the inductance is close to the required value. Final adjustments are made by wiring the coil into the circuit and observing the frequency response of the amplifier. Most any size or type of wire may be used, so long as it will handle the plate current of the tube without overheating. These coils should be impregnated with a good coil dope to keep out any moisture. (Adjustable peaking coils are available from several manufacturers. Almost any value required can be obtained.—*Editor*)

### Gain control

Controlling the gain of a video amplifier presents a serious problem. Ordinary grid-circuit potentiometers cannot be used for two reasons:

1. The ring-shaped construction of a typical potentiometer brings the opposite ends of the resistance element close together. This proximity, plus the usual terminal arrangement, metal dust cover, and grounded shaft, creates a relatively high total shunt capacitance across the *input* side of the control. The capacitance has negligible effect at low frequencies, but above a few kilocycles it bypasses most of the signal.
2. The capacitance between the slider and the ends of the resistance element shunts the *output* circuit. This capacitance varies, of course, with the position of the slider, and actually reduces the high-frequency response more at high-gain settings than at lower values.

Refer to Fig. 2 and assume a 1-megohm control set at two-thirds of its resistance. At low frequencies the output will be two-thirds the input, but as the frequency is increased, the voltage at the center arm will drop off.

A typical compensated attenuator circuit is shown in Fig. 3. Using the values shown, the attenuation factor will be 100. However, the equations may be used to find values for other ratios.

$$C1 = \frac{R2 \times C2}{R1}$$

The reduction ratio is equal to

$$\frac{R2}{R1 + R2}$$

These circuits compensate for the input capacitance of the wiring and of the tube, which are included in C2.

Oscilloscopes use these attenuator circuits in their probes to reduce circuit loading to a minimum. The trimmer capacitor C1 will be mounted in the probe; so will resistors R1 and R2. C2 will consist of the capacitance of the cable and the input circuit of the scope in parallel with the additional capacitance required to maintain the proper C1:C2 ratio. Most good oscilloscopes then have a switch attenuator with ratios of 1:1, 10:1 and 100:1. END

COVER FEATURE

# Model 60 uhf Tuner

*One-tube continuous-tuning converter has 41-mc output.*

By FRED M. BARR*

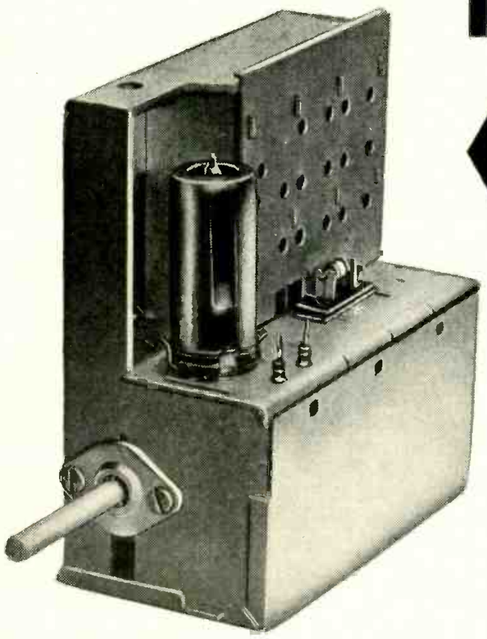


Photo A—The model 60 u.h.f tuner.

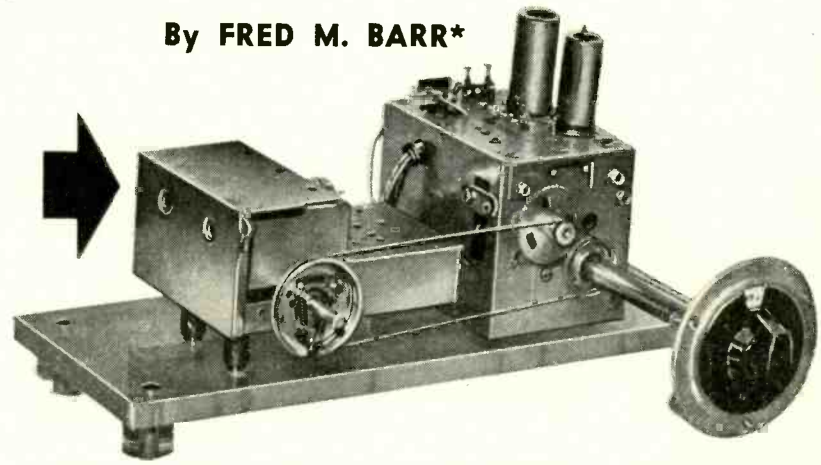


Photo B—Model 60 and 48 tuners set up for single-knob u.h.f-v.h.f. tuning.

THE u.h.f. television band (470–890 mc), is considered an awkward band of frequencies. It is too low for microwave and radar techniques and circuitry to be fully applicable, and it is too high for convenient use of lumped-constant circuitry. Therefore it has been advantageous to combine both techniques in the General Instrument Corporation model 60 u.h.f.-TV tuner. The resulting tuning element is an end-tuned quarter-wave coaxial line.

This quarter-wave coaxial line is capacitance-tuned at its open-circuit end, as shown in Fig. 1. This arrangement yields a tuning range of 2 to 1 or greater, providing continuous coverage of the entire u.h.f.-TV band. Inherently, the unloaded Q to loaded Q ratio of the tuning element is very high, leading automatically to a low dissipation circuit. Since the Q of end-tuned quarter-wave elements increases with increasing frequency, as opposed to the Q of lumped-element circuits where it normally decreases with increasing frequency, their use has permitted the design of a tuner with constant bandwidth and insertion loss over the entire band. A further advantage of end-tuned quarter-wave lines is the mechanical construction of a ganged-rotor tuning device, whose construction is similar to that of a variable capacitor. In addition, this device permits shaping the rotor plates to give a straight-line frequency characteristic with the u.h.f. channels spaced equally over the dial.

The model 60 tuner consists of two tuned r.f. circuits, a half-frequency oscillator, an oscillator-doubler circuit, and a crystal mixer. The output of the tuner is a 41-mc i.f. signal which may be fed through a low-noise i.f. preamplifier into the i.f. system of the TV receiver. A complete schematic of the model 60 is shown in Fig. 2.

The two r.f. sections and the oscillator doubler employ the end-tuned quarter-wave lines. The rotor for each of these sections contains four plates. These are adjusted during alignment for continuous tracking over the band. The r.f. and oscillator-doubler rotors are on the same shaft as the oscillator rotor. The capacitance of the lines at the high-frequency end of the band is adjusted by a small trimmer strap at the open end of each line.

The antenna input is a balanced 300-ohm circuit which is reasonably well matched over the entire band. The first r.f. section is coupled to the second through a window in the shield between the two lines. This coupling provides an overcoupled r.f. characteristic over the entire band. (An earlier version of the model 60, see Photo C, uses closed loops instead of a window for coupling between the first and second r.f. lines. The larger loop provides coupling at the low-frequency end of the band and the small loop works at the high end.) The 1N82 mixer crystal is connected to the 2nd r.f. and oscillator-doubler lines through r.f. chokes whose self-resonant frequency is below the low end of the u.h.f. band. The antenna, r.f., and crystal coupling are adjusted to give uniform loading through the tuning range, yielding a bandwidth of about 10 to 18 mc over the band.

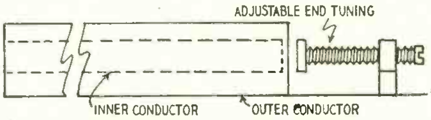



Fig. 1—End-tuned quarter-wave line. Capacitor slug controls the tuning.

## The oscillator circuit

The oscillator employs a 6J6, operating in a push-pull circuit at half the frequency required to give a 41-mc i.f. output. Its circuit is shown in the right-hand side of Fig. 2. The plate inductor of the oscillator is a horseshoe-shaped stamping rigidly mounted to the tuning capacitor support by eyelets and attached to the tube socket by lugs which are a part of the stamping. The center-tapped grid-to-grid inductor is adjusted to resonate at the low end of the band and maintains relatively uniform oscillator drive over the tuning range. The characteristics of this circuit are such that replacing the 6J6 tube normally requires only slight adjustment of the oscillator trimmer to compensate for small capacitance differences.

The use of a half-frequency oscillator makes it necessary to use a frequency-doubling device. An end-tuned quarter-wave line is tuned to twice the oscillator frequency, and excited by a loop which is proximity-coupled to the oscillator plate loop. The efficiency of this doubling action has been increased by including a G7 harmonic-multiplier crystal diode and a biasing circuit. This biasing circuit, consisting of a parallel resistor-capacitor combination in series with the coupling loop and crystal, increases the second-harmonic content of the coupling loop current.

## Tuner output circuits

The u.h.f. tuner may be provided with either a link-coupled or a low-side capacitance-coupled i.f. output circuit as shown in Fig. 3. In each of these, the mixer crystal is bypassed directly at its i.f. end with a 33-μμf capacitor. A test or "looker" point is also provided at the i.f. end of the crystal to permit checking the r.f. pass-band with an oscilloscope during production alignment.

In production, a milliammeter is con-

* General Instrument Corp.

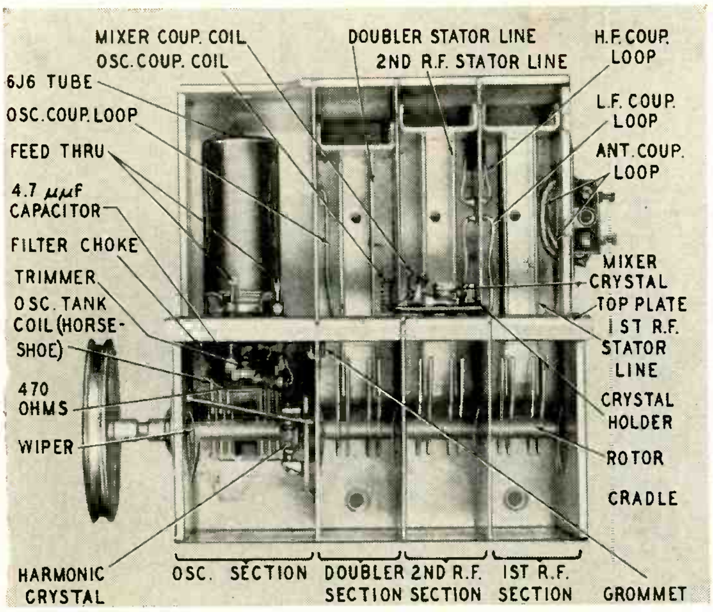



**Photo C—An experimental form of the model-60 u.h.f. tuner with the side cover removed. Windows now replace the coupling loops.**

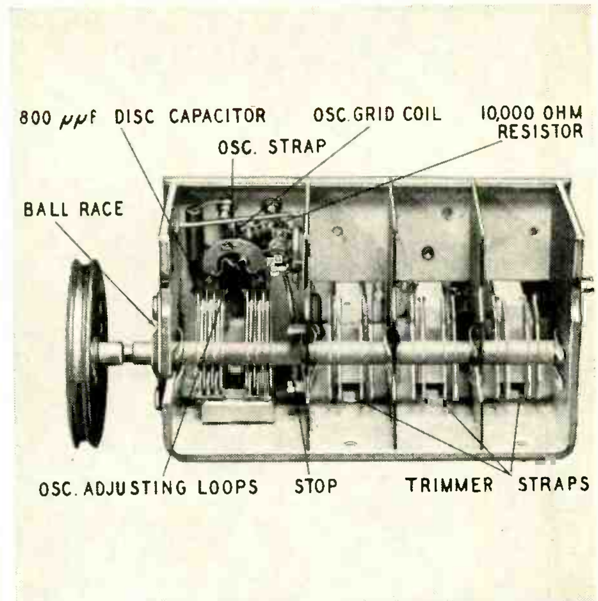



**Photo D—Under the model-60 tuner. Ends of quarter-wave lines form capacitor stators.**

nected from the test point to the chassis ground to measure the crystal injection current while the oscillator and doubler sections are tuned and calibrated. The oscillator-doubler coupling loop and the doubler and mixer coupling coils have been optimized to give a mixer crystal current consistent with low noise figure and low conversion loss. In servicing, the crystal current may be used to check the operation of the oscillator, doubler crystal, and mixer crystal. The i.f. circuits and mixer crystal are mounted on the tuner top plate, and are enclosed by a small shield which is easily removed.

The 41-mc i.f. signal is coupled from the i.f. coil through a short length of 75-ohm cable to an i.f. preamplifier. The use of the link-coupled or low-side capacitance-coupled i.f. circuit depends on the type of circuit the tuner feeds. The link-coupled circuit is used with the General Instrument Corporation model 48 13-position v.h.f. turret tuner. In the 13th position, the v.h.f. tuner is converted into a low-noise 41-mc preamplifier which uses the cascode amplifier as the first stage, and the mixer as the second amplifier stage with the B plus removed from the v.h.f. oscillator.

Setting the v.h.f. tuner in the 13th position operates a slide switch which performs the necessary operations to convert from v.h.f. to u.h.f. operation. This switch is mounted on the v.h.f. tuner and is operated by a cam connected to the rear of the turret shaft. In the u.h.f. position, the switch connects B plus to the u.h.f. tuner, connects the i.f. output to the v.h.f. tuner antenna terminals, and disconnects the v.h.f. antenna from the system. If a common v.h.f.-u.h.f. antenna is used, the switch transfers the antenna lead to the u.h.f. tuner.

## Model 60 installation

Several radio manufacturers are using the model 60 u.h.f. tuner in their TV receivers. The tuner may be purchased with the control shaft extending from the front as in Photo A or from the rear as in Photo B to provide more flexibility in the design of the TV receiver. The Du Mont application of the model 60 u.h.f. tuner was discussed in "Circuit Shorts" in the May, 1953, issue.

When installed in the television receiver, the u.h.f. tuner shaft is usually connected to the fine-tuning control of the v.h.f. tuner by a string drive. This provides one-knob tuning for v.h.f. and u.h.f. channels. The fine-tuning control must be a 360-degree type, without stops, when used for this purpose. The u.h.f. channel-selector dial is fastened

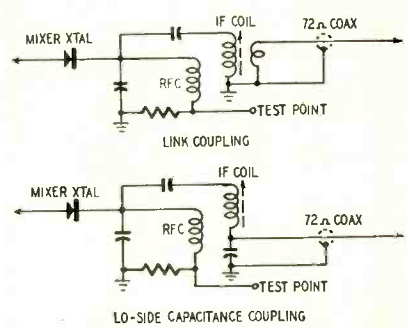



**Fig. 3—Either link coupling or low-side capacitive coupling can be used to match the v.h.f.-amplifier input requirements.**

to an additional sleeve and pulley on the v.h.f. tuner shaft. The dial cord drives this sleeve. The drive connections are shown in Photo B.

The model 60 u.h.f. tuner is mechanically rugged and stable, so its electrical performance is unaffected by forces which would tend to distort the unit. In addition, there are no moving contacts in high-current tuning circuits which can wear or collect dirt, thereby reducing the possibility of intermittent or noisy contacts. END

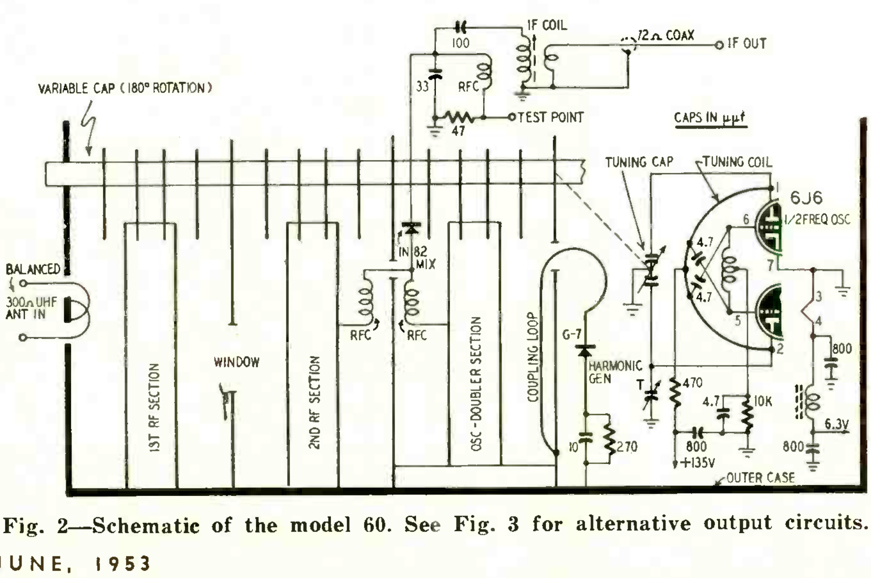
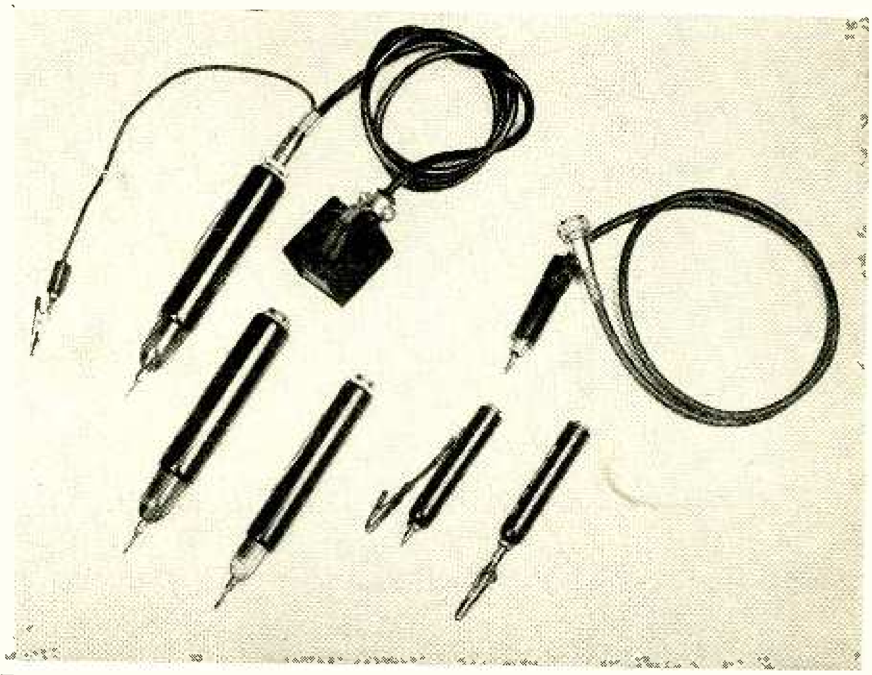



**Fig. 2—Schematic of the model 60. See Fig. 3 for alternative output circuits.**

# SIGNAL TRACING in TV

By Engineering Staff, Scala Radio Co.

## *PART III A real time saver —the 100:1 high-voltage capacitance-divider probe*



Two sets of matched signal-tracing probes. Three at left are Precision Apparatus Company's kit of 10:1 capacitance divider, crystal demodulator, and direct probe, with universal cable. RCA set at right includes direct probe (on cable), with plug-in crystal-demodulator and low-capacitance heads. *Precision* probes have color-coded heads and a shielded plug-in connector for the scope termination.

WHEN alternate light- and dark-gray vertical bars appear at the left side of the raster it may be difficult to tell at a glance whether the difficulty is due to ripple in the high-voltage supply, or to some other cause. But with a high-voltage capacitance-divider probe the technician can see the high-voltage ripple on his scope screen, and measure its peak-to-peak voltage. He is then in a position to discuss matters in practical terms. A commercial high-voltage capacitance-divider probe is shown in Fig. 1.

Similarly, when there are slight rapid fluctuations in picture brightness, you may suspect intermittent leakage in a high-voltage filter capacitor. Of course, a substitution test will answer the question, but you can save time and difficulty with a capacitance-divider probe and scope. In the case of an intermittent leak in a high-voltage filter capacitor, the a.c. ripple across the capacitor will jump substantially during the brightness fluctuations. This test is more accurate than using a v.t.v.m. and high-voltage d.c. probe, because the pointer response of a v.t.v.m. is very sluggish compared with the inertialess response of the electron beam in the cathode-ray tube. These rapid voltage variations are almost completely smoothed out by the mechanical inertia of the meter movement in the v.t.v.m., but they are reproduced faithfully on the scope screen when you use a capacitance-divider probe.

A high-voltage capacitance-divider probe is almost an absolute necessity for checking the shape and peak-to-peak value of the voltage waveform at the plate of the horizontal output tube. This is a key test point in cases of sweep-circuit trouble, and the alert technician usually starts his trouble-shooting here. We cannot hook the scope directly to the plate of the horizontal output tube. The high a.c. voltage at this point would promptly burn out the scope input circuit, as the blocking capacitor in the average scope is rated at only 600 volts.

We cannot use a low-capacitance 10-to-1 probe (Fig. 2) at the plate of the horizontal output tube because the 6,000 to 7,500 volts peak-to-peak at this point invariably flash across the probe network, which is not rated for this type of testing. Some technicians make a practice of using a gimmick for this purpose, or merely hold the tip of a 10-to-1 low-capacitance probe *near* the insulated lead to the plate of the horizontal output tube. Although these expedients will show the a.c.-voltage waveform on the scope screen, they are worthless for checking peak-to-peak voltage, and in most cases we must know the exact value of this voltage to get a true picture of conditions in the circuit.

Another highly questionable expedient in making these tests is to use a high-voltage d.c. probe (actually intended for use with a v.t.v.m.) with the scope. This is even less satisfactory than a 10-to-1 low-capacitance probe, because the unshielded multiplier resistor in the high-voltage d.c. probe is highly susceptible to hand-capacitance effects and 60-cycle stray fields. Besides, the scope pattern changes with the slightest movement of the probe.

### Spotting flyback defects

A typical normal waveform at the plate of the horizontal output tube is shown in Fig. 3. The shape of the wave helps the technician identify certain defects in the flyback transformer, and the peak-to-peak voltage shows the condition of the drive circuit.

For example, a large negative undershoot in the waveform (Fig. 4) indicates excessive leakage reactance between the primary and secondary windings of the transformer. This undershoot may cause Barkhausen oscillations, which show up as one or two vertical black lines at the left side of the picture.

If the transformer has other defects, the undershoot may be followed by a large voltage ripple. This will modulate the intensity of the beam in the picture tube, especially if the receiver has no high-voltage filter network. This form of intensity modulation appears as a series of light- and dark-gray vertical bars starting at the left side of the raster and becoming weaker toward the center. The same screen symptoms can arise also from several other causes, so the scope check of the horizontal output waveform saves valuable time by eliminating certain sources of trouble.

### High-voltage buzz

Experienced technicians have found many other uses for the high-voltage capacitance-divider probe. One of these uses is checking the output of the high-voltage filter system for regulation buzz. This should not be confused with sync buzz. Regulation buzz is caused by the limited current-output capability of most flyback and pulse-operated high-voltage systems—especially those that have voltage-doubler circuits. Since the picture-tube beam current is cut off for approximately 1,100 μsec 60 times a second by the vertical blanking pulse, it follows that the output voltage from the unloaded high-voltage supply will rise several hundred volts for the duration of the blanking pulse, and will then drop several hundred volts when the pulse ends and unblanks the screen. If the audio circuits and picture tube are adequately shielded, and if there are no serious faults in the audio system or FM-sound detector, this regulation buzz is ordinarily below the threshold of audibility. But TV receivers often develop buzz in service, and the test described must then be made.

## Probe design

The essential elements of a high-voltage capacitance-divider probe are shown in Fig. 5. This type of probe is not frequency-compensated like conventional low-capacitance probes (Fig. 6). The chief reason for this omission is that high-voltage tests are made in horizontal sweep circuits where the highest frequency involved is only about the 10th harmonic of 15,750 cycles.

The input impedance of a high-voltage capacitance-divider probe is made as high as possible, and depends, of course, on the frequency. In order to withstand the high voltages encountered in TV test work, the first capacitor in the probe network (C1) is usually a high-voltage rectifier tube, such as a 1X2-A. The plate-to-filament capacitance of these tubes ranges between 0.85 to 1.5 μμf. Thus, the input impedance of the probe at the fundamental frequency of the flyback pulse (15,750 cycles) is approximately 6 megohms, and approximately 0.6 megohm at the 10th harmonic. Since the probe impedance even at the 10th harmonic is still much higher than the internal impedance of the circuit under test, the flyback pulse is reproduced essentially without distortion.

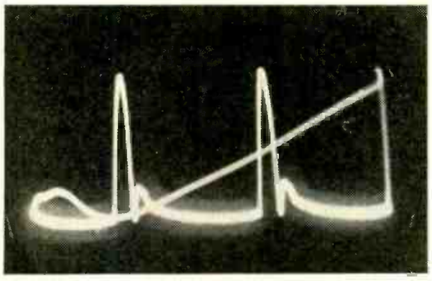


**Fig. 3—Normal sweep waveform at plate of horizontal-output tube, seen with the aid of a 100-to-1 capacitance-divider probe. Diagonal line is scope retrace. Peaks are about 6,000 volts high.**

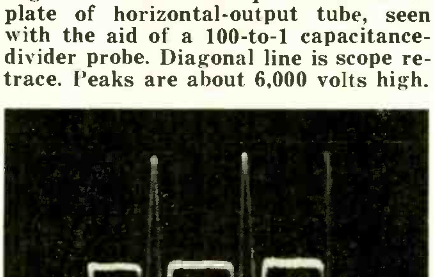


**Fig. 4—Negative pulse in sweep-output waveform indicates excessive leakage reactance in flyback transformer, may also generate Barkhausen oscillations.**

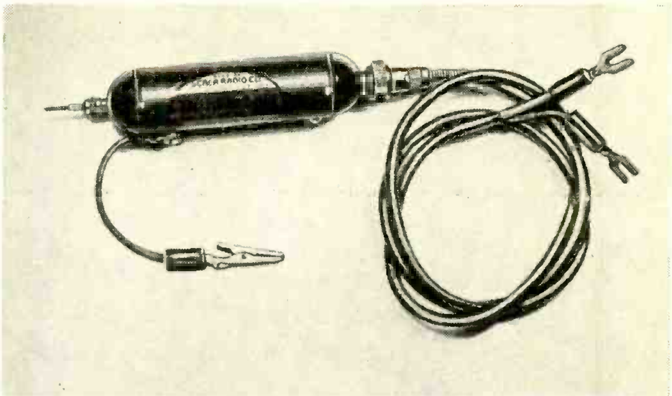


**Fig. 1—A commercial 100-to-1 high-voltage capacitance-divider probe. The head is made of special insulating material to withstand severe stress potentials in TV high-voltage supply networks.**

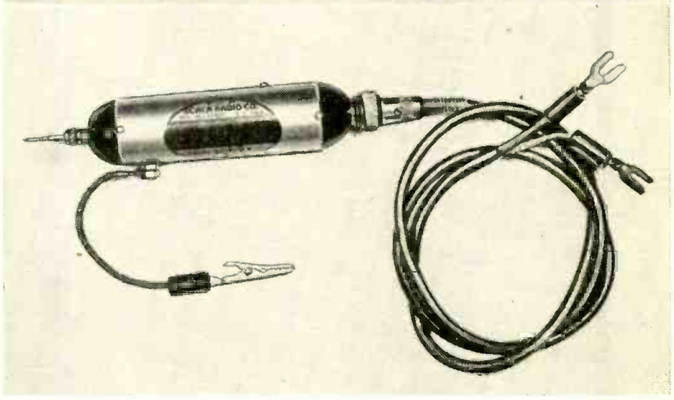


**Fig. 2—A 10-to-1 low-capacitance signal-tracing probe. Two screw adjustments are provided to compensate for cable capacitance and scope terminal impedance.**

In addition to being able to withstand applied voltages up to 12 or 15 kv, this capacitor must have a physical shape that will not encourage corona discharge in the probe head.

A trimmer capacitor is provided so that the capacitance ratio C2/C1 can be adjusted to exactly 100-to-1. This attenuation factor makes it easy to measure peak-to-peak voltages. Once the scope has been calibrated for a given peak-to-peak deflection sensitivity, it is necessary only to multiply the scope reading by 100.

The calibrating trimmer capacitor is mounted in the probe head and does not have to be a high-voltage type. With a 100-to-1 ratio the calibrating capacitor need withstand only 1% of the signal voltage applied to the probe tip. The highest a.c. voltage likely to be encountered in TV work is about 15,000 volts, so that the trimmer capacitor need withstand only 150 volts.

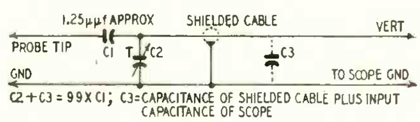



**Fig. 5—Circuit of a high-voltage capacitance-divider probe. C1 may be the plate-filament capacitance of a 1X2-A high-voltage rectifier. Trimmer capacitor C2 is adjusted for a 100-to-1 voltage ratio with a given cable and scope.**

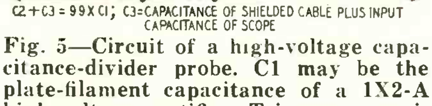



**Fig. 6—Capacitance-divider probe circuit for signal tracing in low-level circuits. The scope-input impedance Z limits the high-frequency response unless compensating components and adjustments are provided in the circuit.**

Commercial probes are shielded to avoid hand-capacitance effects and stray-field pickup that may confuse the scope trace. Since the probe is calibrated for a given shielded-cable capacitance the calibrating capacitor C2 must be readjusted if the probe is used with different cables and scopes.

## Other probe uses

A high-voltage capacitance-divider can give more accurate results than a 10-to-1 capacitance-divider probe in many circuits where the technician ordinarily uses a 10-to-1 type. It is much better, for example, for checking the waveform and peak-to-peak voltage at the plate of the damper tube or at the plate of the horizontal oscillator. The input impedance of the 100-to-1 probe is higher than the input impedance of the 10-to-1 probe, hence, imposes less loading on the circuit. On the other hand, it may be impossible to get usable vertical deflection in low-level circuits with the 100-to-1 probe.

Most typical service scopes have vertical-deflection sensitivity of approximately 0.02 volt r.m.s. per inch at full gain, corresponding to a sensitivity of 0.057 volt peak-to-peak per inch. Under these conditions the 100-to-1 probe will provide 1 inch of deflection with an input signal of 5.7 volts peak-to-peak. If the signal voltage is less than this, the 10-to-1 probe will probably have to be used.

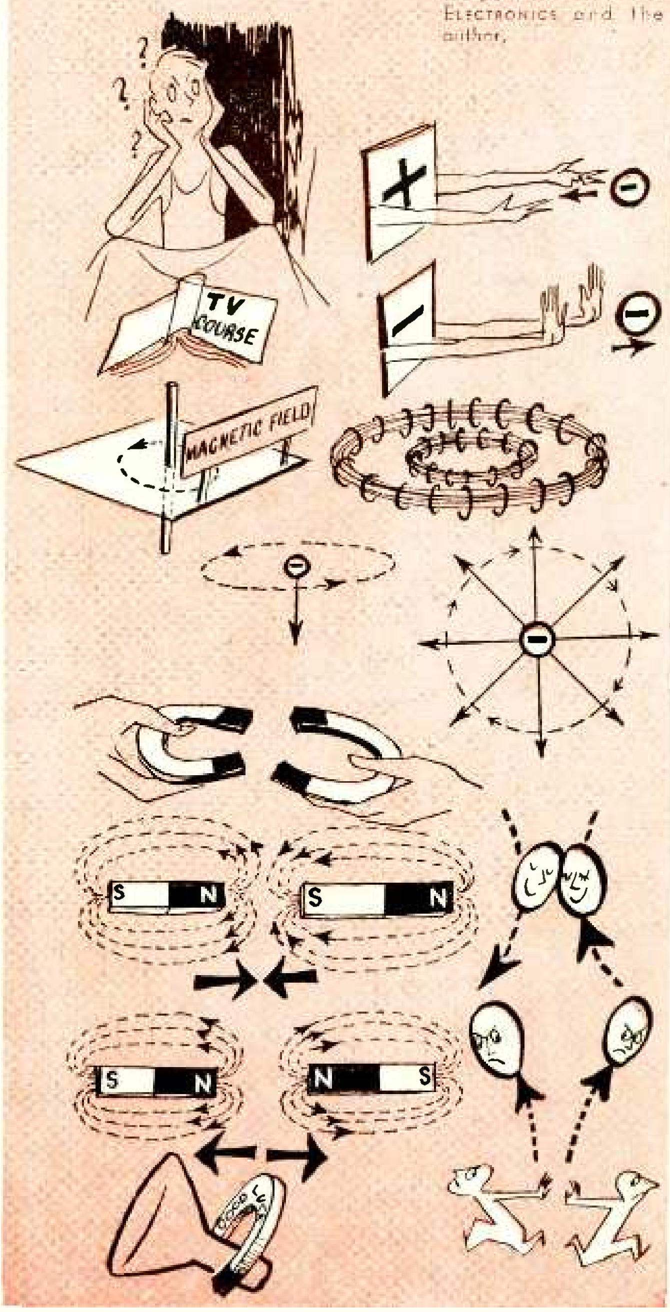
Although it would be possible to provide an individual shielded output cable for each probe, the present trend is to provide a single universal shielded input cable which may be used with any one of an entire kit of probes. END

# TELEVISION . . . it's a cinch!

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

By E. AISBERG

**Fourth conversation: Electrostatic and electromagnetic fields; how the beam is deflected and focused magnetically**




WILL—This damned television is keeping me awake nights! There are about a hundred questions going round in my head: Just what kind of waves do you put on the horizontal and vertical electrodes of your cathode-ray tube? How do you generate them? How big do they have to be? Why . . . ?

KEN—Hold it! Let's have your questions one at a time. Last time we talked about cathode-ray tubes that focused and deflected the beam with electrostatic fields. Those tubes are used only in oscilloscopes, or in the old 7-inch sets. Practically all sets bigger than that use *magnetic deflection*.

WILL—I can't see how. An electron has a negative charge, so a positively charged plate attracts it, and a negative charge repels it. But a magnetic field has no effect on an electrostatic charge.

## From one field to another

KEN—If your electron was standing still, you'd be right; it would be just a negative charge and nothing else. But when it starts moving, it sets up its own magnetic field.

WILL—This isn't what you used to tell me. In other days, when I was learning about radio, you explained that an electric current creates a magnetic field around its conductor, and the field could be thought of as concentric lines of force with the conductor as a center.

KEN—I don't think you ever lost much sleep figuring out the explanation. Otherwise, mightn't it have occurred to you that an electric current is nothing but a lot of electrons going in the same direction?

WILL—I never thought of that! Of course, it's not the conductor, but the moving electron, that has the field around it! If we have electrons in movement we must have magnetism.

KEN—Good! But sometimes we get so wrapped up in this electromagnetic field that accompanies the moving electron that we completely forget it has an electrostatic field, too. Now, what about that?

WILL—That's easy enough. We know the electron is a charged particle. This charge we talk about is an electrostatic charge. And when the electron starts moving, we have an electrostatic charge *and* an electromagnetic field.

KEN—You've got it! Now, have you noticed that the assumed lines of the electric field radiate in a certain way from the electron, so they are always at right angles to the "lines of force" of the magnetic field? That is something worth remembering: *Lines of electric and magnetic fields produced by the same cause are always at right angles.*

## Inside the magnetic field

WILL—Then what happens when you have two magnetic fields produced by two different causes?

KEN—Haven't you seen it happen? When you bring two magnets toward each other . . .

WILL—They attract each other—that is, if you have two north poles against two south poles. If two poles of the same kind are brought close together, they repel each other, the same as two electric fields of the same sign.

KEN—Then we can say that parallel magnetic lines going in the same direction repel each other, but when they go in opposite directions, they attract.

WILL—These magnetic lines of force are like a lot of people—the less you see of them the better. If you try to travel the same road with them, you just can't get along!

## The magnetic theater

KEN—Now you've got that straight, you won't have any trouble figuring out how magnetic deflection works.

WILL—Let me think. It would work all right to put a horseshoe magnet over the neck of the tube so the electrons would pass through its magnetic field.

KEN—And which way would the electrons be deflected?

WILL—Why, they'd be attracted by one pole and repelled by the other, of course.

KEN—Oh, well, I suppose this is what you get for trying to use analogies on people without brains! But, Will, even you should know better than that. Have you been wandering off on a tangent ever since I pointed out that the electric and magnetic fields around an electron are perpendicular to each other at all points?

WILL—Are you trying to insinuate that the electrons are deviated at a right angle to the magnetic lines?

KEN—I'm not insinuating anything. I'm just trying to get you to think a little. Now, just to give us a better look at things, I'll draw a cathode-ray tube in a rather uncommon way. We'll cut the neck off just ahead of the magnet and show a cross-section. We won't bother drawing any electrodes, either. Now, imagine your eye in place of the fluorescent screen. The black dot at the center is an electron coming directly at you.

WILL—Quite a setup! Now that we've got all the scenery set and the actors in place, when does the show start?

KEN—At once. We're going to stage a scene of conflict presented by two forces. One of them is the field of the magnet (the parallel lines) and the other is the magnetic field around the electron in motion. We'll represent that field by circles around the electron. Now, how will these two fields interact?

WILL—At each side the circle cuts the straight lines more or less at a right angle. So there'll be no interaction. But at the top the lines are going in opposite directions, so they'll attract each other. And on the bottom they're going in the same direction, so they'll repel.

KEN—So how is our play going to end?

WILL—The electron will have to go up. It's pulled from above and pushed from below.

KEN—Exactly. And if we reverse the magnet?

WILL—The electron will be deflected downward. But it bothers me a little to see a horizontal field deflecting the electron beam up and down.

KEN—It tangles up a lot of television students. But you shouldn't have any trouble if you keep in mind that an electron always moves *at right angles* to a magnetic field. And besides, remember the deflection plates on the electrostatic cathode-ray tube. Didn't the plates in the vertical plane produce the horizontal deflection, and the horizontal plates . . . ?

WILL—I remember. The horizontally mounted plates deflected the beam vertically. I guess the trouble is that I've just got to stop and think about it.

### Making magnetic fields

KEN—You'll have no trouble in seeing, Will, that if we want to keep our spot in continuous movement, we have to keep the value and the direction of the magnetic field changing continuously. And we can't do that by juggling with permanent magnets.

WILL—I suppose you could use electromagnets—coils carrying currents of the right size and direction to make the magnetic fields you need.

KEN—That's the way it's done! And, since we used two pairs of plates for electrostatic deflection, if we want to get horizontal and vertical movement of the beam with magnetic fields, we need . . .

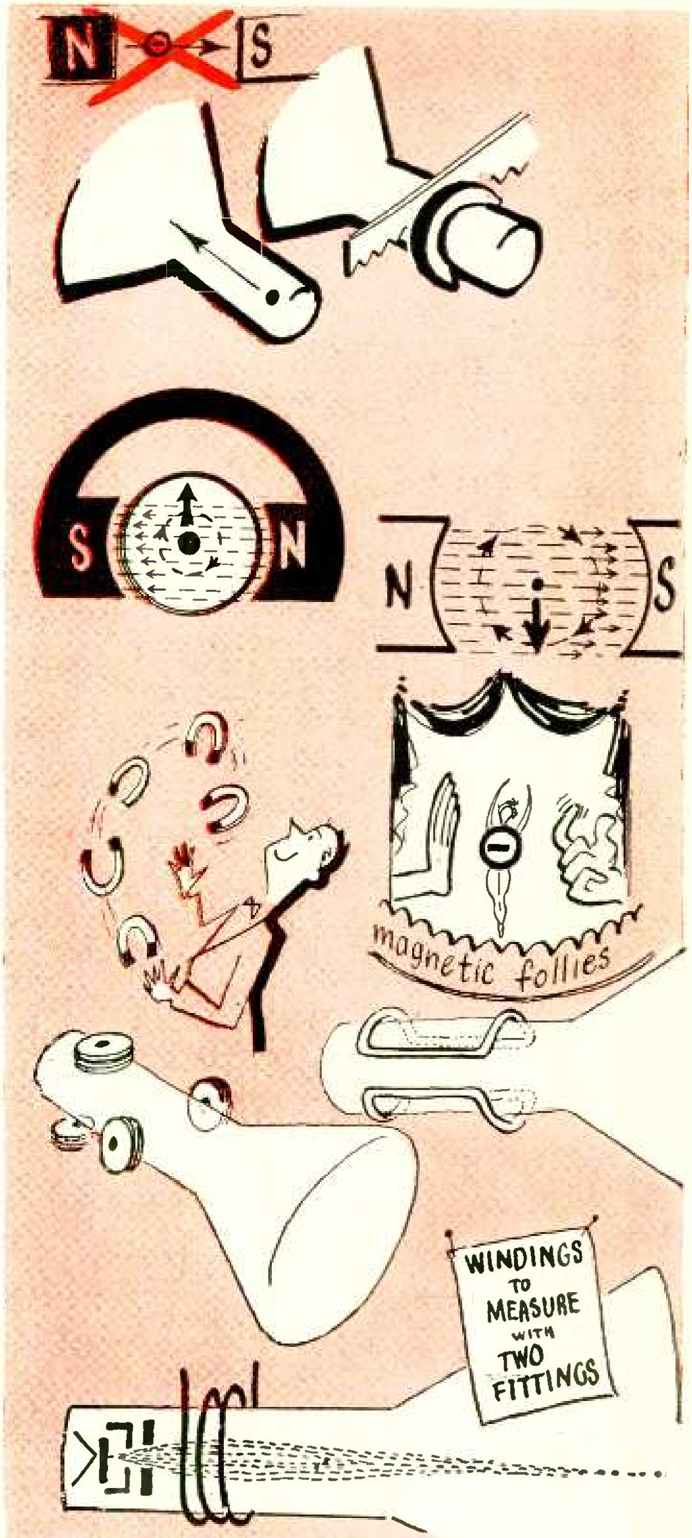
WILL—. . . two pairs of electromagnets; one pair mounted vertically to give the horizontal deflection and the other pair with a horizontal axis for the vertical deflection.

KEN—That's right, Will. The two coils are usually placed right where the neck of the tube joins the cone.

WILL—Are they iron- or air-cored coils?

KEN—They can be air-cored, but in modern sets usually powdered-iron- or ferrite-cored. They are wound in rectangular form, then shaped to fit tight to the glass of the tube. In cases where iron-core coils are used, the pole pieces are usually shaped to keep them as close to the glass as possible.

WILL—This may be dumb, but I've been wondering if the electrons couldn't be focused just as well by a magnetic field as by what you call "an electronic lens"?




KEN—Nothing dumb about that! When we were talking about electrostatic focusing, I told you that most tubes use a different kind. Well, this is it! Just as magnetic deflection makes it possible to get rid of the two pairs of deflection plates and simplify the tube construction, so does magnetic focusing permit us to get rid of the focusing electrodes. That makes life easier for the tube manufacturers.

WILL—H'm—if we keep on throwing out surplus electrodes, pretty soon we won't even be able to call it a tube. But how do we make a "magnetic lens"?

KEN—What's needed is a field in which the magnetic lines run along the tube in the same direction as the electrons. So all you have to do is put a simple coil around the neck of the tube.

WILL—And I suppose you adjust the focus by varying the strength of the current through the coil?

KEN—Exactly! And, because this field has to be constant, the electromagnet can be replaced by a permanent magnet placed around the neck of the tube, or by much smaller ones, placed inside it.

## Dance of the electrons

WILL—I sort of understand how—if we have a uniform magnetic field along the axis of the tube—the electrons would be concentrated in a beam along the same axis. Each electron that left the center of the tube would—if I have the idea right—be sort of taken by the hand and led gently back to the electronic path of virtue.

KEN—Your instinct is O.K. But what really happens is a lot more complex. Suppose an electron in a uniform field starts to move downward. We'll cut out this circle of paper and let the center represent an electron, and the edge its magnetic field. Then if the electron moves downward as well as forward, our circle leans ahead. If this bothers you, remember the magnetic field must always be at right angles to the electron's motion. The upper and lower edges of our leaning field are still at right angles to the lines of force in the uniform field it's traveling in, but its sides are no longer at right angles to the lines in the uniform field. So, you have attraction on one side, repulsion on the other. Result . . .

WILL—The electron is pushed sideways. Nothing ever happens the way you'd expect it in one of these magnetic fields! So, if our electron moves to the left . . .

KEN—The same reasoning shows it will be shoved upward.

WILL—And then the field will push it to the right. And so on! Our electron is traveling in circles around the tube's axis. But how does all this end?

KEN—The circles just get smaller till the electron gets back to the axis and decides to follow it without making any more trouble. You can say the electron follows a spiral—or even better, a corkscrew—path.

WILL—This magnetic focusing makes me think of a scalp dance.

KEN—Now, where did you get that . . .?

WILL—Well, the Indians tied their prisoner to a stake, then danced around him in smaller and smaller circles, till . . .

KEN— . . . at the last moment, some providential intervention saved the brave hero's scalp! I was brought up on Mayne Reid and Fenimore Cooper, too!

## Question of sensitivity

WILL—Now just how does magnetic shape up against electrostatic focusing? Magnetic-focus tubes should be a lot easier to make. But it should be easier to deflect and focus electrostatic tubes, because all you have to do is apply simple voltages to set up your electric fields. With magnetic deflection and focusing, you have to pass currents through coils. That means some loss of energy, so you must need some power, at least.

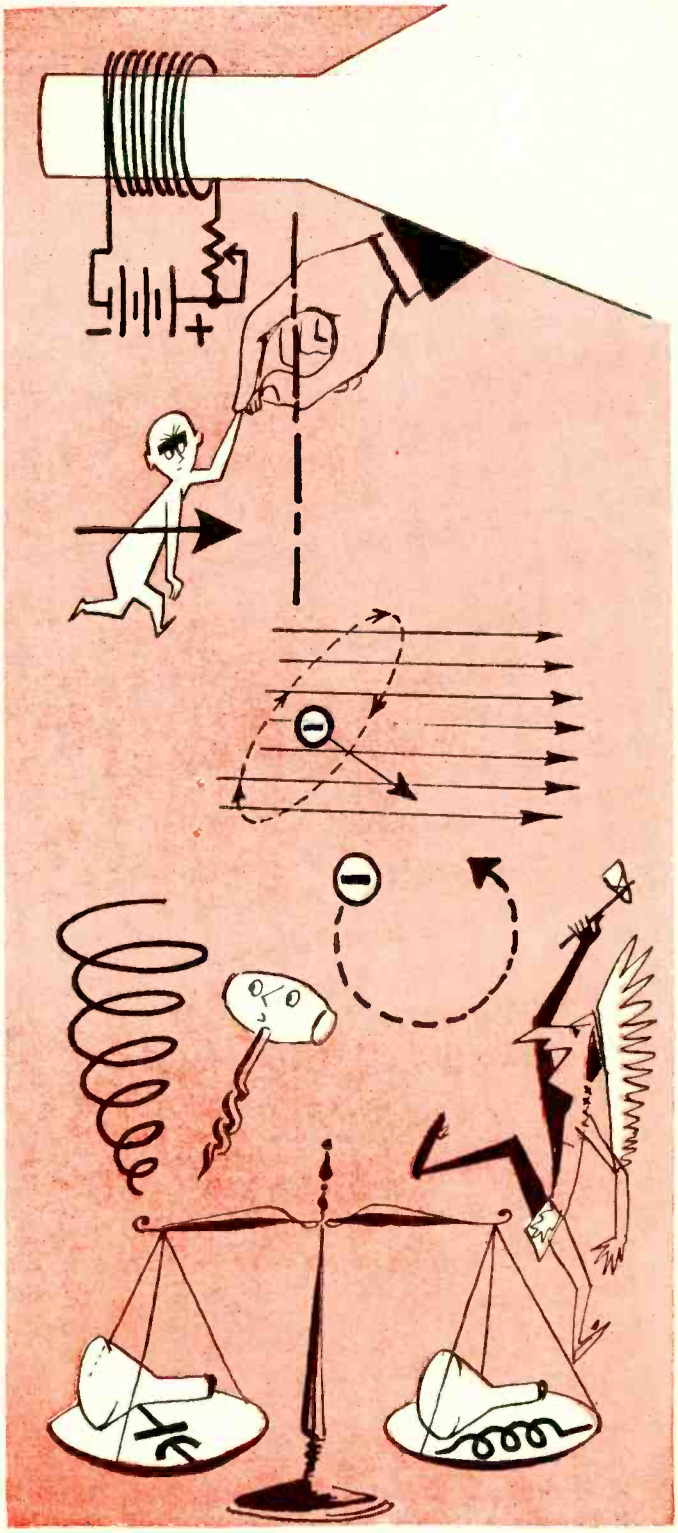
KEN—At first glance, all you say is absolutely right. But in practice, it applies only to small tubes—7-inchers or thereabouts. You just didn't think of the sensitivity factor.

WILL—What's a cathode-ray tube got to be sensitive about?

KEN—What I'm talking about is deflection sensitivity. It's a value you get—for any particular tube—by fiinding out how far the spot moves if you change the voltage on the deflection plates by 1 volt or change the strength of the magnetic field by 1 gauss.

WILL—If the spot moves further across the screen for a given voltage or current change, I suppose the tube is more sensitive?

KEN—That's the way it goes. Or you can say that the more sensitive a tube is, the smaller the voltage (or magnetic field strength) it takes to move the spot a given amount—say an inch.

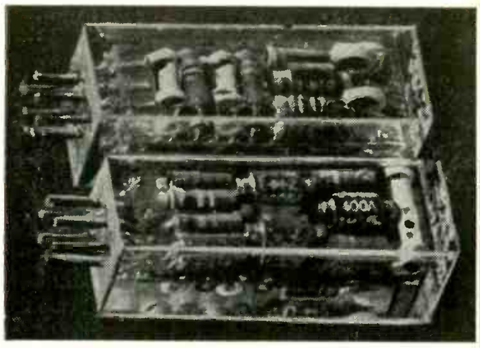


WILL—And what does the sensitivity of an electrostatic tube depend on?

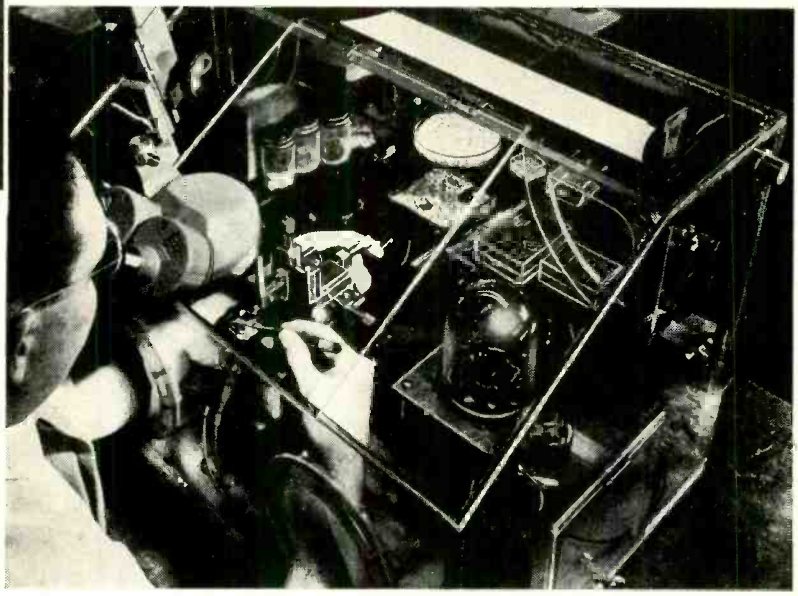
KEN—The longer the electrons are in the deflecting field, the greater is the deflection. So the longer the plates are, the greater is the sensitivity. At the same time the sensitivity increases as the plates are brought closer together, because that makes the field stronger.

WILL—So you can make very high-sensitivity tubes by making the deflection plates very long and cutting the distance between them down to a minimum?

KEN—You can't get very far along that path. With



Complete amplifiers, oscillators, and other transistor-operated circuit assemblies, hermetically sealed in clear plastic plug-in packets.



Assembling experimental transistors in a dust- and moisture-proof box.

A little phosphorus, arsenic, or antimony will produce excess electrons in germanium, and these can move about and make the material a conductor. But what happens when one adds instead a little boron, aluminum, gallium, or indium, which have *one less* outer electron per atom than germanium has? The cloud of electrons surrounding the nuclei now has fewer than the normal number of electrons; we say it has *holes* in it. The *holes* can move about freely, acting just as if they were *positive* charges! Don't let anyone tell you that this is easy to see. Authoritative books take long mathematical chapters to prove it. But at least we know it is so, because experiment bears out the theory.

Thus we can make one kind of germanium with *excess electrons*, which are negative charges free to move and carry current. This is called n-type germanium, because the current-carriers are negative. Or we can make another kind—a germanium with *holes* that act like positive charges. This is called p-type germanium because the carriers are, in effect, positive.

Now electrons and holes can get into

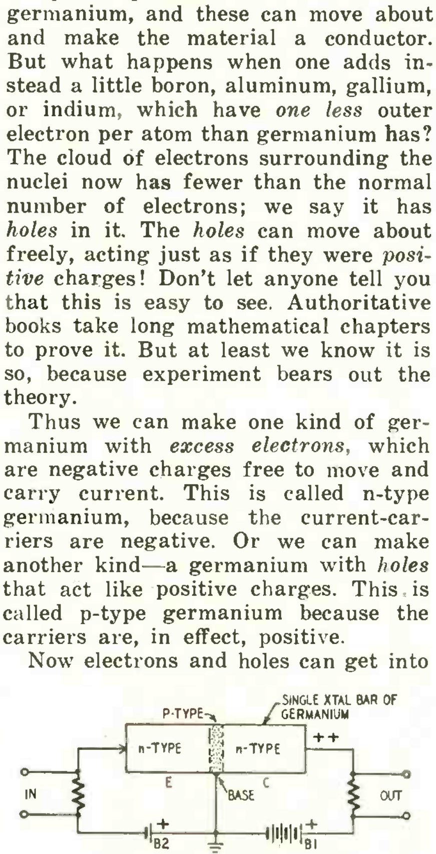



**Fig. 2—A junction-transistor circuit. Some of the electrons driven from the n-type emitter by B1 are absorbed by positive holes in the p-type base layer, and cannot reach the collector. The input signal varies the number of electrons released by the emitter, modulating the collector current. The additional drop across B2 amplifies the signal.**

germanium in more ways than by being built in. They can be injected into the germanium. Suppose a fine pointed wire touches a strip of n-type germanium. If the wire is made positive, *holes* will be injected. How do we know? By making the experiment shown in Fig. 1. Here we have a long strip of n-type germanium and a battery (B1) that makes the right end negative. This end will attract *holes*. (Of course, the polarity of the battery also makes a current of *electrons* flow through the strip from right to left.)

Near the left end, we feed a positive pulse to a pointed wire touching the strip. This injects *holes*. Near the right end we have another wire touching the strip. B2 makes this point a little more negative than the extreme end of the strip. Thus *electrons* flowing from *right to left* detour around this point, but *holes* moving from *left to right* are attracted to it. We connect this point to an oscilloscope.

What do we see on the scope? A small replica of the positive input pulse just when the pulse is applied, caused by a movement of electrons away from the collector and toward the positive emitter. Then—a fraction of a millisecond later—we see a stronger, broader pulse. This second pulse is the arrival at the collector of the injected holes which have been drifting through the germanium. As they drifted they banged repeatedly against irregularities in the crystal, reaching the collector by various paths, some shorter, some longer. This caused the spreading of the pulse. Some of the injected holes were lost en route by combining with free electrons, but most of them managed to reach the collector, and we can see their effect.

## Junction transistors

The type of transistor easiest to understand is the *junction transistor*, first described by Shockley and others in 1951. This type, shown in Fig. 2, is a single-crystal bar of n-type germanium, with a thin layer of p-type about 1 mil thick dividing it at the center. The left-hand end is called the *emitter;* in this circuit it is used as the *input* electrode. The center slab of p-type germanium is called the *base* (by analogy with earlier types of transistors). In this case the base is grounded. The right-hand end is called the *collector;* in this instance it forms the output electrode of the circuit.

In Fig. 2 the collector is positive, so as to attract *electrons*. Why doesn't it draw a lot of current from the base? Because the p-type base is full of *positive holes*, which the positive collector repels; but it has *no free electrons*. Thus a negligible electron current flows from base to collector.

The *emitter*, however, has lots of free electrons, and because B2 holds it a little negative with respect to the base, electrons flow from the emitter into the base. There they are free to move through the thin p-layer and, attracted by the positive collector, they go to it and form the output current.

You will see that this n-p-n transistor works just like a grounded-grid triode. The emitter supplies electrons, just as does the cathode of the triode. The base acts just like a biased grid (*positive*

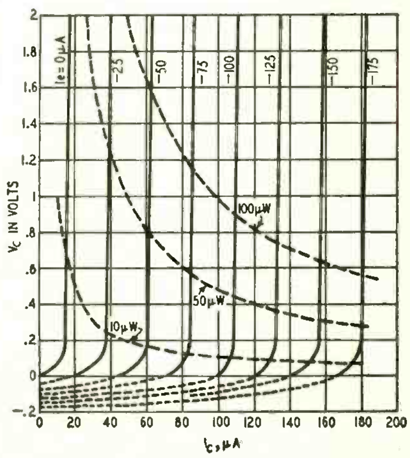



**Fig. 3—Characteristics of a commercial junction transistor (Bell Laboratories type M-1752). See text for explanation.**

*in this case*), which has complete control over the emitter current. The collector, of course, acts like the plate, and can attract only electrons which have passed through the base. We can make *p-n-p* transistors—p-type at the ends and n-type in the middle—which operate with a *negative collector* and have an output current of *holes*, not of electrons!

There are differences of performance,

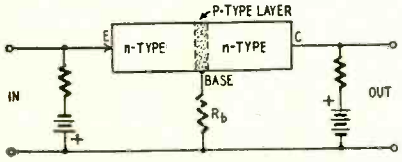



**Fig. 4—One undesirable effect of the ultra-thin p-layer required for high-frequency junction transistors is equivalent to inserting a large resistor ($R_b$) in the base-circuit return lead.**

as well. Some of the electrons traveling through the center p-type layer combine with *holes*. Thus the collector current is less than the emitter current, and the difference flows in the base electrode and corresponds to grid current in a triode. The ratio of collector current to emitter current is called *alpha* and is designated by the Greek letter $\alpha$. If *alpha* were 1, there would be no base current. *Alpha* usually ranges from 0.95 to 0.995. When *alpha* is very high (approaching 1) the transistor can be used satisfactorily in a grounded-emitter circuit, corresponding to the usual grounded-cathode vacuum-tube circuit. This is important because a grounded-grid circuit requires resonant circuits or transformers of some sort between stages to get voltage gain, but with grounded-emitter circuits one can get gain merely by coupling the collector (plate) to the next base (grid).

## Power supply

The astounding thing about the low-frequency characteristics of junction transistors is that their characteristics stay good down to very low operating voltages. Fig. 3 shows the characteristics of the Bell Laboratories M-1752 junction transistor. The collector voltage is plotted against emitter current for various values of collector current. We see that when the collector voltage is above 0.2 volt, the collector current is almost independent of collector voltage. This corresponds to a very high plate resistance.

Some dashed curves are drawn on Fig. 3 corresponding to power inputs (collector voltage times collector current) of 100, 50, and 10 microwatts. We see that with 10 microwatts power supplied, the characteristics are pretty good at a collector voltage of around 0.2 volt. This makes it possible to run junction-transistor oscillators from batteries made of a coin and a paper clip separated by saliva-moistened paper, or even from the output of the photocell of an exposure meter.

Transistors for high-power applications are not as good yet as for low power, but powers of several watts have been attained with experimental models.

## Transistor problems

What about noise in transistors? There is noise, of course. At audio frequencies, the noise is worse than in vacuum tubes, but transistor noise varies approximately *inversely* with frequency—that is, twice the frequency, half the noise—and in the megacycle range (if the particular transistor can get there) it is pretty good.

Transistors do have their troubles at high frequencies. The electrons drift through the p-layer of the n-p-n junction transistor of Fig. 2, colliding here and there with imperfections in the crystal. This stop-and-go, zig-zag motion prolongs the time it takes for an electron to reach the collector, and different electrons follow different paths and take different times. If the frequency of the input signal is high enough, the injected electrons may reach the collector spread all over the cycle, so that there is little effective a.c. output current. Because the ratio of

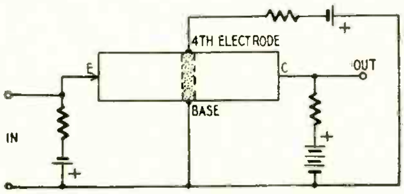



**Fig. 5—Reducing the thickness of the germanium bar, and biasing the side of the p-layer opposite the base connection *negative*, forces electrons to pass through the layer in a narrow region close to the base lead. This reduces p-layer high-frequency losses by 90%.**

the output (collector) current to emitter current is designated by *alpha*, this falling off in the ratio with increasing frequency is called *alpha cutoff*. The *alpha* cutoff may range from 1 or 2 mc to around 100 mc. What controls it? The thickness of the layer of p-type germanium which forms the base electrode. To increase the *alpha* cutoff we make the layer very thin.

Not only is this hard to do, but it introduces another problem as well. The resistance of the thin p-layer becomes very high crosswise to the slab. The wire connected to one side of the p-layer no longer grounds the whole layer effectively. It is as if we had a resistance of perhaps 1,000 ohms in the base lead, and this of course introduces considerable degeneration. See Fig. 4.

R. L. Wallace of the Bell Laboratories figured out a way of overcoming this defect by making a *tetrode transistor*, as shown in Fig. 5. First, he made the cross-section of the germanium bar as small as he could—about 1/100 of an inch square. Then he added a fourth lead, connected to the p-layer *opposite the base lead*. He biased this fourth lead *negative* with respect to the base lead, so as to repel electrons. As a result, the electrons from the emitter had to pass through the p-layer in the region near the base lead, so there couldn't be much resistance between the point where they crossed and the base lead. In this way, Wallace reduced the base resistance from over 1,000 ohms to around 100 ohms. With these tetrode transistors we can make video amplifiers that are good up to 10 mc, and tuned amplifiers or oscillators that will work at frequencies up around 100 mc.

## Contact transistors

Of course, not all transistors are of the junction type. The original point-contact type is still more common. In this type (Fig. 6), a small piece of germanium, the base, is soldered to a metal electrode. The emitter and collector are two pointed wires, touching the germanium close to one another. The operation of the point-contact transistor is the same as that of the p-n-p junction transistor, for, by an electrical *forming* operation, small islands of p-type germanium are formed about the emitter and collector points, and these regions of p-type material act just like the emitter and collector of a junction transistor.

Point-contact transistors behave differently from junction transistors in one way. Because the area of the collector is very small, the charge of the electrons which form the collector current affects the electric potential in the germanium near the collector. Thus, when the collector current changes, the potential inside the germanium changes, and this tends to change the collector current more. In fact, when the emitter current is changed the collector current may change as greatly as 50 times as much, giving an *alpha* of 50. Thus, unlike junction transistors, point-contact transistors can have current gain even in grounded-base circuits, but they will

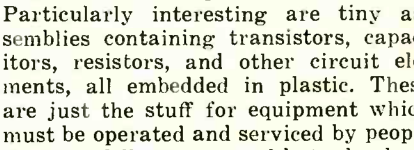



**Fig. 6—Circuit of a contact transistor.**

not operate at as low voltages as the junction type will.

Transistors come in many forms, and I have included pictures of several. Particularly interesting are tiny assemblies containing transistors, capacitors, resistors, and other circuit elements, all embedded in plastic. These are just the stuff for equipment which must be operated and serviced by people who can follow a manual but who don't know much about circuits.

What will newer, better, and cheaper transistors make possible? Radios no bigger than a match box or even a wrist watch seem feasible. But transistors mean a lot more than that. Because they are small and take little power, they will be used where vacuum tubes are impractical. Think of a "thinking machine" with all the vacuum tubes torn out and their spaces filled completely with transistors. Surely the machine would have a lot more brains! END

*A simple network to help maintain tonal balance at low volume levels*

# A BRIDGED-T AUDIO CONTROL

By WM. AUSTIN

THE loudness control, which boosts the bass and treble frequencies as the volume is reduced, thus compensating for the loudness-frequency characteristics of the human ear, has become an important element of a large number of high-fidelity audio systems.

Most loudness controls operate by adding low-pass filter sections as volume is decreased. This calls for an expensive step-by-step control, or multiple taps on a potentiometer. Tap switches are cumbersome and costly, and potentiometers with the required number of taps are special jobs.

By using the bridged-T circuit—together with the regular bass and treble controls of the amplifier—an effect approaching that of a loudness control may be obtained with an ordinary potentiometer, three small capacitors, and three fixed resistors.

Fig. 1 shows the basic bridged-T circuit. It presents nearly infinite impedance at a frequency f (where $f = 1/2\pi RC$) with rising response above and below this frequency. All that is needed to use it to control loudness is to choose values giving maximum impedance at a frequency near the center of the audio range (1,000 to 3,000 cycles), and to provide a means of varying this impedance as volume is changed.

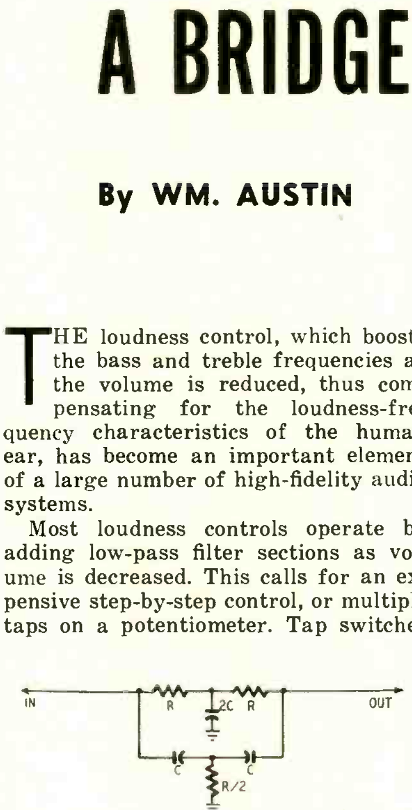



Fig. 1—Basic bridged-T filter circuit.

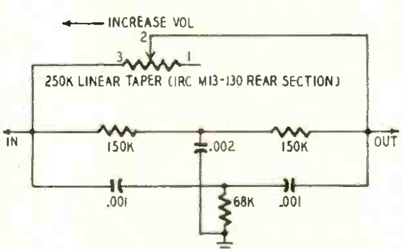



Fig. 2—Circuit of the bridged-T control.

## A practical hookup

Fig. 2 is the circuit. The component values give maximum attenuation at about 1,000 cycles. Fig. 3 shows the effect of the control on the frequency response at various volume levels. As volume is increased, the bridge is shunted gradually, until at full volume the response is flat except for a small amount of bass boost. This can be minimized by using a fairly low value of plate-load resistance in the stage preceding the loudness control. Since this circuit provides considerably more treble boost than the Fletcher-Munson curve indicates is necessary at low volume levels, it is desirable to use a simple treble-cut tone control to reduce the high end.

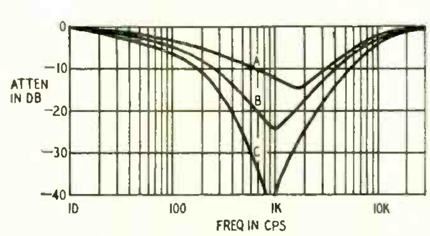



Fig. 3—Frequency-response characteristics of the bridged-T control. A, B, and C show the response at three-quarters, one-half, and minimum-volume potentiometer settings respectively.

## Don't discard tone controls

This unit is *not* a substitute for individual bass and treble controls. Individual tastes and the characteristics of program sources vary and it is still desirable to have both ends under control. The Fletcher-Munson curves show that the ratio of bass to treble boost varies with loudness. An ideal arrangement is to retain the individual bass and treble controls and use the loudness control in tandem with the regular volume control. The 250,000-ohm linear potentiometer can then be the rear section of a dual control and the front section can be a standard audio-taper volume control of whatever value is desired. An on-off switch also can be added if desired.

I use this setup in a *Radio Craftsmen* RC10 tuner with excellent results. This tuner has a bass-treble control circuit between the two audio stages. See Fig. 4. The bridged-T control is between the plate circuit of the first stage and the bass-treble control (point X in Fig. 4). The original volume control follows the plate circuit of the second stage. END

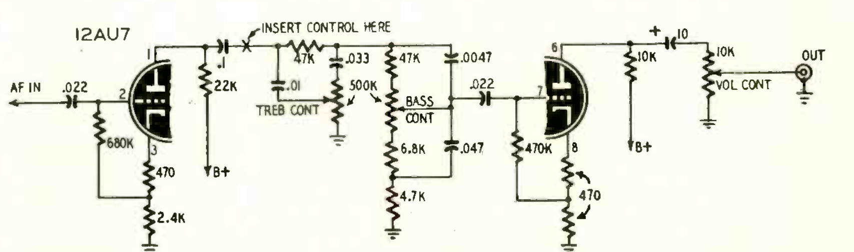



Fig. 4—Applying the bridged-T control to a commercial audio amplifier (*Radio Craftsmen* RC10 AM-FM tuner). Control is inserted at point X in the diagram.

# OVERCOMING PA hookup problems

By N. H. CROWHURST

OCCASIONS frequently arise where the PA engineer has to feed two or more independent sound systems from the same program source. Electrical hookup between separate systems is often fraught with various difficulties, so the most common method is to run out a separate microphone for each system to be tied in, resulting in the veritable battery of microphones often seen when a celebrity speaks on an important occasion. This method has serious disadvantages, the greatest of which is the variation of level, whenever the speaker moves or turns his head, on some of the systems whose microphones are not so well placed as others.

Obviously the best approach to the problem would be to use only one high-quality microphone (with an extra one as a stand-by), to supply all the different systems. This would simplify program pickup, as well as monitoring problems on each of the systems hooked together. There would still be problems, but they need not be insurmountable once they are understood.

The chief problems may be listed under four headings:

1. When two systems are coupled together, a severe line hum often develops in one or both systems, that was not present in either before the connection was made.
2. It may be difficult to provide the right impedance match between the two systems without affecting the volume level in one or both.
3. Where several systems are fed from a common source there may be interaction between controls on the different systems. One operator altering his volume or tone-control settings may affect the volume and quality of the signals delivered to other parts of the hookup.
4. One or more systems in the hookup —recording units for example—may not require the entire program, and may adopt different methods of cutting in and out of the network. Precautions must be taken to see that any such circuit modifications in one part of the system do not interfere with the rest of the hookup.

## 500-ohm bus system

By far the most versatile method is to set up a 500- or 600-ohm balanced line that serves as a basic interconnecting bus. The best arrangement is to have a microphone amplifier that will deliver an output level of about 1 volt into a balanced 600-ohm line (0 vu), but this is by no means essential; any good amplifier with the necessary microphone-control facilities can generally be made to serve this purpose by padding the output to 500 ohms.

With this system not only can a program from a single source be fed into a number of systems, but also various program sources can be brought into the hookup by using separate local amplifiers to feed into the 500-ohm bus at the desired points. Much of the hum trouble can be eliminated by careful attention to impedance and level matching. However, an important cause of hum that cannot be taken care of in this way is that due to differences in potential between the ground connections of the individual systems.

## Ground potentials

In the interests of public safety, all power circuits are connected to ground somewhere, and a ground connection also is provided on some power-supply outlets as a safety precaution. The association between the ground connections of the various supply circuits in the building sets up small currents at the line frequency in the grounded framework. These currents in turn set up slight potential differences, usually only a small fraction of a volt, but even such a minute potential can create a serious hum if it gets into any high-gain amplifier. This often happens when two systems are coupled together, so the solution rests in careful selection of ground-connection points.

While on this subject, it is well to mention that a good-quality PA amplifier should operate well *with or without* a ground connection, and the effect of breaking or making this connection should be almost inaudible—even with the volume turned up to maximum and the ear close to the loudspeaker. If an amplifier does not satisfy these require-

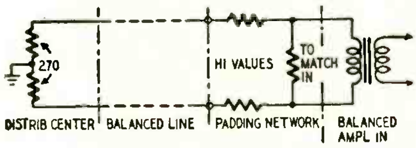



**Fig. 1—Method of connecting a balanced-input amplifier to a balanced 500-ohm line. Series resistors in padding network reduce loading, and allow several amplifiers to be fed from one line.**

ments, it is wiser to leave it out of any hookup system and look for a better one. If no better amplifier is available, then careful treatment may produce passable results, as explained later in this article.

## Getting on the bus

Assume that we have a microphone amplifier delivering an output of 1 volt into a 500-ohm balanced line, and we are going to feed a number of sound systems from this line. Most PA amplifiers are provided with separate microphone and phono inputs; the microphone input is generally the best one to match the 500-ohm line to, because it will have adequate reserve of gain, whereas the phono input may not. Microphone inputs are usually low-impedance, between 10 and 50 ohms; some are balanced to ground; some may be floating; and some may have one side connected to chassis.

Fig. 1 shows the simplest method of connecting the line to a balanced microphone input. For a single-ended input it may be possible to unhook the ground connection inside the amplifier, but this may give rise to trouble because the ground connection is probably included to maintain stability in the amplifier. If this is removed, and the input circuit is grounded only at some remote point, hum trouble will probably appear.

Fig. 2 shows one method of connection where one side of the amplifier input is grounded. This may give trouble for two reasons: the unbalanced line is likely to pick up hum or cross-

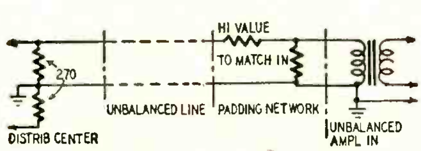



**Fig. 2—Feeding an unbalanced-input amplifier from a balanced line. Potential differences between the two grounds may introduce hum at power frequency.**

talk from telephone lines or other speech circuits that may run near it; and the small potential difference between the two ground connections may inject a line-frequency hum.

Fig. 3 shows an alternative method of connection that avoids strapping the two ground connections together as in Fig. 2, and also provides a balanced connecting line. One of these two methods of connection should prove satisfactory. When going into low-level low-impedance inputs, the resistor values should be adjusted so the resistance from both lines to ground is equal at the distributing center. If this is checked by d.c.-resistance measurement, all amplifier inputs and outputs should be disconnected, or the winding resistance of their input and output transformers will invalidate the result.

Most high-impedance phono or crystal-microphone inputs are *unbalanced*. Fig. 4 shows the simpler method of connection here corresponding to Fig. 2 for low impedance, while Fig. 5 shows the method to adopt where a balanced line is necessary.

## Line impedance

An important feature to realize about these circuits is that the impedance of

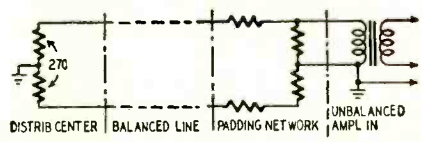



**Fig. 3—One method of reducing line hum by the insertion of an isolating resistance between the two ground points**

the connecting lines must be in the vicinity of 500 ohms. This is achieved in each of the circuits shown by inserting padding resistors at the receiving end of the line. Two factors feature in the reason for this precaution: (a) transmission losses; (b) pickup of hum or cross-talk.

Lines run at low impedance—that is, by putting the resistor networks at the output end of the line as in Figs. 1, 2, and 3—introduce line loss due to the fact that the line-conductor resistance may be an appreciable fraction of the operating impedance. Such low-impedance circuits are also more susceptible to inductive pickup from magnetic hum fields through which the line may pass. The currents induced in the line will be of the same magnitude whether the line is 500 ohms or low impedance, but in the case of the 500-ohm line they will be attenuated by the padding network at the receiving end.

Lines run at high impedance—that is, by placing the padding resistors of Figs. 4 and 5 at the opposite end of the line, cause excessive loss of high frequencies due to line capacitance. The line is also prone to pick up noise from electrostatic fields. Of the two extremes a low-impedance line is preferable because the inductive components it picks up predominate at very low audio frequencies, which may not get through the average PA amplifier-speaker com-

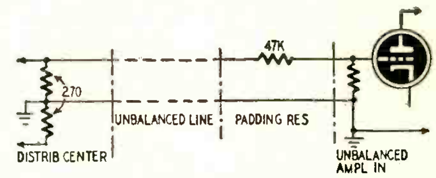



**Fig. 4—A simple method of feeding an unbalanced high-impedance input from a low-impedance unbalanced audio line.**

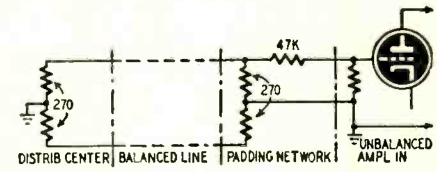



**Fig. 5—Connecting a balanced low-impedance line to a high-impedance single-ended amplifier input. If additional units are fed from the same line the value of the shunt resistors in the padding network should be increased.**

bination; while the static pickup in a high-impedance line contains high-frequency components with a greater annoyance potential, and loss of high-frequency signal components in the high-impedance line interferes with program quality.

Physically a balanced 500-ohm line is generally made up of a twisted pair run inside flexible shielding. High-impedance lines are usually single-conductor shielded wire, coaxial line, or an unshielded twisted pair with one of the conductors grounded.

Besides providing good program quality with freedom from spurious pickup, the correct padding network, properly placed, will usually take care of problems 3 and 4 listed at the beginning. The values of the padding network should be chosen so that whatever happens at the outlet end will not materially affect signal voltages at the input end.

For example, phone plugs and jacks are sometimes used as input connections to an amplifier. When a plug of this type is inserted into its jack, the line connected to the plug is shorted momentarily. If the main 500-ohm line is connected to the plug, then insertion or removal of the plug would momentarily short-circuit the whole program. Inserting a padding network between the line and the plug avoids this. In some tape recorders inserting the input plug disconnects the playback head, so that if an operator wishes to listen to a section of recording on his tape he has to remove the input plug. Unless the foregoing precaution is observed this operation could involve interference with the program.

Another wise precaution is to see that all padding resistors are soldered securely to the lines (once the values have been satisfactorily determined by experiment), and are suitably covered with insulating tape or otherwise protected against any possibility of accidental short-circuit or contact that might interfere with the program in any way.

## Improvising outputs

The foregoing assumes that a suitable microphone amplifier with a balanced 500-ohm output is the signal source for the entire network. If such an amplifier is not available, additional padding will be necessary to match the output of the microphone amplifier to the 500-ohm bus. If the amplifier has the usual low-impedance voice-coil output, a dummy load equal to the proper voice-coil impedance should be connected across the output, after which resistors of 270 ohms should be connected in series with each side of the line as shown in Fig. 6.

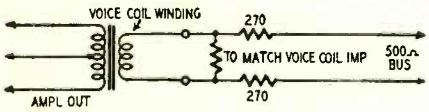



**Fig. 6—Padding out a low-impedance output winding to feed a 500-ohm line.**

The voice-coil winding *should not be connected to ground on either side*, or the line will not be balanced. If the amplifier requires a ground connection to the voice-coil winding for satisfactory operation, the dummy load resistor

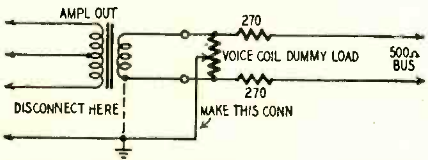



**Fig. 7—Changes required where one side of the voice-coil winding is grounded.**

should be center-tapped or made up of two equal resistors and the ground connection made to the center tap as in Fig. 7. If the secondary of the output transformer is used for feedback purposes, one side will be connected to the internal amplifier ground and the other side through a suitable resistor to the appropriate feedback point. In this case the modification of Fig. 7 would

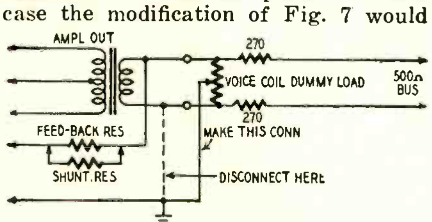



**Fig. 8—Circuit modifications where output-transformer secondary is part of feedback network. See details in text.**

cut the feedback in half. To rectify this, the feedback resistor also should be halved. The simplest procedure in this case, involving minimum alteration to the amplifier (this is something that must always be borne in mind, because the amplifier must be put back to normal after the hookup), is to disconnect the ground connection from one side of the transformer secondary and connect it to the center-tap of the dummy-load resistor. Then shunt the feedback resistor with another resistor of the same value. These changes are shown in Fig. 8.

Most amplifiers can be treated in this way to supply the necessary 500-ohm output, but you may find one that has high-impedance output, above 500 ohms. I have frequently used an amplifier with 2,000-ohm output (intended for constant-voltage-line work) for this purpose. The procedure is similar in this case, but the series resistors will have to be much higher than the line impedance. This type of network is shown in Fig. 9.

## Multiple signal sources

Where programs are to be taken from more than one source in the system, it will be advantageous to feed the 500-ohm bus from a local microphone amplifier at each point of origin. If

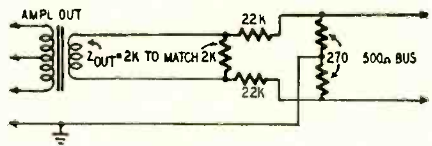



**Fig. 9—Padding a network for matching a high-impedance output transformer to feed a balanced 500-ohm line.**

the amplifier is one specially designed to feed a 500-ohm balanced line, additional precautions are necessary to see that its operation will not interfere with programs originating from other amplifiers. The plate resistance of the output stage is usually much lower than its load resistance, which means that, even though it is connected to a 500-ohm output circuit, when the amplifier is warmed up, a signal from another source will "see" this output circuit as 500 ohms shunted by the plate resistance, or much less than 500 ohms. Now suppose the amplifier is switched off: The shunting effect of the plate resistance disappears and the other amplifier will be feeding into a circuit that has now risen to its true 500 ohms. Thus, switching the first amplifier on and off, although it may not be carrying any program, will affect the output from a second amplifier, changing its volume level by from 10 to 20 db.

From this viewpoint, amplifiers with padding networks may be better than those specifically designed for 500-ohm output. For the correctly designed amplifier the best plan is to insert a resistor of 150 ohms in series with each side of the line at the output, to limit the reduction in shunt impedance when the amplifier is on, as viewed from another amplifier feeding the 500-ohm bus. This will take care of impedance matching, but may still leave a possible change of level of about 6 db, should the amplifier be switched on and off while the program is coming from other source. A wise precaution is to establish a recognized rule, that

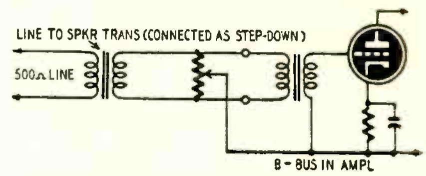



**Fig. 11—Another method of connecting an a.c.-d.c. amplifier to a 500-ohm line. The potentiometer across the input terminals is for balancing out line hum.**

the amplifier must be kept running throughout the whole program, whenever any part of the system is being used. This rule may not be necessary with amplifiers padded out from lower or higher impedance to 500 ohms.

## Isolating grounds

The padding arrangements shown in Figs. 1 through 5 usually prove perfectly adequate with good amplifiers. Sometimes, however, an amplifier must be pressed into service which does not meet the conditions specified earlier, of satisfactory operation with or without a ground connection. Many amplifiers designed for universal operation come in this category. Complete isolation must be provided between the system ground and the chassis (or ground bus) of this particular amplifier.

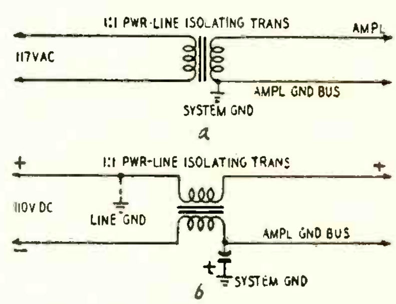



**Fig. 12—Isolating the a.c.-d.c. amplifier from the power line. (a) A 1:1 power transformer for a.c. operation. (b) The same transformer connected as a dual choke for operation from d.c. power lines. See the text for further details.**

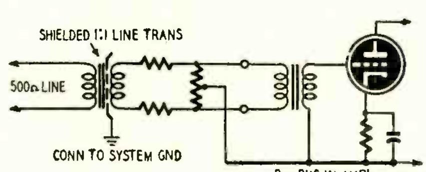


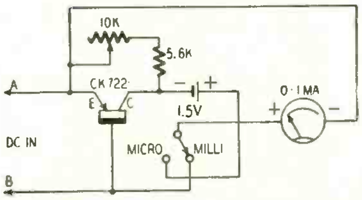

**Fig. 10—An isolation transformer may be needed to reduce hum when feeding an a.c.-d.c. amplifier with a floating B minus return from an audio line.**

Several methods of attack can be tried, and the choice will be controlled by the equipment available. If a shielded line-to-line transformer is available, the method shown in Fig. 10 should be satisfactory. If only a line-to-speaker matching transformer or some such component is available, the circuit of Fig. 11 can be used. The potentiometer may be almost any value, as long as it is higher than the other components in the circuit. It is used to balance out hum pickup.

An alternative approach is to use an isolating transformer between the power line and the amplifier in question. See Fig. 12-a. An isolating transformer also can be used as shown in Fig. 12-b when the supply is d.c. with the wrong side grounded. END

# TRANSISTOR MICROAMMETER

BY NATHANIEL RHITA



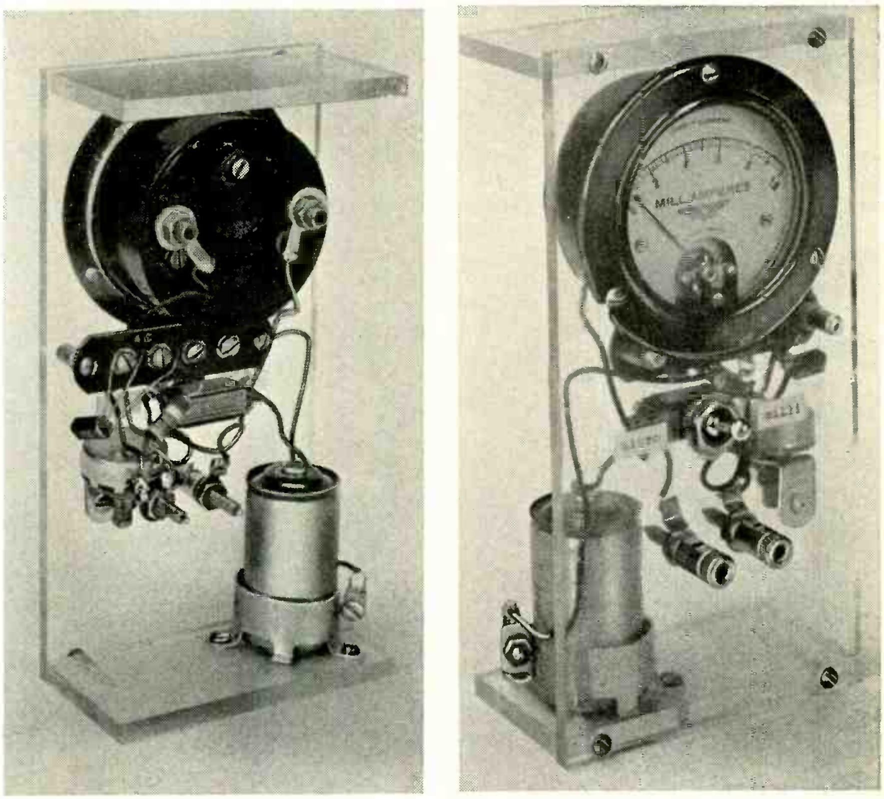

**This simple transistor amplifier has a current gain of approximately 10:1.**

THE transistor is to current what a triode tube is to voltage. A transistor makes an excellent current amplifier. We have constructed a circuit using Raytheon's type CK722 that gives a gain of 10 with about 100 microamperes input to the emitter. When the transistor feeds into a 0-1 ma meter, we can actually measure *0-100 microamperes* full scale. The advantage of this circuit is that we can measure weak currents with an inexpensive, rugged instrument.

The photos and schematic show a 2-range micrometer using a 1-ma movement. When the switch is thrown to MILLI the range is 0-1 ma since the meter itself is across the input. With the switch in MICRO the 10-to-1 current amplifier precedes the meter so the range is 0-100 microamperes. To avoid unnecessary battery drain leave the range switch in the MILLI position when the meter is not in use.

Actually the transistor amplification is not constant all over the scale. It is slightly higher than 10 near full scale, and less than 10 near the bottom of the scale. To reduce error, a compensating circuit is included. Adjust the variable resistor for exact reading near 0.8 on the meter. Then accuracy will hold over most of the range. We find that the error is only 2% or 3% from .2 ma on the meter (20 microamperes input) right up to full scale. Readings near zero have greater error, but this is not serious.

As a microammeter, the positive input terminal is A which ties to the emitter. As a milliammeter, the positive terminal is B. Note that in the MILLI position, the 1.5-v cell is disconnected but that the transistor input circuit is left across terminals A and B. This produces negligible error. END




**Inside and outside views of the transistor microammeter. The two-way switch allows the meter to be used alone where 100-μamp sensitivity is not required.**

# The Wench With the Wrench

**Pretty Celeste Mogab wasn't too sure at first about the right way to install a simple thing like a new *Platinum-Plate* u.h.f.-v.h.f.-AM-FM-TV tuner and needle-scratch filter with overdrive and deep-freeze attachments—but Raytheon's new TV servicing television program showed her all she needed to know. This novel method of delivering the latest dope on u.h.f. techniques was devised by Raytheon as a means of reaching the maximum number of technicians in a given area with minimum inconvenience to busy shops' service activities. Another advantage is that it gives everyone a front-row view of what's going on. Technicians who tuned in the first broadcast over WFPG-TV, Atlantic City's new channel-46 station, agreed enthusiastically that Raytheon's new model has several interesting features.**

# TV CHASSIS SIMPLIFIED

MANUFACTURERS realize that TV receivers have to be serviced. At least two of the 1953 series reflect that realization in chassis design. The Stewart-Warner 9300 chassis pictured here is possibly the best example of the trend toward a "serviceable" TV chassis.

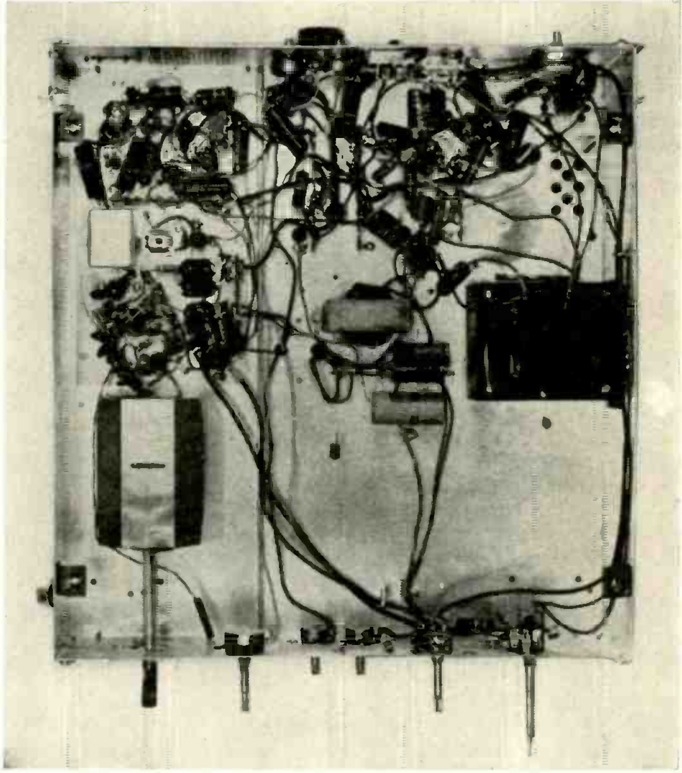
The 9300 under-chassis view, contrasted with that of an older receiver, shows what can be done when engineers want to simplify a TV set. The top views shows a "unitized" construction in which all parts are readily accessible, and no tubes are mounted under the kinescope (or under the chassis!). Power and high-voltage fuses are both mounted in top-chassis, easily accessible positions.

A bridge support at the rear of the chassis makes it possible to rest it on either side, or to turn it upside down on the bench, with complete safety. The flyback transformer—a high-mortality-rate component, and one which the service technician often wishes to check—is mounted with plug-in connectors instead of soldered leads. A transformer can be removed by unscrewing two sheet-metal screws and pulling out five connectors. A complete replacement takes less than five minutes, in the customer's home.

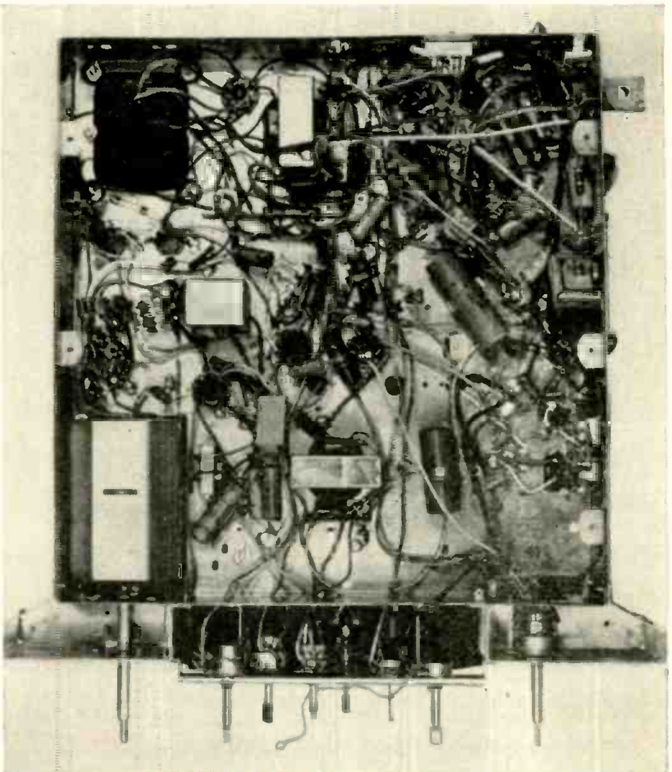
Another striking difference between old and new TV models is visible in the two Sonora chassis illustrated. They are the company's 1952 and 1953 21-inch models. The same number of components are to be found in each set, but there is a striking difference in the way they are arranged in the 1953 model.

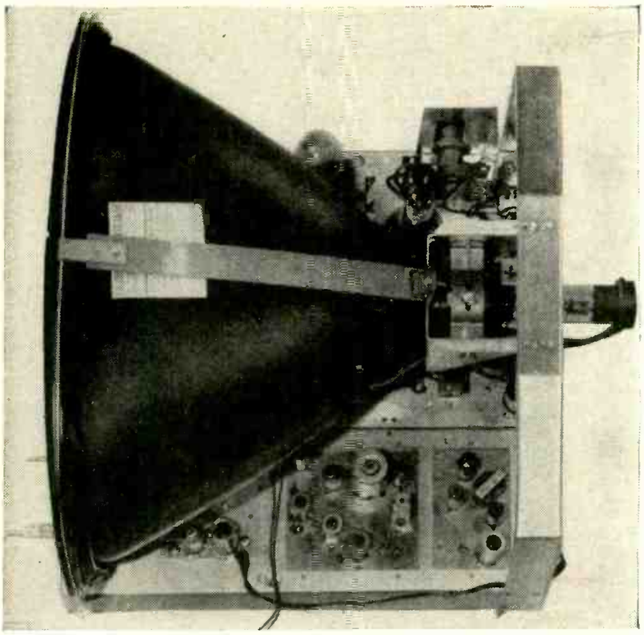
The distribution of parts above-chassis does not show quite the same advantages of convenience and accessibility as the below-chassis arrangement. A couple of the tubes are hard to see or to get at while the chassis is in the cabinet, and the rectifier tube on top of the transformer is not an aid to easy replacement of tubes on that side of the chassis. The setup is a decided improvement in heat dissipation, however. The power transformer has been removed to the top of the chassis, and the position of the rectifier tube is excellent from the radiation point of view. A number of the larger capacitors are mounted on a vertical subpanel in a cooler part of the chassis area.

Slight differences in chassis layout and component accessibility may well mean the difference between a simple repair job and a heart-breaker. Service technicians will watch with great interest for further indications of this trend toward simplification. END

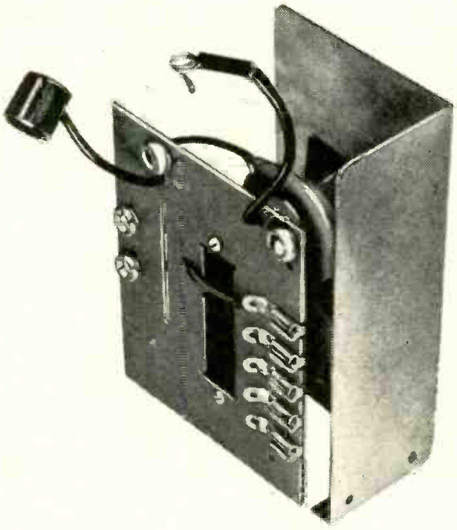


Underchassis view of S-W 9300 (above) compared to old standard chassis shows new inspection and servicing ease.

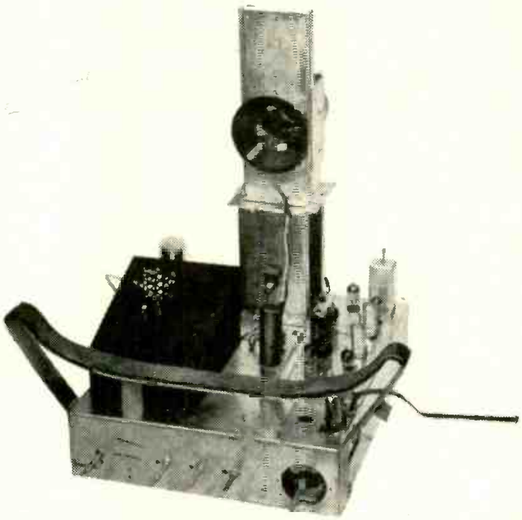




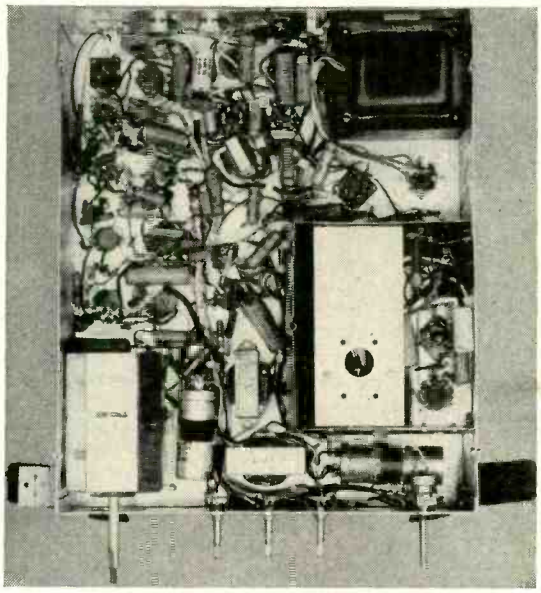
Top view of the 9300. High-voltage can (top) is removed. Note support at rear.



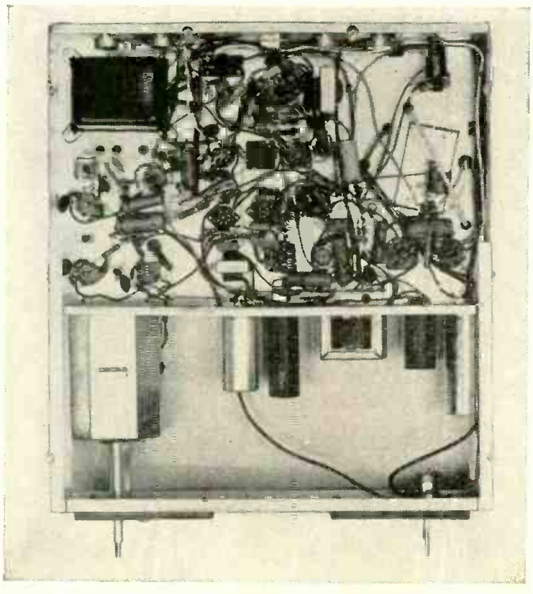
A transformer with plug-in terminals.

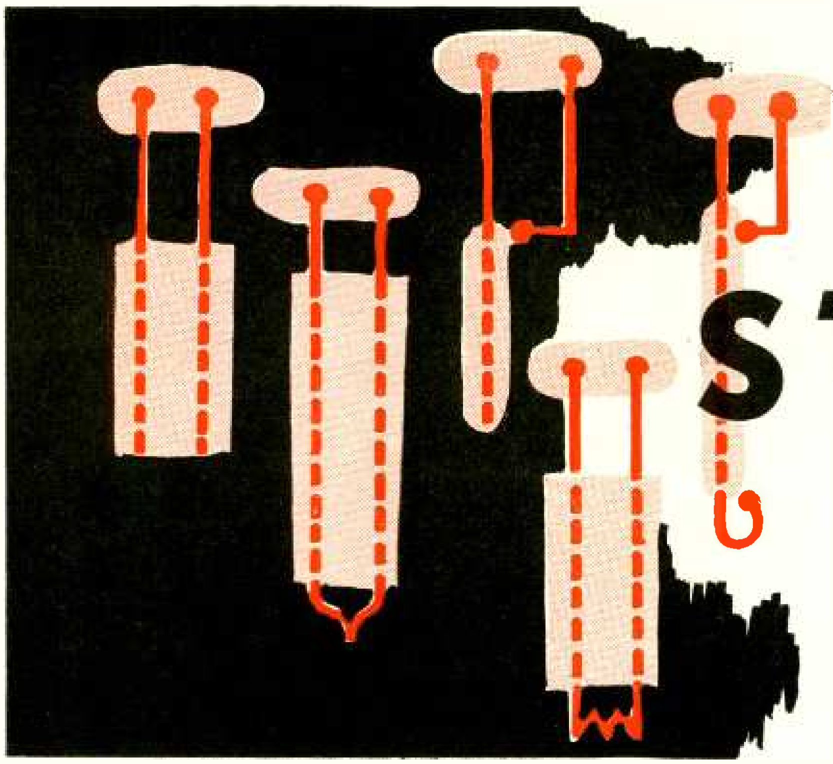


The above-chassis views of two Sonoras show improvement in heat radiation. Capacitors are mounted in cool area.



Old (above) and new (below) 21-inch Sonoras compared. Tuner and power transformer were put above chassis and parts layout much improved in the newer model.





# STUBS

*make excellent traps for reducing TV interference*

By JESSE DINES*

WHERE interference enters a TV receiver through the antenna or transmission line, stubs provide a reliable and permanent solution. Several factors favor their use: They are easy to make and install, their cost is very low, and they can reject almost all types of outside interference except co-channel interference (two stations picked up on the same channel) and broad-band noise. Generally speaking, stubs have a limited bandpass characteristic, which especially favors their use for eliminating FM-broadcast interference (88 to 108 mc). This characteristic, however, becomes a handicap when we want to eliminate adjacent-channel interference; but even this limitation can be overcome. Steps to alleviate this condition are given later.

* Editorial Dep't., John F. Rider Publisher.

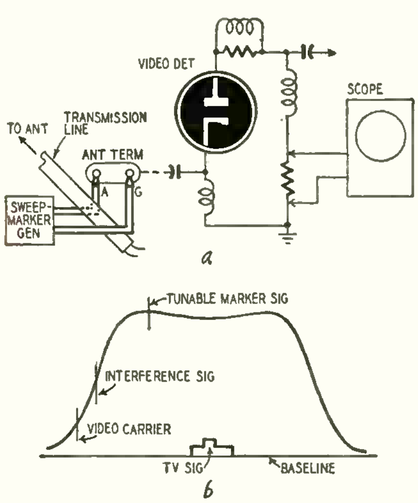



**Fig. 1—(a) Equipment setup for finding interference frequency. Generator output must be kept low to avoid overloading. (b) Typical scope trace. The interference frequency can be read directly from the marker dial when both pips coincide. See text for details.**

Before we can make a stub, we must first know the interference frequency. One of the most accurate methods is to use a standard sweep-marker generator and oscilloscope, arranged as shown in Fig. 1-a. Disconnect the transmission line from the receiver, and couple it loosely to the output leads of the marker generator, as shown. Connect the marker generator to the antenna terminals of the receiver and hook the scope across the video-detector load resistor. The next step is to turn to the channel where the interference is most severe and adjust the fine-tuning control of the receiver for maximum interference. Cover this channel with about a 10-mc sweep from the generator to obtain a response curve similar to Fig. 1-b. Three pips should appear on the curve: the video-carrier signal, the generator-marker signal, and the interference signal. Vary the marker-frequency control of the generator so that the marker pip lines up with the interference pip. At this point, the marker-frequency dial of the generator gives you the interference frequency.

When the frequencies of the marker and interference signals are not exactly equal, a sine wave appears on the base-line. This is the frequency difference between the two signals. The frequency of the beat decreases as the signals are brought closer together. The beat disappears completely when the two signals are equal.

## Open and shorted stubs

The quarter-wave open and half-wave shorted stubs are the easiest to construct and install. Both types are equally effective for all practical purposes, and either may be used. They are constructed from the same material as the transmission line of the receiver. Four examples of stubs for both 300-ohm ribbon lead and 75-ohm coaxial lines are shown in Fig. 2. Their lengths, *l*, are computed from the formulas given in Table I. The length of the stub, *l*, is in inches and f is the interference frequency in megacycles. As an example, consider the case where we want to find the length of a shorted half-wave stub to eliminate 200-mc interference from a receiver with 300-ohm input. The length of the stub is then determined from the formula given in the chart. That is,

$$l = \frac{4{,}850}{f} = \frac{4{,}850}{200} \text{ or } 24.25 \text{ inches}$$

or a little over 2 feet.

Always cut a stub several inches longer than its calculated length to allow for final adjustments after the stub is installed. With quarter-wave open stubs, cut off ¼-inch sections from the open end until interference rejection is maximum. In the case of half-wave, shorted stubs, short out ¼-inch sections by cutting through the insulation and shorting the wires with a razor blade or fine knife. Twist and solder the wires at the point where the least amount of interference is observed. On coaxial lines, puncture the insulation with a needle or thumb-tack, thereby shorting the inner and outer conductors.

Stubs may be taped, tacked (use

fiber-head tacks), or stapled to wood receiver cabinets. (With ribbon line the staple must lie parallel to the stub wires—never across them.) If the cabinet is plastic or steel, fasten the stub firmly to some nearby wooden structure such as a table or chair. *Never bend or twist stubs.* Doing so may change their natural resonant frequencies.

*An important point to remember is that the quarter-wave stub greatly attenuates second harmonics and the half-wave does the same to third harmonics.* For example, if a quarter-wave stub is cut to eliminate 91-mc interference from an FM station, then it will also eliminate 182 mc. This will attenuate the video signal on channel 8 (180–186 mc). A half-wave stub cut to 91 mc will attenuate 273 mc. This is well above the television spectrum.

## Stub switching

After a stub has been installed and trimmed for maximum interference rejection, turn to all other channels to make sure it does not have any detrimental effects on them. If it does (which is most likely in fringe or weak-signal areas), then add a switching arrangement to take the stub out of the circuit except when it is needed. A d.p.s.t. switch, as shown in Fig. 3, may be used. A rotary switch is preferable since the capacitance between the contacts of most types is fairly low.

## Reducing stub Q

Stub switching may not be necessary if the interference is much weaker than the channel being viewed. A stub having a lower Q and, therefore, less interference rejection, may be used instead. To reduce Q, we add a series resistor to the quarter-wave open stub or a parallel resistor to the half-wave shorted stub. The connections for these resistors are shown in Fig. 4. Their ability to reject varies inversely with their ohmic values. That is, the larger the ohmic value, the less the interference rejection; conversely, the smaller the ohmic value, the greater the interference rejection. The resistor for any particular installation is best determined by experiment. In an actual case a carbon resistor of about 25 ohms gave a 2-to-1 reduction in interference.

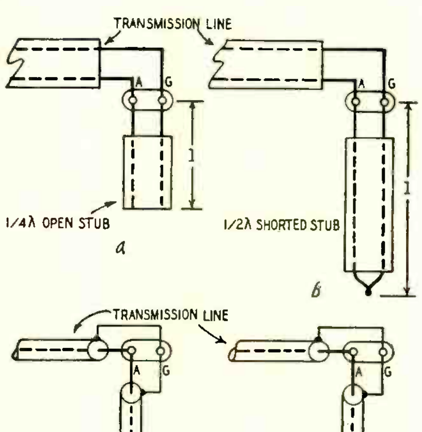



**Fig. 2—Four types of stubs. (a) 300-ohm, quarter-wave open stub. (b) 300-ohm half-wave shorted stub. (c) Coaxial-line quarter-wave open stub. (d) Coaxial-line half-wave shorted stub.**

**TABLE I**

| Stub Type | LENGTH ($l$) IN INCHES |
|---|---|
| Quarter-wave open (300-ohm lead) | $l = \frac{2,425}{f}$ |
| Half-wave shorted (300-ohm lead) | $l = \frac{4,850}{f}$ |
| Quarter-wave open (75-ohm coaxial) | $l = \frac{1,950}{f}$ |
| Half-wave shorted (75-ohm coaxial) | $l = \frac{3,900}{f}$ |

## Tunable stubs

A type of stub used quite often for its greater efficiency and its comparatively short length, is the tunable absorption stub. Assuming that the receiver uses 300-ohm transmission line, the stub is constructed from two pieces of the same line. The pieces are cut to a length slightly longer than that computed from the approximate formula

$$l = \frac{450}{f}$$

where $l$ is the length of each piece in inches and f is the interference frequency in megacycles.

After cutting off about an inch of insulation from both ends of each piece, they are placed parallel to each other, as shown in Fig. 5-a, leaving enough room between the pieces to permit the transmission line to the receiver to pass through. Referring to the figure, wire 1 is soldered to 2, 3 to 4, 5 to 6, and 7 to 8. Make sure that the calculated length $l$ is not changed when soldering the wires. The finished stub is shown in Fig. 5-b. Two capacitors are inserted across the parallel connection. One is a 7-45-μμf variable ceramic (zero temperature coefficient) to make the stub tunable; and the other is a 15- or 20-μμf fixed ceramic capacitor.

To install the stub, disconnect the transmission line temporarily from the receiver antenna terminals and run it through the center of the stub, as shown in Fig. 6. The stub should be at least one foot from the antenna terminals of the receiver, because the stub has a tendency to re-radiate.

If the interference is very strong, one stub may not reject it completely. In such a case, more than one absorption stub can be used, along the transmission line. The spacing between stubs is not critical, although they should not be too close to one another. Each stub is tuned separately to the interference frequency. When tuning one stub, all others must be made inactive by wrapping them tightly with tin or aluminum foil. END

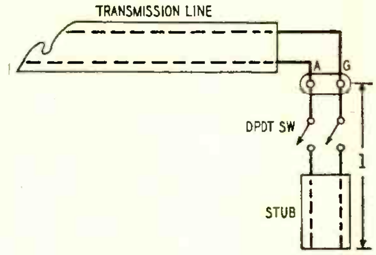



**Fig. 3—Stubs may be switched out of circuit if harmonics fall on desired channel frequencies. Switch must have low capacitance between contacts for minimum absorption in *open* position.**

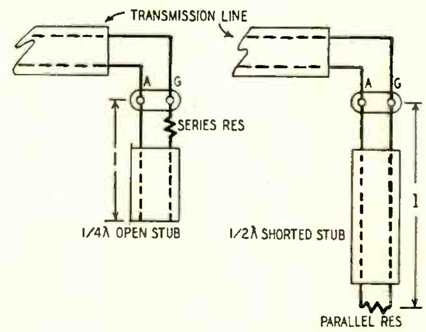



**Fig. 4—Inserting resistance as shown reduces stub Q. See text for details.**

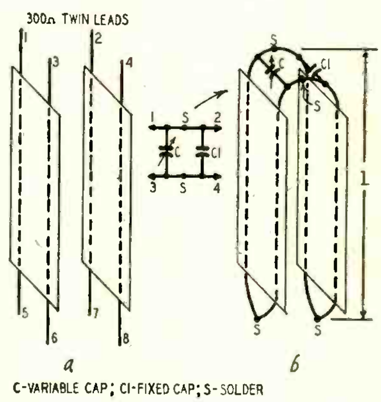



**Fig. 5—Steps in constructing a tunable absorption-type stub. (a) Identical "sandwich" layers before joining. (b) Connections of completed stub. Formula for length $l$ is given in text.**

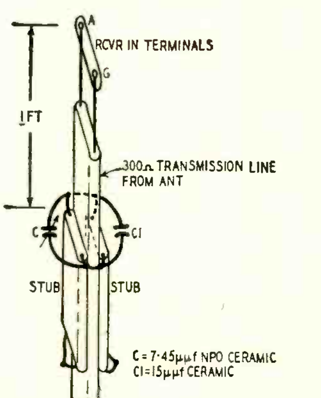



**Fig. 6—Stub installed on transmission line. Note spacing from receiver input.**

# THE EFFECT OF SPORADIC E

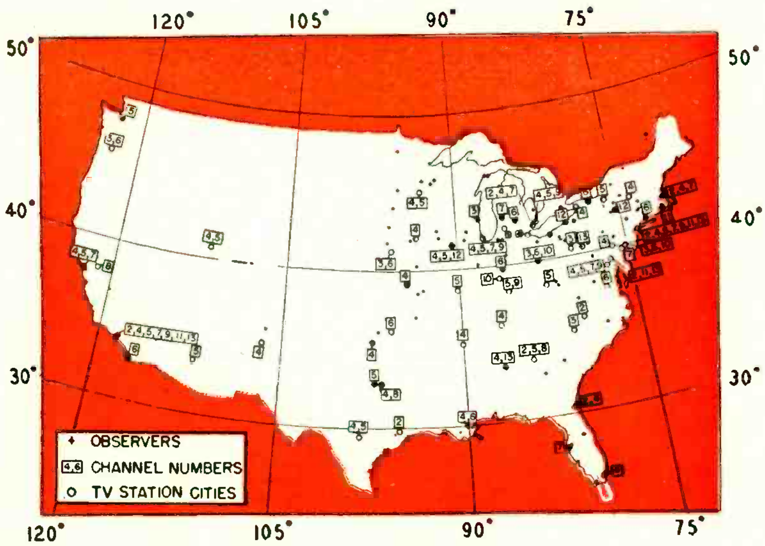



Fig. 1—Locations of observers reporting TV dx reception.

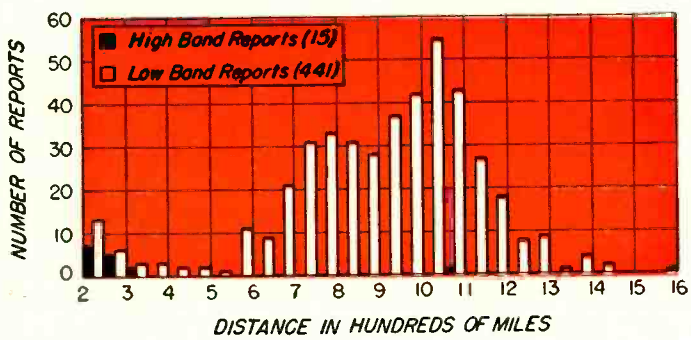



Fig. 2—Average of TV dx reports by band and distance.

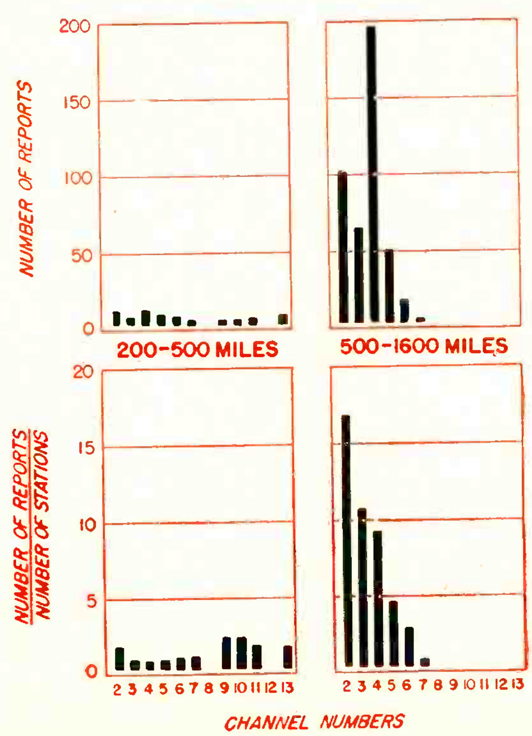



Fig. 3—(Above) Total number of dx reports received for each channel at various distances. (Below) Relation between number of dx reports for each channel and total number of active stations on that channel.

FOR several years reports of long distance reception have been coming in from television viewers. Most frequently these receptions have spanned distances of around 1,000 miles. There has been considerable speculation as to whether such abnormal reception is tropospheric in origin or transmitted via the sporadic-E region of the ionosphere. The type of evidence considered here leads one to conclude that transmission paths up to 500 miles can, roughly speaking, be attributed to tropospheric propagation, while sporadic-E accounts for transmissions between 500 and 1,600 miles. The importance of such reception to television service in the United States lies not so much in the service gained through the long-distance reception itself but in possible interference to a station's fringe area from distant co-channel stations.

Some expected differences between tropospheric and sporadic-E transmission:

First, skip distance does not apply to tropospheric propagation, while it does apply to sporadic-E. Tropospheric phenomena become more important as frequency increases, while sporadic-E reflections decrease with increasing frequency. Signals supported by the troposphere decrease with path length, whereas those due to sporadic-E will be most numerous at distances of around 1,000 miles. This is due to the fact that although the skip distance curve would give us an increasing number of possible receptions up to the maximum distance for single-hop propagation, low radiation angles of transmitting and receiving antennas have an opposite effect.

Extraordinary tropospheric propagation over long paths depends on conditions obtaining over a large extent of the path, whereas sporadic-E transmission depends on the ionospheric conditions over the path mid-point only. Sporadic-E can be a highly localized phenomenon, so if mid-points for a short time interval form a tight cluster on a map, sporadic-E rather than tropospheric propagation is indicated. Further evidence that sporadic-E is responsible for abnormal reception is obtained when reception mid-points are found falling close to the location of an ionosphere sounding station and when at the time of the television reception sporadic-E is identified on the ionosphere sounder.

### R-E TV dx reports used

The data utilized in this study were taken from the file of listener reports of RADIO-ELECTRONICS magazine.

# ON TV RECEPTION

By ERNEST K. SMITH, JR.*

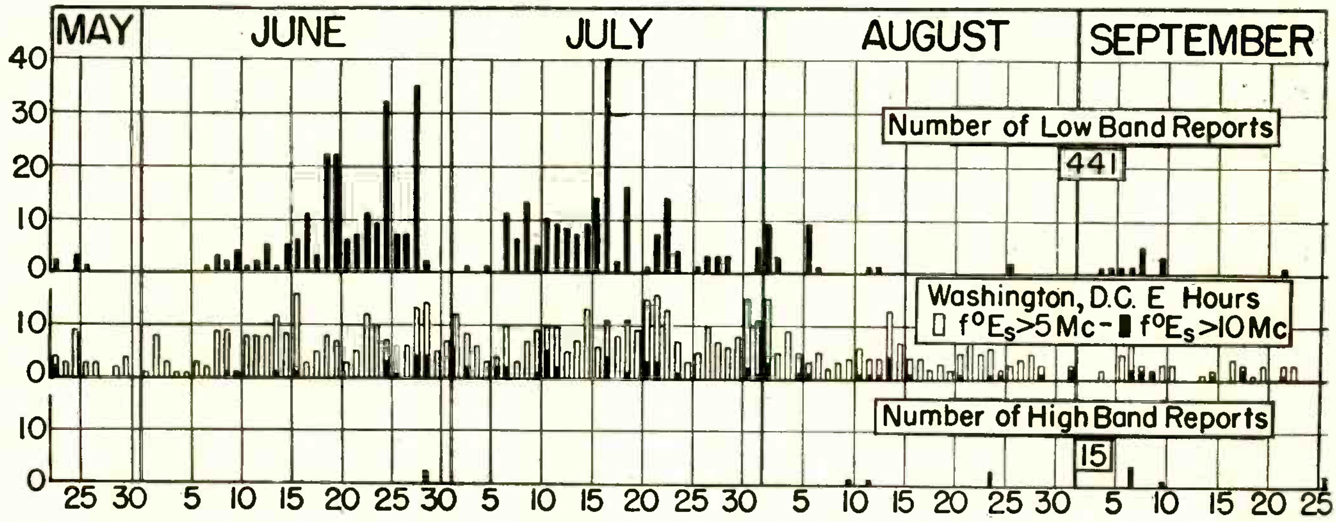



**Fig. 4—TV dx reports by days for the period May 22-September 25, compared with the hours per day of vertical-incidence sporadic-E reflections at Washington, D.C. Note low-band peaks in June and July, months of maximum sporadic-E.**

These data contained 456 reports of receptions of stations on the various TV channels over distances of greater than 200 miles. These reports were submitted by 103 persons and covered the period from May 22 to September 25, 1950. The crosses on Fig. 1 mark the locations of the observers. Cities with operating television stations are shown by circles. The channel numbers of operating television stations are shown for each city.

Shown in Fig. 2 is a histogram of the number of reports falling in the various class intervals of distance. The vast majority of reports are seen to fall in the 500- to 1,600-miles grouping and to consist almost wholly of reception of low-band (54–88 mc) stations. Note that in the 200- to 500-mile range there are receptions of high-band (174–216 mc) as well as low-band stations and that there is a decrease with distance, so that reports on both bands drop to a minimum at 500 miles. The former (high-band) group is believed to be troposphere-propagated; sporadic-E reflections could be responsible for the latter.

When the number of reports in the two distance divisions are plotted by channel as shown in Fig. 3, two apparent difficulties arise. In the 200- to 500-mile grouping, at the top, the number of reports appears to decrease with increasing channel frequency. The reverse would be expected for tropospheric transmission. In the 500–1,600-mile grouping, channel 4 rather than channel 2 received the greatest number of reports. However, there are more stations on channel 4 than on any other channel and also more low-band than high-band stations. If the number of reports for each channel is prorated by the number of stations operating on the channel, the distribution seen in the lower two charts is obtained. The high-band values now exceed the low-band ones for the 200- to 500-mile range, as would be expected for tropospheric transmission, and the values decrease with channel frequency in the 500- to 1,600-mile range as would be expected for sporadic-E[1].

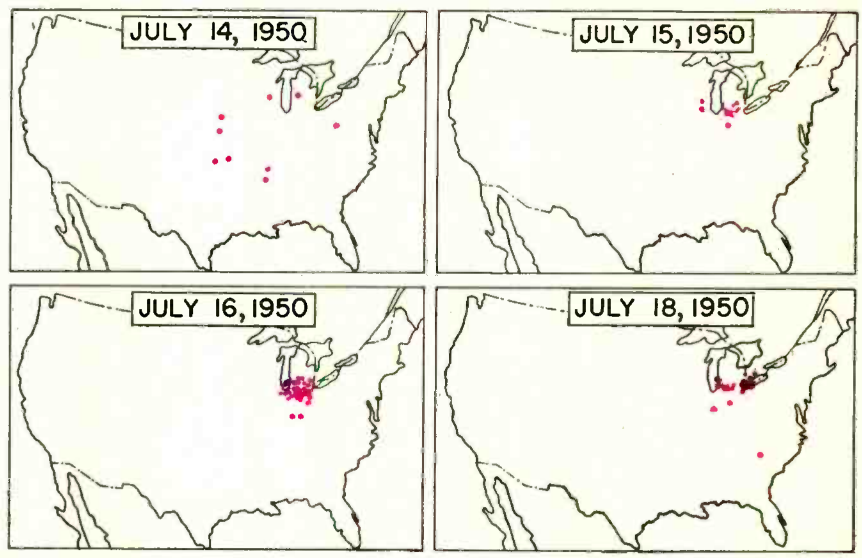



**Fig. 5—Geographical distribution of path mid-points during period of maximum low-band dx activity. Note concentration in Great Lakes area, corresponding to path of sporadic-E cloud cited by Ferrell and Gerson. See text and footnotes.**

Fig. 4 is a chart of the number of reports per day for the period (May 22 to Sept. 25). The low-band reports are plotted in the upper histogram, the few high-band reports in the lower one. The number of hours of vertical-incidence sporadic-E reflections at Washington, D. C., obtained at frequencies above 5 and 10 mc is shown in the center histogram. As the separation of the average mid-point from the Washington ionosphere sounder is almost a thousand miles, the day-by-day correlation between low-band reports and sporadic-E is about as good as could be expected. On a monthly basis, it should be noted that the greatest numbers of low-band reports occur in the months of June and July. These are also the months of greatest incidence of sporadic-E over Washington, D. C.

There are several days with an exceptionally large number of low-band reports. July 16 in particular has 40. Note in Fig. 5 that on July 16 the mid-points form a dense cluster be-

*National Bureau of Standards
Boulder, Colorado

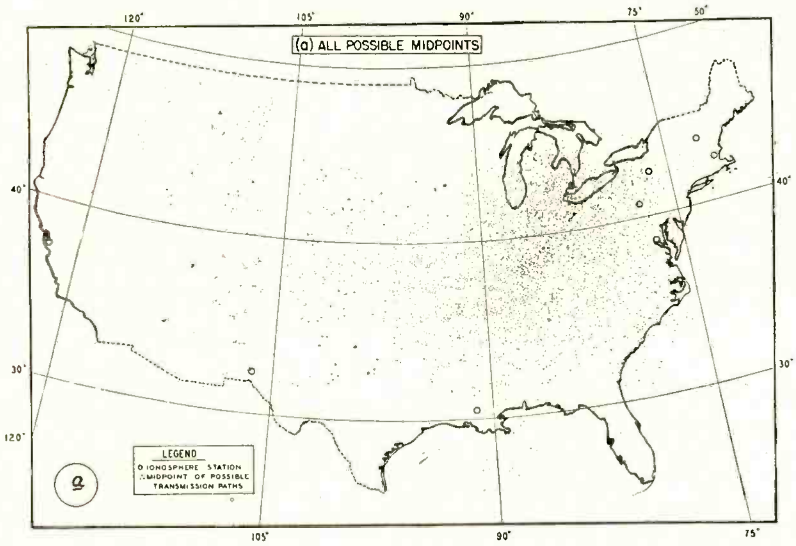
tween Lake Michigan and Lake Erie. This looks like a sporadic-E cloud of the type reported by Ferrell and Gerson[2]. The cloud appears to have persisted for about four days from July 15 through July 18.

Shown on the upper map in Fig. 6 are points representing the loci of all possible mid-points between the 103 observers and the cities in or near which the television stations are located. The circles on the two maps represent the locations of ionosphere sounding stations from which overhead sporadic-E data might be available. In the lower map the mid-points of the reported TV dx receptions are presented. Also a certain number of the mid-points seem to be located close to the Washington ionosphere sounder. Four of these fall on the same day, June 27.

The location of these four mid-points is indicated in Fig. 7 with the location of the ionosphere station at Washington. Fig. 8 is a 1-day chart of sporadic-E recorded at Washington, D. C. (solid curve), along with the occurence times for the mid-points plotted at their equivalent vertical critical frequencies. The coincidence is certainly striking.

## Summary of results

To summarize the findings then: the distribution of reception reports by distance indicates that two distinct types of propagation are indicated for transmissions greater than 200 miles. One type seems to disappear at around 500 miles, which happens to be the point at which the other type becomes noticeable. This second grouping contains about 90% of the reception reports over distances greater than 200 miles. When plotted as number of reception reports per station operating on the channel, the distribution by channel predominates in the high band for the 200- to 500-mile grouping as expected for tropospheric propagation, and decreases progressively with channel frequency for the 500- to 1,600-mile group as would be expected for sporadic-E. When compared to sporadic-E at Washington, D. C., on a day-to-day basis, the low-band reports and sporadic-E are seen to have a similar seasonal distribution. Not so the high-band reports. This is as expected, for they appear (with a single exception) in the 200- to 500-mile group. The path mid-points of the day for which the maximum number of receptions were reported are seen to form a tight cluster as they would if reflected from a slowly moving sporadic-E cloud. A coincidence test for a day when four of the reception paths over 500 miles in length resulted in mid-points near Washington, D. C., showed excellent simultaneity with observed sporadic-E in three of the four cases. END



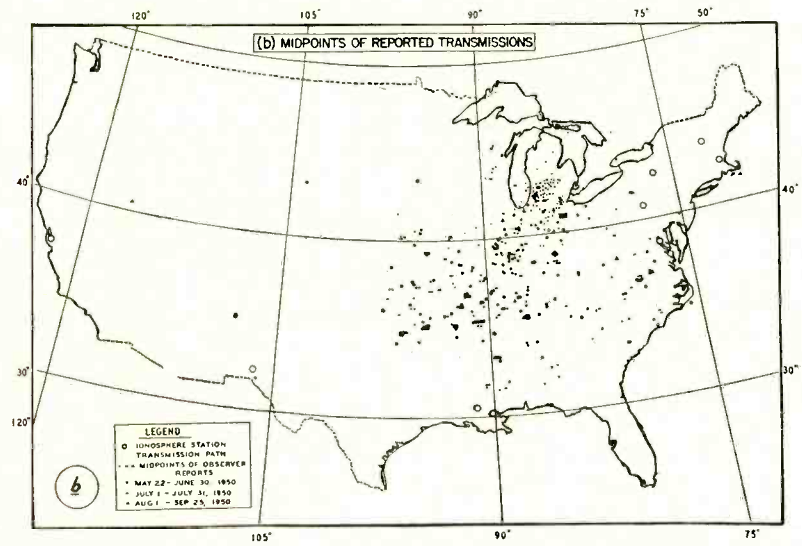




Fig. 6—(a) Locations of all possible path mid-points between dx observers and TV stations. (b) Path mid-points of actual dx receptions reported. Circles on both maps indicate the locations of U. S. Government ionosphere-sounding stations.

**List of References**

[1]For a similar chart see E. P. Tilton, RADIO-ELECTRONICS, Vol. 22, No. 8, 28 (May, 1951).

[2]O. P. Ferrell, *Proc. IRE*, 35, 493 (1947); 36, 879 (1948).
N. C. Gerson, *Nature*, 116, 316 (August 19, 1950): *Proc. Conf. Ionosph. Phys.*, Pennsylvania State College, 2, 20CC (1950).

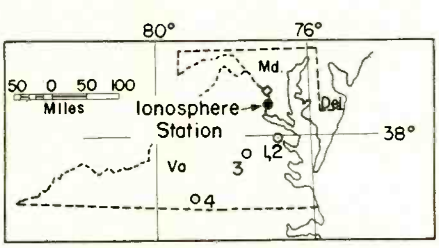
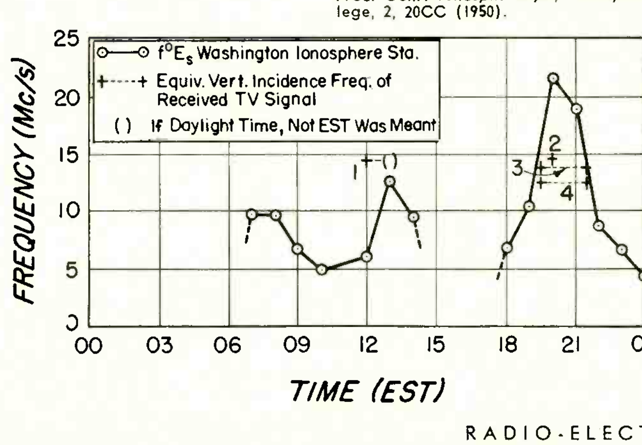



Fig. 7 (above)—Four path mid-points of TV dx reported in one day near Washington, D.C. Fig. 8 (right)—Hourly record of sporadic-E on the same day.

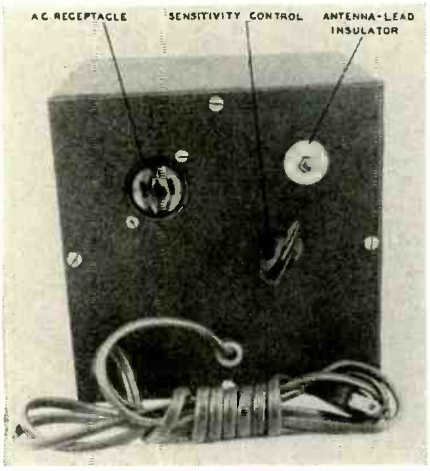


# SENSITIVE CAPACITY RELAY


The front panel of the capacity relay.

***provides protection against intrusion or accident—control of industrial operations —or just plain fun***

By E. W. SCOTT

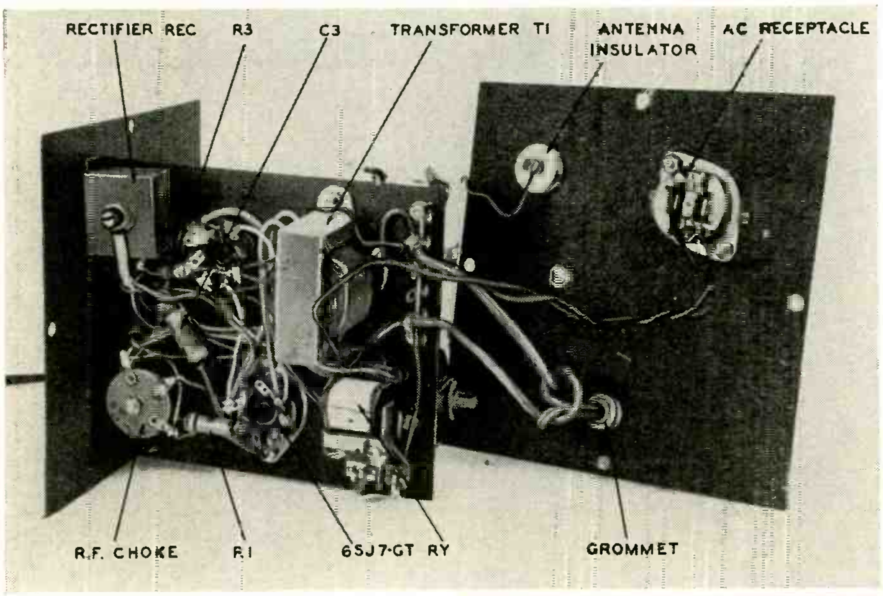


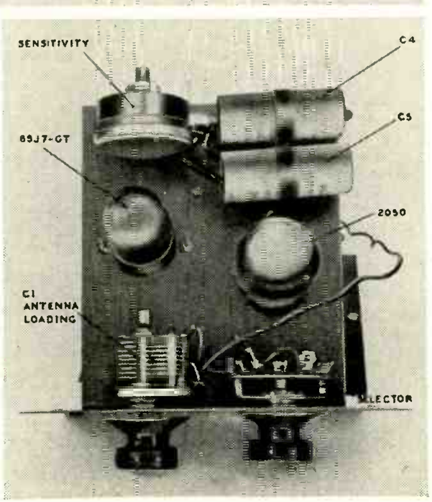

THIS inexpensive little electronic gadget can perform innumerable tasks in your home, office, plant, or store; or provide entertainment for you and your friends. Called a "capacity relay"—the home-front equivalent of a proximity fuse—it will close an electric-alarm circuit the instant any person, large animal, or any large metallic or nonmetallic object enters the electric field surrounding its antenna or "feeler."

The unit operates from standard 117-volt, 60-cycle a.c. lines, and the parts are obtainable at any well-stocked radio supply house. The foundation is a 6 x 6 x 6-inch metal utility box with attached chassis (Bud type C-1798 or equivalent). The general layout is shown in the photographs. Drill holes in the front panel for the shafts of the variable capacitor (ANTENNA LOADING control) and the rotary (SELECTOR) switch. Be sure to use an insulated bushing when mounting the variable capacitor because it must be insulated from the panel and chassis.

If the 6.3-volt filament transformer T1 and the relay RY that you purchase differ in size and shape from the ones used in this particular job, mount these components wherever they fit best. The position of these components is not critical, so any convenient spot will do. If your relay is a large one, mount it on the rear cover and connect it to the circuit with flexible hookup wire. Study the photos for the locations of the other components. If you must shift the positions of some of them, the holes for the receptacle, sensitivity control, antenna, and line cord may have to be relocated.

After mounting all the components, wire the circuit as shown in the schematic diagram (Fig. 1).




**Top photo—The back cover of the relay housing carries input and output connections and the sensitivity control. Center photo—Internal assembly of the relay unit. Large components may be mounted wherever convenient. Bottom photo—Arrangement of components and controls on the chassis top.**

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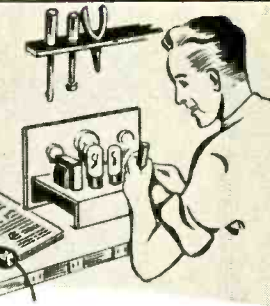

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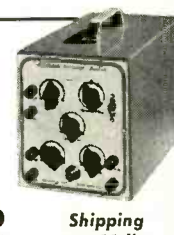

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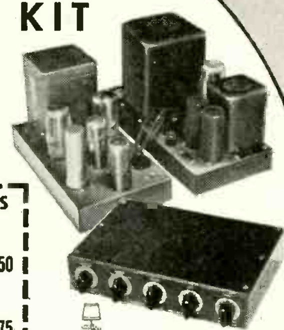

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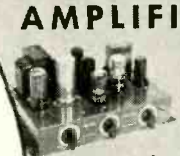

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## Adjustments

To operate the unit, plug in the line cord and plug a test lamp—an ordinary table lamp will do—into the receptacle on the rear of the relay. Throw the SELECTOR to ON. Allow about 15 seconds for the unit to warm up. The test lamp will probably come on and remain lighted for a few seconds, and then go off. Connect a length of flexible wire—about 6 feet—to the antenna terminal on the rear. Rotate the SENSITIVITY CONTROL so its arm, the No. 2 terminal, is against the No. 1 terminal. Back off the control until the relay opens and the light goes out. Now adjust the ANTENNA LOADING control slowly so the light comes on again. Back off the control a hair so the light goes off. Bring your hand near the wire and the light will come on and remain lighted until you remove your hand. Make fine adjustments with the two controls for maximum sensitivity. The light should come on when your hand is within 12 inches of the wire.

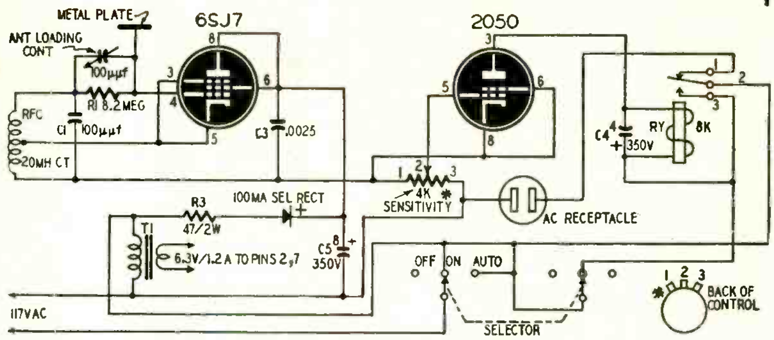


Fig. 1—Schematic of the capacity relay. Parts layout is shown in the photographs.

## Alarm circuits

Take a longer wire and form it into an inverted U around the casing of a door. Connect one end of the wire to the antenna post and adjust the loading control to the point where the light comes on. Back off the control until the light goes out again. Walk toward the door. The light should come on when you are about 4 feet away. If you must be much closer before the relay operates, make minor adjustments with the SENSITIVITY and ANTENNA LOADING controls until you get the desired sensitivity.

As long as the SELECTOR is set at ON, the light should go off when you back away from the door. To have the light remain on even after you leave the door, throw the SELECTOR to AUTO. When it is in this position, the alarm circuit will remain closed until you open it by throwing the SELECTOR to ON or OFF.

After adjusting the relay to your satisfaction, you can connect it to a doorbell alarm as shown in Fig. 2-a or 2-b. In Fig. 2-a the alarm bell is operated from the power line. If an intruder should manage to cut the power lines outside the house, the alarm will not ring. In Fig. 2-b the power for the alarm circuit comes from four No. 6 dry cells in series. If the power fails, the relay will open and start the alarm ringing.

If you are an apartment dweller in fear of having an intruder enter through a window on a fire escape, this little gadget will do much to reassure you. All you need do is place the antenna in a loop around the window casing or connect it to an ungrounded wire window screen. Connect the doorbell alarm as shown in Fig. 2 and your fears are over. In some installations, it may be possible to connect the antenna directly to the fire escape so the alarm sounds the instant anyone places a foot on it. In one installation, this device controlled a powerful spotlight and alarm bell mounted on the edge of the roof. When anyone mounted the fire-escape ladder, the bell sounded and the light lit up the entire area.

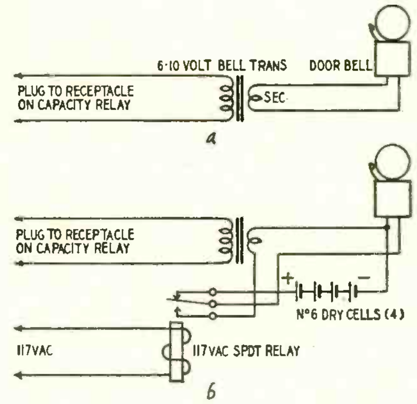


Fig. 2—(a) Bell-alarm unit for use with capacity relay. (b) Auxiliary alarm circuit. Dry cells ring alarm bell if a.c. power-line wires are cut.

### Materials for relay

**Resistors:** 1—8.2 megohms, ½ watt; 1—47 ohms, 2 watts; 1—4,000-ohm wirewound potentiometer.
**Capacitors:** 1—100 μμf, mica or ceramic; 1—.0025 μf paper; 1—4 μf, 1—8-μf, 350 volts, electrolytic; 1—100- or 140-μμf air variable.
**Miscellaneous:** 1—100-ma selenium rectifier; 1—6SJ7; 1—2050; 1 d.c.-operated relay, 8,000-ohm coil, s.p.d.t. contacts; 1—2-pole, 3-position, shorting-type selector switch; 1—6.3-volt, 1.2-amp filament transformer; 1—20-mh, center-tapped r.f. choke (J. W. Miller type 691-T or equivalent); 2 octal sockets; 1—a.c. power receptacle; cabinet; line cord and plug; terminals, hardware, wire, solder.
**Optional parts** (Fig. 2) 1—6-10-volt doorbell; 1—6-10-volt bell transformer; 4—No. 6 dry cells; 1—a.c.-operated relay, 117-volt coil, s.p.d.t. contacts; line cord and plug.

Of course, the capacity relay can be hooked up to other types of indicators, or applied as a safety device in industrial operations. For example, anyone approaching a dangerous part of a machine tool or a high-voltage electrical installation would actuate the device automatically and shut off the power.

For maximum sensitivity, the antenna should be as short as practical. For this reason, always install the relay unit as close as possible to the area to be protected. If you must use a long antenna or if you have it connected to a large metallic body, the relay may not operate properly unless you connect a 100- or 200-μμf mica capacitor in parallel with the ANTENNA LOADING control, or in series with the feeler wire. END


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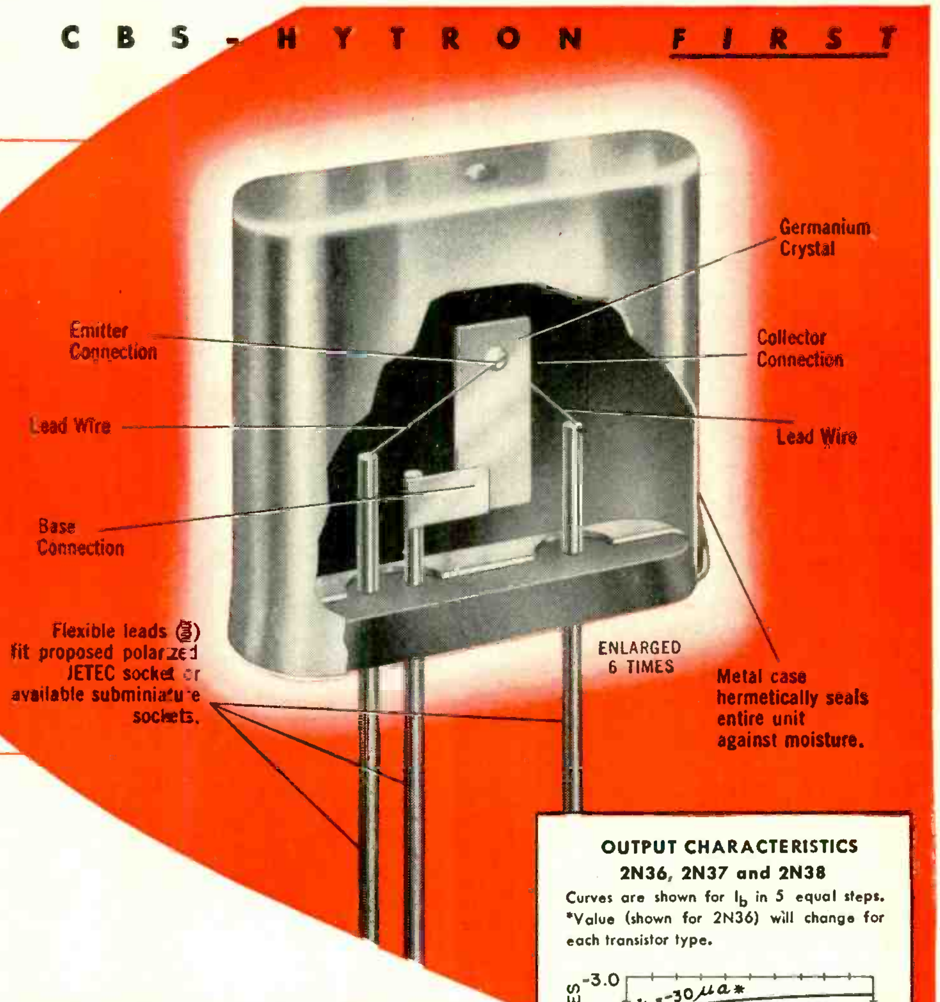


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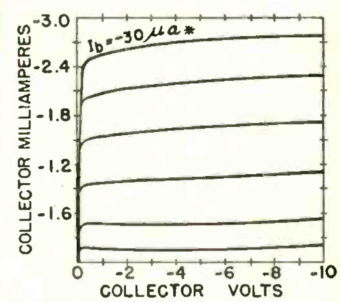


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| Characteristic | 2N36 | 2N37 | 2N38 | |
|---|---|---|---|---|
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| Collector current | —1 | —1 | —1 | ma. |
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†Typical values at 25°C. #Grounded emitter connection.

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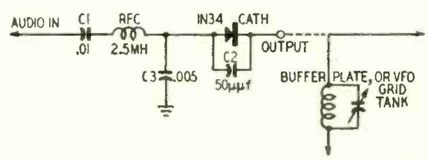
## 1N34 NBFM-PM MODULATOR

By GEORGE W. MAKI

A narrow-band FM signal that tunes and sounds like AM on an ordinary receiver is certainly most desirable. With a signal like this, the operator at the other end can tune in your carrier on the nose rather than tuning to one side and losing signal strength as he has to do with most NBFM stations. Also desirable is a simple, inexpensive modulator that provides good, understandable speech with enough punch to cut through QRM.

This germanium-diode FM-PM modulator comes closer to accomplishing this than anything that I've tried before. For the modulator all you need is an r.f. choke, three fixed capacitors, and a 1N34 diode. Of course, you'll need a speech amplifier. I used an 8-watt unit with a 600-ohm output. Its gain control was hardly ever more than one-quarter open. A speech clipper set for about 6 db is a decided advantage but the germanium-crystal modulator works well without it.

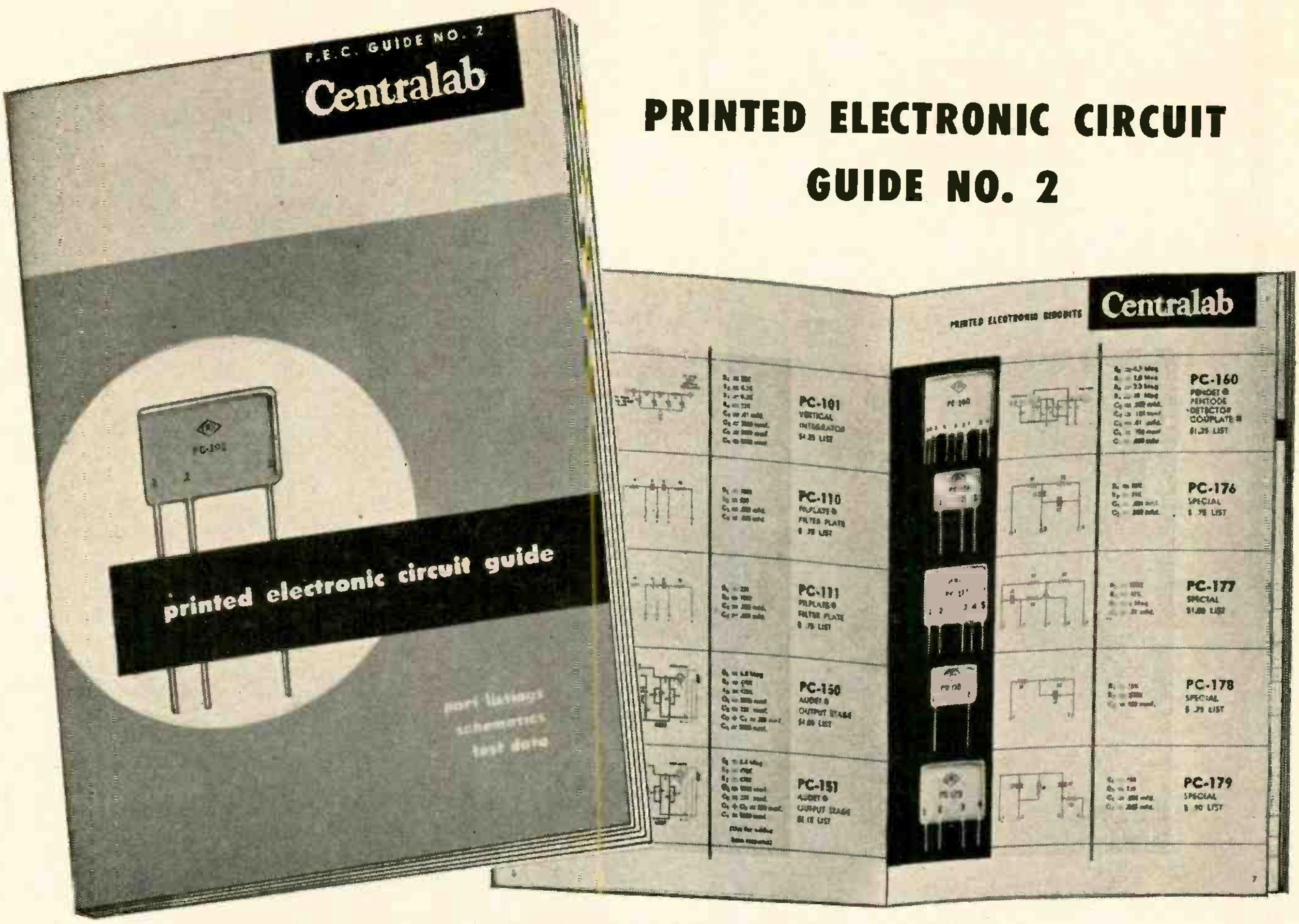



To illustrate how easily the NBFM-PM modulator can be connected to most transmitters, I pulled the driver and modulator tubes in the rig. Next, I twisted a piece of wire around the plate pin of the driver tube and pushed it back into its socket, leaving the modulator tubes out. The other end of the wire lead was connected to the audio input terminal of the diode modulator. The modulator output terminal was connected to the cathode pin of the oscillator tube in the BC-459-A used as a 40-meter v.f.o. The installation was completed by grounding the modulator to the v.f.o. chassis. Using this connection, I tried NBFM on 20. The results were quite satisfactory.

Next, I tried phase modulation (PM) by connecting the output of the crystal modulator across the plate tank of the buffer amplifier. We could not get enough swing since there was but one doubler between the buffer and the final. However, it did prove to my satisfaction that the circuit can be used successfully for PM if you have enough frequency multiplication. For 20-meter operation, you would probably have to run the oscillator and buffer in the 160-meter band.

The capacitor values are not critical. Modulation swing increases as C2 and C3 are made larger. Since these capacitors are effectively paralleled across the oscillator grid or buffer plate tank circuits (for NBFM or PM, respectively), you will have to compensate for the circuit detuning which occurs when the diode modulator is connected. The detuning is particularly noticeable by a change in the calibration of the v.f.o. END

# FREE!

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NEW DESIGN

# IRE CONVENTION 1953

By FRED SHUNAMAN
Managing Editor

THE official slogan of the 1953 National Convention of the Institute of Radio Engineers was "Radio-Electronics, a Preview of Progress." But even before the first day of the convention was over it had been displaced by the unofficial slogan, "The Year of the Transistor," which remained the real theme of the convention till the end. Though transistors were the subject of only two of the convention's 43 sessions, they kept bobbing up in audio, in television, in military equipment, and in most of the other subjects of the convention sessions.

Not only were new transistor circuits described, but also new types of transistors to use the new circuits. Some of them were so small that a whole audio amplifier—transistors, components, and all—could be installed in a 1-inch piece of medium-sized spaghetti. Others were comparative giants with cooling vanes. These ranged up to three-quarters of an inch in diameter and were capable of dissipating several watts of power.

Although transistors have barely just arrived, it's evident that they're already going places.

The transistorized convention was the biggest the Institute has ever held. More than 35,000 engineers were present, as contrasted with 28,600 last year. Six parallel sessions ran for three and a half days to read and discuss more than 200 technical papers, which in turn were divided into 43 sessions, ranging through subjects as diverse as microwave antennas and acoustics.

Most popular of all sessions were those dealing with the new theme of the convention. The first session on transistors overflowed before half the intended audience had got into the hall. It had to be repeated the next morning—coincidentally just when the overflow meeting would take pressure off the second transistor circuitry session.

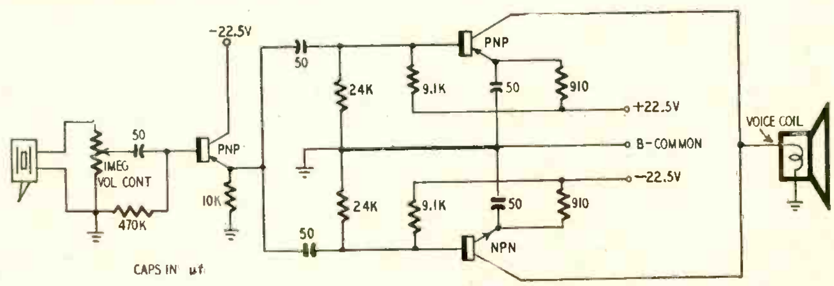
## Push-pull transistors

The most impressive new information on transistors was that on *symmetrical circuits*. Already described to a limited extent by RCA, the symmetrical circuit was the subject of a paper and a demonstration by Dr. George Sziklai of the RCA laboratories. As explained by Dr. Sziklai, the symmetrical circuit

(CONTINUED ON PAGE 72)

**Dr. George Sziklai of RCA holding model of the all-transistor audio power amplifier.**

**Fig. 1 Below—Symmetrical transistor audio amplifier. Push-pull output is obtained by feeding a p-n-p and an n-p-n transistor from a single-ended signal source. The low impedance of the power-type transistors matches the speaker voice coil, and eliminates the output transformer. Note the different symbols for n-p-n and p-n-p transistors.**

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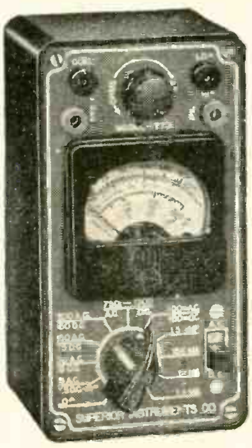

*Superior's new model 770* AN ACCURATE POCKET-SIZE

# VOLT-OHM MILLIAMMETER
(SENSITIVITY—1000 OHMS PER VOLT)

FEATURES:

★ Compact—measures 3⅛" x 5⅞" x 2¼".

★ Uses latest design 2% accurate 1 Mil. D'Arsonval type meter.

★ Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range.

★ Housed in round-cornered, molded case.

★ Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

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

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES: 0—15/30/150/300/1500/3000 VOLTS

6 D.C. VOLTAGE RANGES: 0—7.5/15/75/150/750/1500 VOLTS

4 D.C. CURRENT RANGES: 0—1.5/15/150 MA. 0—1.5 AMPS.

2 RESISTANCE RANGES: 0—500 OHMS 0—1 MEGOHM

**$14.90 NET**

Measures 6¼" x 9½" x 4½"

*Superior's new Model 670-A*

# SUPER METER
*A COMBINATION* VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

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

ADDED FEATURE:

**The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.**

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

**$28.40 NET**

*Superior's new Model TV-11*

# TUBE TESTER
SPECIFICATIONS:

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

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

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

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

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

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

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

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

**$47.50 NET**

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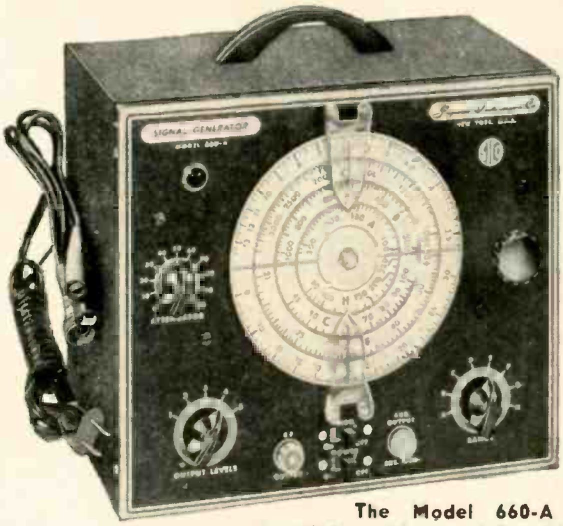


*Superior's New Model 660-A* **AN AC OPERATED**

## SIGNAL GENERATOR

***PROVIDES COMPLETE COVERAGE for AM-FM & TV Alignment***

**SPECIFICATIONS:**

● Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. ● Accuracy and Stability are assured by the use of permeability trimmed Hi-Q coils. ● R.F. available separately or modulated by the internal audio oscillator. — Built in 400 cycle sine wave audio oscillator used to modulate the R.F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. ● R.F. Oscillator Circuit: A high transconductance heptode is used as an R.F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. ● A.F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a High-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. ● Attenuator: A 5 step ladder type of attenuator is used.

**The Model 660-A comes complete with coaxial cable test lead and instructions.**

Tubes used: 1—6BE6 as R.F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier.

**$42.95 NET**

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**Superior's New**

## TELEVISION BAR GENERATOR

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Two Simple Steps

1. Connect Bar Generator to Antenna Post of any TV Receiver.
2. Plug Line Cord into A.C. Outlet and Throw Switch.

**Result:** A stable never-shifting vertical or horizontal pattern projected on the screen of the TV receiver under test.

**FEATURES:**

1. Provides linear pattern to adjust VERTICAL linearity, height, centering.
2. Provides linear pattern to adjust HORIZONTAL drive, width, peaking, linearity, centering.
3. Provides vertical sweep signal for adjusting and synchronizing vertical oscillator discharge and output tubes.
4. Provides vertical signal to replace vertical oscillator to check vertical amplifier operation.
5. Provides horizontal sweep signal for adjusting and synchronizing horizontal oscillator A.F.C. and output tubes.
6. Provides horizontal sweep signal to check H.V. section of fly-back and pulse operating power supplies.
7. Provides signal for testing video amplifiers.
8. Can be used when no stations are on the air.

**SPECIFICATIONS:**

Power Supply: 105-125 Volt 60 Cycles
Power Consumption: 20 Watts
Channels: 2-5 on panel, 7-13 by harmonics
Horizontal lines: 4 to 12 (Variable)
Vertical lines: 12 (Fixed)
Vertical sweep output: 60 Cycles
Horizontal sweep output: 15,750 Cycles

**TV BAR GENERATOR COMES COMPLETE WITH SHIELDED LEADS AND DETAILED OPERATING INSTRUCTIONS. ONLY**

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☐ MODEL 660-A ........................ Total Price $42.95
$12.95 down payment. Balance $5.00 monthly for 6 months.

☐ I enclose $.................. as down payment.

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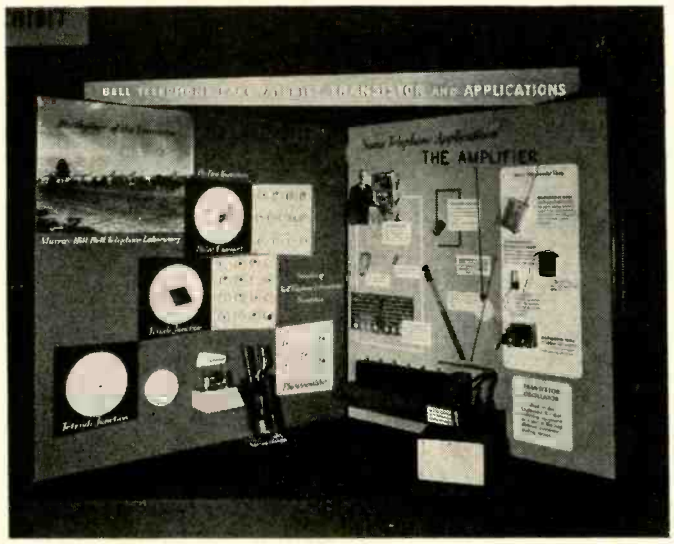


**Part of Bell Telephone Laboratories' transistor exhibit at the 1953 I.R.E. convention. The tiny amplifier described in the text is circled at the right.**

is based on two dissimilar junction transistors. One is an n-p-n unit, a junction transistor with the ends negative and the narrow central "base" positive. The other is a p-n-p transistor. If these two are hooked up with their inputs in parallel, the output is push-pull. (See Fig. 1.)

These stages can be cascaded, said Dr. Sziklai, by varying the three fundamental ways (grounded-base, grounded-emitter and grounded-collector) in which a transistor can be hooked up. An amplifier which contains practically nothing but the transistors and their batteries can thus be constructed. He demonstrated a six-transistor amplifier which dispensed even with the output transformer, feeding direct into the voice coil of a speaker and supplying music loud enough for dancing. Dr. Sziklai was also co-author of a paper which showed how transistors can be used in many sections of a television receiver.

Another transistor amplifier — intended for telephone use—was exhibited by Bell Laboratories. Little larger than a match, it occupied (with 11 other components) a piece of cable about ⅓ inch in diameter and less than 2 inches long. It was designed to replace a 2-inch section of conductor in multiple telephone cable. Power for the transistor amplifiers can be carried easily by one of the conductors in the cable, and their small size would permit their insertion at many points where vacuum-tube amplifiers are now impractical. This should make it possible to improve the quality of telephone transmission over many existing and future circuits.

Transistor receivers and transmitters were exhibited by RCA and General Electric Co. Frequency meters, Geiger counters, and a display of printed circuits for further miniaturization and ruggedization of transistor equipment were displayed by the Signal Corps. Raytheon showed seven brands of hearing aids using Raytheon junction transistors, and Bell Laboratories exhibited (along with the match-sized amplifier) transistor telephone-dialing equipment and three experimental transmitters, one an FM job.

**Professor Grant Fairbanks (left) and Dean W. L. Everitt of the University of Illinois, demonstrate the "speech compressor".**

**General Electric's new hermetically-sealed junction transistor operates even in boiling water. J. H. Sweeney and Conrad H. Zierdt, Jr. of G-E demonstrate the new transistor in a miniature transmitter atop the coffee-maker kettle.**


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# SYLVANIA

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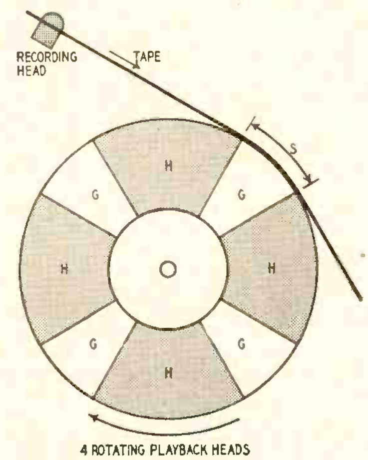
### A speech compressor

Leaving transistors (with difficulty) the visitor noted few of the startling disclosures and devices of earlier meetings. No radio to the moon, no dx microwave transmission. The emphasis was on solid progress along lines already partly explored. One of the most important innovations was the internal-magnetic-focus TV tube, in which both the ion-trap and the focus magnets are inside the tube. This tube was announced in last month's RADIO-ELECTRONICS and is discussed elsewhere in this issue.

Another new instrument was the speech compressor described by Grant Fairbanks, W. L. Everitt, and R. P. Jaeger of the University of Illinois. This device is as simple in construction as it is remarkable in operation. It is a machine which will take 10 minutes of speech or music, and turn out a tape which can be played back in a shorter time—say 8 minutes—with no apparent change in the frequencies or other characteristics of the original speech or music.




H-HEAD; S-SECTION OF TAPE NOT RE-RECORDED; G-GAP BETWEEN HEADS

**Fig. 2—Basic mechanism of the "speech compressor" developed at the University of Illinois. The rotating playback head contains four pickup units which move in the same direction as the tape, but at a lower speed. Program material picked up by the heads is re-recorded on a second tape. Original program in gaps between pickup heads is not re-recorded, thus cutting playback time.**

Tape editors know that pieces can be cut from a tape—preferably between words but even in the middle of long vowels—when it is necessary to shorten a recording. If the pieces cut out are short enough, they have no effect on the intelligibility of the final record. This principle is used in multiplex telephony, where the system is known as "sampling" (RADIO-ELECTRONICS, February, 1948).

Researchers in a psychology project at the University of Illinois had been studying certain aspects of speech by a method which required snipping little pieces out of the tape at regular short intervals. Cutting the tape by hand was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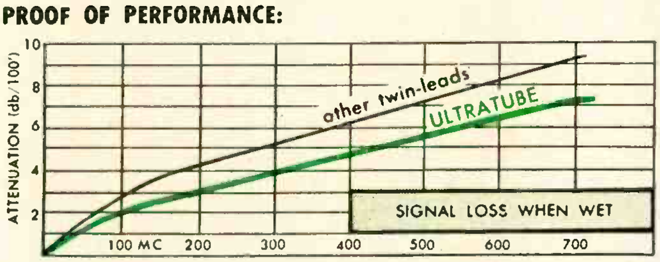


ULTRATUBE and other twin-lead constructions were tested under both wet and dry conditions. The data clearly show that for clear, strong signals under adverse weather conditions, no transmission line gives better reception than Synkote ULTRATUBE.

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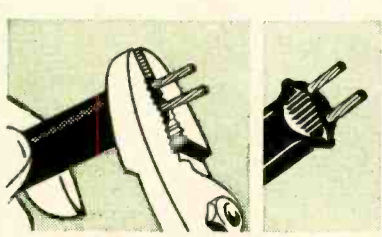

## For Unexcelled UHF Transmission Under All Weather Conditions

Look at this cross-section of Synkote "ULTRATUBE". Note how the conductors are spaced equidistant from the outer insulation by *several millimeters.* This means that no matter how encrusted with salt or moisture the insulation becomes, the magnetic field between the two leads is practically unaffected — and signal strength is undiminished all the way down the line. For UHF — for better VHF — for fringe area reception, — there's nothing finer than Synkote "ULTRATUBE"!

Ask your Plastoid representative for samples of Synkote "ULTRATUBE" — for ultra-high frequency but *not* at ultra-high prices. Catalog No. PP 4911.

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## NEW DESIGN

slow and difficult work, and they sought a way of doing it automatically. The result of their search was a machine which does far more than they had originally expected.

The instrument is a much modified tape recorder. It has a standard recording head, on which a tape can be recorded in the usual way. This tape then passes over a *rotating* playback unit. The signal picked off the tape by this playback unit is not fed to a loudspeaker, but recorded on a second tape.

It is the rotating playback unit that does the compressing. It carries four playback heads (Fig. 2) so that one of them is in contact with the tape nearly all the time. If this unit is kept stationary, so that a single playback unit is in contact with the tape, it will act like a standard head, and the program on the second tape will be a faithful reproduction of the first. If it revolves at the same speed as the tape, there will be no *relative motion* of tape with respect to the head (the tape will be stationary as far as the head is concerned), and nothing will be recorded. But, if the unit revolves slowly in the direction of the tape, the effect is just the same as if the tape is slowed down. For instance, if it moves one-fifth as fast as the tape, it will take any part of the tape 20% longer to pass the head. Four-fifths of an inch of recording on the original tape will then be recorded over a full inch of the second one. Of course, the frequencies of the voice and music recorded on the second tape also will be 20% lower than on the original one.

When one of the four heads reaches that point in its rotation where it leaves the tape, the one behind it comes into contact with the tape and starts recording, so the recording of the second tape is uninterrupted. But there is a slight gap in the first tape between the point where one of the heads cuts out and the next takes over, so that regularly spaced little bits of the first tape will not be recorded on the second tape. These bits are effectively "cut out" of the tape.

Now if tape No. 2 is speeded up and played back in four-fifths of the time


"I *told* you television wasn't here to stay."


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it took to record, the lowered tones come back to the original frequencies, and the replay takes 20% less time than the original recording. The space discarded on the first tape is turned into discarded time on the second one.

The compressor is likely to be a godsend to radio directors faced with programs that run over appointed time. It will have a use also in speeding up military messages, and at the same time make them harder to read. Worked in reverse as a "speech stretcher," it will enable students of foreign languages or musical compositions to slow down their subject matter without changing the frequencies of the original.

### Everybody's TV transmitter

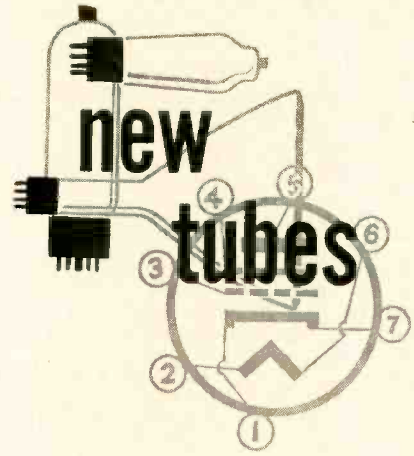
Television was the subject of a number of sessions in the convention, but the most impressive TV development described used no new principles, but rather made old ones available in a new and ingenious way. This was a midget television camera that can make any home television receiver into a closed-circuit TV system. It includes a control box with a number of plugs which fit in certain tube sockets on an ordinary TV receiver.

The camera can be set up near a child's crib, in a nursery, or even pointing at the glass door of the kitchen oven. A switch on the receiver enables the viewer to watch either regular TV programs or the scene on which the camera is trained. Thus a housewife could watch TV while making sure that everything was normal in the nursery (or that the roast was progressing normally) by switching to closed-circuit every few minutes.

Dr. Zworykin, who considered the device important enough to present in person, said that though the research laboratory could not guess how soon the device might be placed on the market, or what the price would be, he could see no reason why the cost of the control unit and camera should be greater than that of the TV receiver itself.

The applications to education, business, and low-cost industrial uses are almost too obvious to need mention. Dr. Zworykin mentioned especially the small shop or store, where the sole proprietor might be doing work away from the store area (for example, at a service bench). The viewer could keep him informed of all customers, saving needless trips to the front of the store.

Speech stretchers, home-TV closed-circuit systems, and internal-focus picture tubes made the greatest impression on the less scientific of the convention's visitors. Engineers and physicists were attracted even more by information theory, computer problems, telemetry, and instrumentation. Acoustics and medical electronics also received more attention than at any previous convention. While nothing startling came out of any of those sessions, it is safe to say that they are the groundwork for new discoveries and new inventions that will be announced at future IRE meetings. END

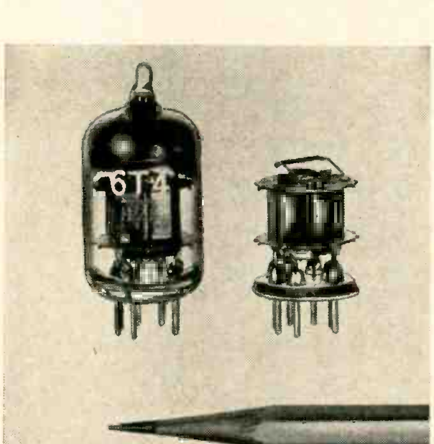



HERE are additional details on the new G-E internal-magnetic-focus picture tube described in the "Radio Month" column of the May issue. The first type in production—the 21JP4—is an all-glass rectangular tube with standard 70° deflection and a 19⅛ x 13⅞-inch picture. The 21JP4 has an external conductive coating and standard 5-pin duodecal basing. The maximum ultor-voltage rating is 20,000, but the value recommended for TV operation is 14,000 ± 2,000 volts. The built-in Alnico-V focusing and ion-trap magnets will give optimum spot size and brightness over this range.

A small magnetic shunt can be mounted on the neck of the picture tube for extremely critical focusing, or for operation at ultor voltages higher or lower than the recommended values.

The 5AW4 announced last month by CBS-Hytron is a full-wave, filament-type rectifier intended as an extra-heavy-duty replacement for the 5U4-G. In addition to higher average and peak current ratings than the 5U4-G, the 5AW4 has a heavier filament and a new plate structure which reduces the possibility of plate-filament shorts when the set is operated on its side. Tentative ratings of the 5AW4 are: Filament, 5 volts at 4 amp; average d.c. output current, 250 ma max.; peak d.c. output current, 750 ma.

Both CBS-Hytron and Sylvania have announced the 6T4, a 7-pin miniature




6T4 miniature u.h.f. oscillator triode.

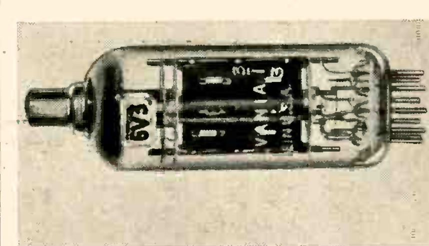
triode oscillator for u.h.f. television receivers. The 6T4 can deliver 160 mw at 950 mc with 100 volts on the plate and 4 volts of bias across a 10,000-ohm grid leak. Plate current under these conditions is 22 ma, and grid current 0.4 ma. The 6T4 has a 6.3-volt, 0.225-amp heater. Basing is given in the accompanying diagram.

Relief from u.h.f.-converter interference may be in sight with the introduction of the 6AJ4 u.h.f. amplifier triode. The 6AJ4, announced by General Electric, Raytheon, and other manufacturers, is a 9-pin miniature grounded-grid amplifier with a power gain of 7 db and a noise figure of 15 db at 900 mc.

G-E 6AJ4 grounded-grid u.h.f. triode.

Recommended operating conditions and characteristics in u.h.f.-amplifier service: Plate voltage, 125; plate current, 16 ma; cathode resistor, 68 ohms; gm, 10,000 μmhos; μ, 42; plate resistance, 4,200 ohms (approx.); bandwidth, 10 mc. In u.h.f. service all five grid pins (see basing diagram) should be grounded to reduce lead inductance.

The Sylvania 6V3 is a new 9-pin miniature damper tube that has been incorporated in several late 1952 and 1953 TV receivers. The 6V3 has exceptionally high heater-cathode insulation (6,750 volts peak) made possible by bringing the cathode connection to a top cap, to handle the large-amplitude

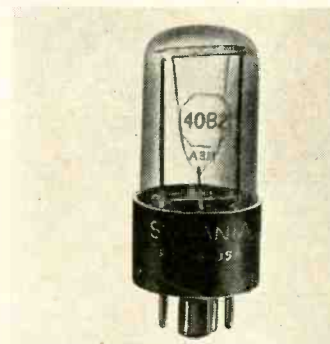


Sylvania 6V3 miniature damper diode.

flyback pulses in modern high-efficiency horizontal sweep circuits. Heater rating is 6.3 volts at 1.75 amp, and the 6V3 can supply a boosted B plus load of 135 ma. See the accompanying diagram for base connections.

Sylvania has introduced a new horizontal-deflection stabilizer tube—the 40B2—with different current and voltage ratings than the earlier 40A1. These tubes contain a special nonlinear resistance element which can be used

as the cathode resistor of the horizontal output tube. The nonlinear resistance characteristic holds the total cathode current constant over a wide range of line-voltage variations. This stabilizes the horizontal sweep and high-voltage outputs, and makes it possible to get full picture width and brightness at low line voltage without exceeding the maximum ratings of the output tube when the line voltage is normal or high. The 40B2 is designed to maintain an average current of 150 ma at a 40-volt drop. Both types have a 5-pin octal



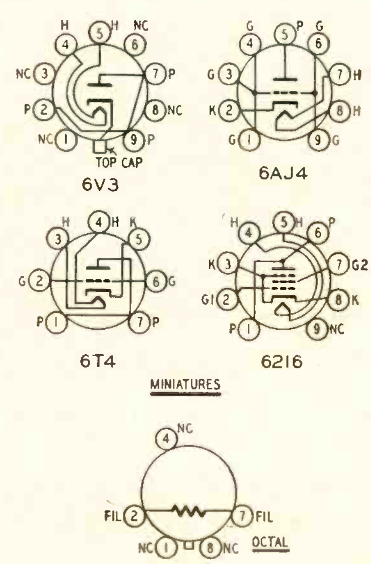

Sylvania 40B2 sweep-regulator tube.

base, with the resistance element connected to pins 2 and 7.

### Special-purpose tubes

Du Mont announces two new 10-stage photomultiplier tubes of special value in nuclear-physics work. The 6291 and 6292 have identical straight-line dynode structures which give maximum physical separation between photocathode and anode, and differ only in diameter.

The new photomultipliers are designed to have higher stability over long periods than previous types, through the use of silver-magnesium for the dynode elements and improvements in the internal structure. The photocathode has an average sensitivity

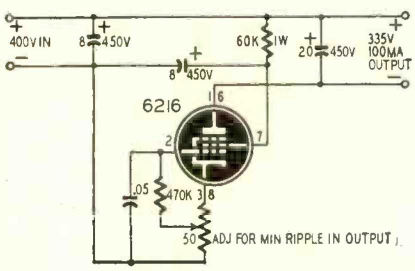



Basing diagrams of new tube types.

of 60 μamp per lumen, with maximum response in the visible portion of the light spectrum.

While their small size (the 6291 is only 1½ inches and the 6292 is 2 inches in diameter) makes them specially suitable for portable scintillation counters, the new tubes have numerous other applications in astronomy, biology, and industrial electronic equipment. Where maximum gain is the prime requirement the tubes can be operated at dynode potentials as high as 190 volts per stage.

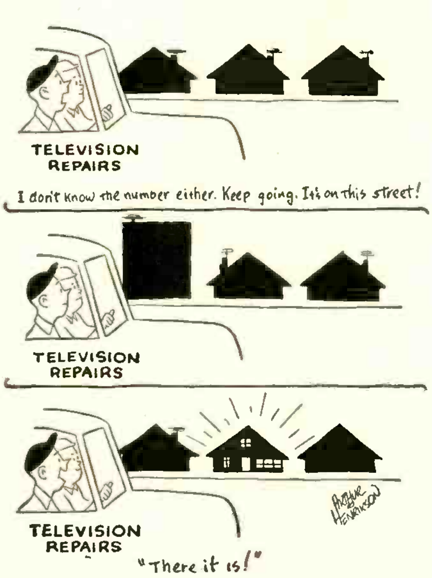
The CBS-Hytron 6216 is a new 9-pin miniature beam-power amplifier developed primarily as a filter-reactor tube for airborne and mobile equipment. In the circuit shown it provides the same filtering as a 12-henry, 100-ma, iron-core choke with a d.c. resistance of 350 ohms, at a tremendous saving in weight and space. These characteristics may also make it popular in TV receiver circuits which use the audio output tube as a combined dropping resistor and isolating filter between the full B supply voltage and the 135-volt line to the i.f.'s and other stages.




Circuit for 6126 filter-reactor tube.

The 6216 has a 6.3-volt, 1.2-amp heater, with maximum heater-cathode rating of 150 volts. The output ripple in the filter-reactor circuit shown is approximately 210 mv.

The 6216 can also be used as an audio amplifier, class-C oscillator-amplifier, or frequency multiplier. Basing is shown in the diagram. END



## NEW YORK SEES FILMS

Members of the Associated Radio-Television Servicemen of New York (City) heard preliminary plans for an extended educational program for the city, state, and possibly national organization at a well attended meeting Thursday, April 16.

During the meeting Zenith representatives showed two films, "Fog Over Portland", summary of the difficulties which accompanied the commencement of commercial u.h.f. TV broadcasting in the United States, and "Phonevision", a descriptive piece showing how Zenith's proposed subscription TV system would work.

## EASTERN GROUPS MEET

A two-day conference of TV service group representatives was held April 11 and 12 at Paterson, N. J. The conference was organized by a joint meeting (at Trenton, March 8) of representatives of the National Electronics and Service Dealers Associations (NETSDA), the Federation of Radio Servicemen's Associations of Pennsylvania (FRSAP) and the Radio Associations of New Jersey (RANJ).

The conference was attended by more than 30 delegates and visitors, and discussed such problems as flat-rate racketeering competition, retail sales by jobbers, the service contract, licensing for control or revenue, and other points of importance to the service dealer. Papers on business insurance, credit bureaus and u.h.f. were heard by the assembled service dealers.

The April 12 meeting passed resolutions urging the establishment of local associations; interchange of information through such associations; and establishing a plan for a sustained public relations program, to be drafted by the conference secretary. The broadcasting industry was thanked for the favorable notice taken of the television service industry by broadcasters, and an expression of appreciation was drafted to the New Jersey group and the Tennessee delegates for their actions in laying the groundwork for association federation in their states.

## LICENSE BILL IN PA.

A new proposal to license radio and TV technicians has been introduced in the State Legislature by Representative Vincent F. Guttendorf of Luzerne.

Two bills were introduced. Under the terms of HB 838, a state board of examiners of radio and TV service technicians would be set up and their duties defined. A companion bill, HB 839, would regulate TV and radio service.

According to Dave Krantz, chairman of the Federation of Radio Servicemen's Associations of Pennsylvania, the new bill is an improvement on one presented to the Legislature last year but not acted on, in that it provides for more participation by the service technicians and more representation by them on boards established by the acts. The State Federation is supporting the bills, Mr. Krantz stated.

## WITH THE TECHNICIAN

### AGAINST LICENSING

The Northeast Television Service Dealers Association of Philadelphia has rejected the pending state bill to license TV technicians. Mr. Albert Haas, spokesman for the group, stated that the bill, HB 839, had been read at a meeting, and that the members felt there were too many loopholes in the wording.

### U.H.F. PROBLEM

The manner in which the local u.h.f. situation was being used for advertising purposes was the subject of the March meeting of the Radio and Television Association of Springfield and Vicinity (Ohio).

A letter pointing out the difficulties of the dealer and technician faced with the problem of selling sets in spite of alarmist statements about color and misleading claims on indoor antennas was sent to local distributors, newspapers, broadcast stations, and chambers of commerce. It summarized the situation existing at the time (March) and offered the following suggestions to local advertisers and publishers or broadcasters of advertising copy:

1. Keep to the facts!
2. U.h.f. is not here (in Springfield—*Editor*) today.
3. Stop keeping the public in suspense by saying it's "gonna" be on anytime now; give us a specific date instead.
4. Think of your numerous fringe viewers. Remind them that built-in antennas are for metropolitan use only, and usually not effective 25 miles from the station.
5. When advertising u.h.f. sets, antennas, attachments etc., state calculated coverage also.
6. Refrain from advertising "trouble-free TV", but instead inform the viewer that maintenance (don't call it repair) will be necessary on a TV set and amounts to a yearly average of about $40.00 (estimated).
7. For such maintenance, refer the viewer to a franchised dealer. Warn him to stay away from wildcat outfits which have neither the capital nor the equipment to do a serious job, and usually get their victims by advertising night and Sunday service, often at ridiculously low fees.

### ESFETA ELECTS

The annual meeting of the Empire State Federation of Electronic Technicians took place at Binghamton, N. Y., April 19.

The new slate of officers is: Max Leibowitz, ARTSNY, New York City, president; Jack Wheaton, Long Island Radio Technicians Guild, vice-president; Chas. Kohl, UETA, Kingston, treasurer; Wayne Shaw, RSA, Binghamton, secretary; and Andrew Wentworth, RTG, Rochester, sergeant-at-arms.

Organizational and other problems were discussed, and arrangements made for a technical lecture program, to include material on transistors, u.h.f. and color TV.

## NEW CHICAGO GROUP

More than 100 service firms meeting in Chicago March 19 agreed to contribute 1% of their wholesale parts purchases toward a Greater Chicago consumer education campaign. Each of the firms also agreed to set aside $10 as an annual membership fee in a new organization, which was not given a name at the meeting.

A rough draft of the campaign, worked out by a Chicago advertising agency, was presented to the meeting. Details of the campaign, it was stated, would not be worked out till it becomes clear how much money would be available for the work. No actual cost figures were presented, but it was understood that the temporary officers of the group were thinking in terms of an annual cost of $200,000 to $250,000 for the campaign.

## NATESA CONVENTION

The Natesa Convention and Exhibition at Kansas City, April 10-12, was attended by just under 500 people, who registered from 35 states and more than 60 cities.

Thirty exhibitors had large display booths of various types of equipment and working exhibits. There were addresses by John Thompson of G-E, Frank Mansfield of Sylvania, Lloyd Austin of Simpson Electric, Harold Rieth of Regency, Robert Artman of Empire Coil, Larry Kearney of La-Pointe Electronics, Chet Jur of Merit, Al Saunders of Saunders Radio and Electronic School (Boston), and Louis Calamaras of NEDA.

A very comprehensive business meeting was held, at which the subject of consumer relations was explored fully. A plan was established to obtain the cooperation of public utilities in the consumer relations program. The services of the FTC are to be enlisted to establish definitions and practices for the service trades. The theme of the convention was "Reciprocal Co-operation".

Arrangements are in progress for the September convention to be held in the city of Chicago.

## EMERGENCY CALLS

According to Penny Martin, of the Television Service Association, Pittsburgh, Pa., the new Pittsburgh telephone directories will list the following emergency calls:

FIRE — POLICE
DOCTOR — TV REPAIRMAN

## NEW JERSEY COUNCIL

TV service organizations met on the evening of Saturday, April 11, to form the New Jersey Council of Television Service Associations, as the nucleus for a state-wide group to assist local associations in public relations, education and legislation. A steering committee composed of Harold B. (Dusty) Rhodes, Paterson, Roger K. Haines, Haddonfield, and David Van Nest, Trenton, was appointed to get the new state council under way. The N. J. groups were attending the Paterson conference.

END

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- NO ADDITIONAL PARTS NEEDED
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The Progressive Radio "Edu-Kit" offers you a home study course at a rock bottom price. Our Kit is designed to train Radio Technicians, with the basic facts of Radio Theory and Construction Practice expressed simply and clearly. You will gain a knowledge of basic Radio Principles involved in Radio Reception, Radio Transmission and Audio Amplification.

You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio circuit schematics; how to mount various radio parts; how to wire and solder in a professional manner. You will learn how to operate Receivers, Transmitters, and Audio Amplifiers. You will learn how to service and trouble-shoot radios. You will learn code. You will receive training for F.C.C. license.

In brief, you will receive a basic education in Radio exactly like the kind you would expect to receive in a Radio Course costing several hundreds of dollars.

## THE KIT FOR EVERYONE

The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The Kit has been used successfully by young and old in all parts of the world. It is not necessary that you have even the slightest background in science or radio.

The Progressive Radio "Edu-Kit" is used by many Radio Schools and Clubs in this country and abroad. It is used by the Veterans Administration for Vocational Guidance and Training.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. All parts are individually boxed, and identified by name, photograph and diagram. Every step involved in building these sets is carefully explained. You cannot make a mistake.

## PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" comes complete with instructions. These instructions are arranged in a clear, simple and progressive manner. The theory of Radio Transmission, Radio Reception, Audio Amplification and servicing by Signal Tracing is clearly explained. Every part is identified by photograph and diagram. You will learn the function and theory of every part used.

The Progressive Radio "Edu-Kit" uses the principle of "Learn by Doing". Therefore you will build radios to illustrate the principles which you learn. These radios are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced radio sets, and doing work like a professional Radio Technician. Altogether you will build fifteen radios, including Receivers, Transmitters, Amplifiers, Code Oscillator and Signal Tracer.

## The Progressive Radio "EDU-KIT" Is Complete

You will receive every part necessary to build 15 different radio sets. Our kits contain tubes, tube sockets, chassis, variable condensers, electrolytic condensers, mica condensers, paper condensers, resistors, line cords, selenium rectifiers, tie strips, coils, hardware, tubing, hook-up wire, solder, etc.

Every part that you need is included. These parts are individually packaged, so that you can easily identify every item. Tools are included, as well as an Electrical and Radio Tester. Complete, easy-to-follow instructions are provided.

In addition, the "Edu-Kit" now contains lessons for servicing with the Progressive Signal Tracer, F.C.C. instructions, quizzes. The "Edu-Kit" is a complete radio course, down to the smallest detail.

## TROUBLE-SHOOTING LESSONS

Trouble-shooting and servicing are included. You will be taught to recognize and repair troubles. You will build and learn to operate a professional Signal Tracer. You receive an Electrical and Radio Tester, and learn to use it for radio repairs. While you are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge fees which will far exceed the cost of the "Edu-Kit". Here is your opportunity to learn radio quickly and easily, and have others pay for it. Our Consultation Service will help you with any technical problems which you may have.

## FREE EXTRAS IN 1953

- ELECTRICAL AND RADIO TESTER
- ELECTRIC SOLDERING IRON
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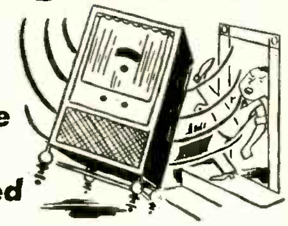
# IT'S A SHAME

**to throw away that beautiful old Console . . . *replace the obsolete radio with a modern, easily-installed***



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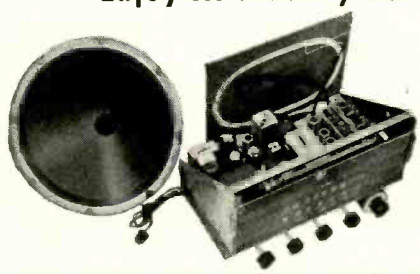

**It is not necessary to spend a large sum of money to modernize your old radio or to became a "High Fidelity" enthusiast. ESPEY chassis provide the Highest Quality at moderate prices.**

**Fully licensed under RCA and Hazeltine patents. The photo shows the Espey Model 511-C, supplied ready to play. Equipped with tubes, antenna, speaker, and all necessary hardware for mounting.**

NEW FEATURES—Improved Frequency modulation circuit, drift compensated • 12 tubes plus rectifier, and pre-amplifier 12AT7 tube • 4 dual purpose tubes • High quality AM-FM reception • Push-pull beam power audio output 10 watts • Switch for easy changing to crystal or variable reluctance pick-ups • Multi-tap audio output transformer supplying 3.2—8—500 ohms.

***Makers of fine radios since 1928.***

Write Dept. RE-6 for literature and complete specifications on Model 511-C and others.

**ESPEY MANUFACTURING COMPANY, INC.**

**528 EAST 72nd STREET, NEW YORK 21, N. Y.**

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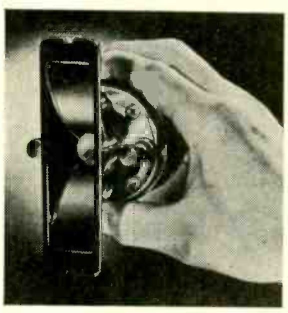
## NEW AUDIO COMPONENTS

Sargent-Rayment Co., 1401 Middle Harbor Rd., Oakland, Calif., has added four new items to its "building-block" series of high-fidelity audio components. The new units are the SR-68 AM-FM tuner, the SR-58 AM tuner, SR-38 phono preamplifier and

tone control, and the SR-9 *Ultra-Linear* Williamson-type power amplifier. Full specifications on these and previously announced components in the line can be obtained from the manufacturer.

## NEW ELECTRO-VOICE TWEETER

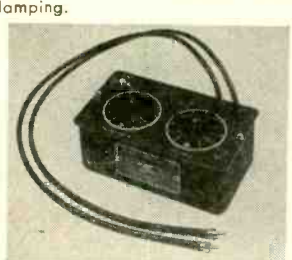
Electro-Voice, Inc., Buchanan, Mich., has developed the new T-35 high-frequency driver unit and diffraction horn. The tweeter may be used with sound systems handling up to 40 watts. The voice-coil impedance is 16 ohms, potentiometer diameter is 2½ inches, overall depth 3¼ inches, weight 2



pounds. The horn cutoff is at 1,500 cycles. The driver takes over from 3,500 cycles to the limits of audibility. The AT-37 level control and X-36-1 crossover network may be used to connect the T-35 to existing high-fidelity systems.

## SPEAKER CROSSOVER

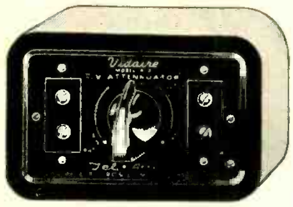
Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., is offering a variable speaker crossover. With the 214-XB, speaker woofers and tweeters can operate under the best conditions of speaker damping, relative output balance, and without interposition of L-C crossover networks. Speakers may be connected directly to the amplifiers, with optimum damping. Resistive-capacitive, the unit eliminates all effects of resonant under-damping.



There are two controls. One provides continuous adjustment of crossover frequency from 175 to 3,000 cycles, and the other allows continuous adjustment of acoustical balance between woofer and tweeter to compensate for different speaker efficiencies.

## TV ATTENUATOR

Vidaire Electronics Mfg. Co., Lynbrook, N. Y., has introduced a television attenuator that eliminates overloading due to strong signals. The *Tel-Atten* was designed to reduce buzz in intercarrier sets, and most cross-modulation effects. It also features



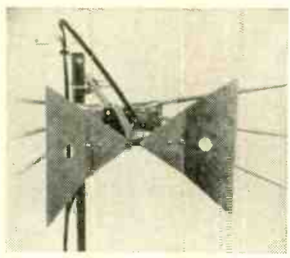
1,000-to-1 change in signal reaching antenna posts, and vernier adjustment for all signal areas.

Model A-2 measures 3-5/8 x 2-3/8 x 1-¼ inches and is suitable for mounting on the set itself or on a nearby wall.

## UHF DEVICES

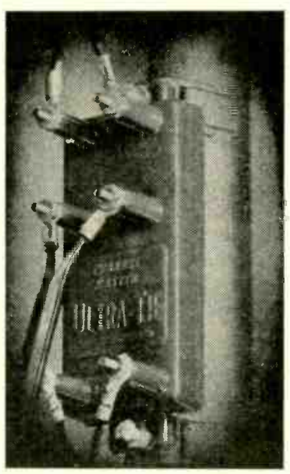
Channel Master Corp., Ellenville, N. Y., has announced three products for u.h.f.

The *Delta-Weld Yagi*, a 10-element u.h.f. antenna, provides up to 11 db gain single and 14 db gain stacked.



The *Ultra-Tie*, model 9034, combines separate antennas into a single u.h.f.-v.h.f. system. It joins them together at the mast for use with a single transmission line and separates the signals at the set or converter.

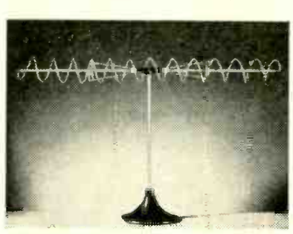
The model 415 u.h.f. antenna adapter, the *Econo-dapter*, is an all-chan-



nel u.h.f. triangular dipole for adding u.h.f. to v.h.f. *Super Fan* installations. It is designed for use with separate v.h.f. and u.h.f. leads to the TV set or converter.

## UHF ANTENNA

The Hi-Lo TV Antenna Corp., 3540 N. Ravenswood Ave., Chicago 13, Ill., has announced the indoor u.h.f. *Spiral-Tenna*, model 202 U-V. It can be used for all channels (u.h.f. and v.h.f.) with Hi-Lo's u.h.f. antenna adapter. The unit measures 20 x 32 inches.



## NEW DEVICES

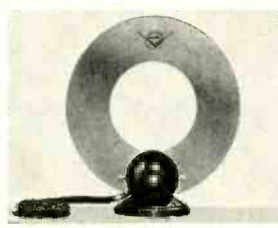
### PORTABLE RECORDER

**Amplifier Corp. of America**, 398 Broadway, New York 13, N. Y., has announced a portable tape recorder, the 110-volt a.c. *Magnematic*. The recorder weighs 19 pounds and attains a frequency response of 50 to 15,000 cycles at 7½ i.p.s. (inches per second).

It is completely operated by push-button control, and features a solenoid-operated clutch-controlled capstan drive to start and stop tape travel within 1/20th of a second. The unit incorporates relay-operated modified Geneva movement to control high-speed rewind and 60 i.p.s. fast-forward movements. The *Magnematic* uses 5-inch plastic or metal reels of standard ¼-inch tape and has provision for headphone monitoring and optional erase.

### INDOOR UHF ANTENNA

**Radion Corp.**, 1130 W. Wisconsin Ave., Chicago, Ill., is producing an indoor u.h.f. antenna, the *Bullseye*. It is a full-wave loop, engineered for broad-band coverage, low standing wave ratio and low Q.



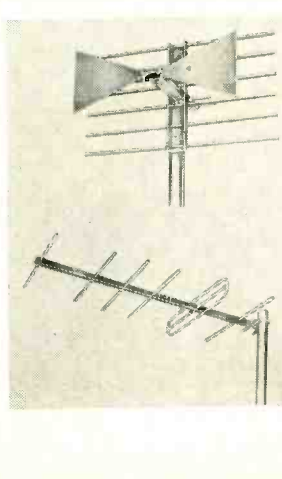
The antenna is 10 inches high and 9 inches wide and weighs under 1 pound. The loop is of rose-gold colored anodized aluminum with a mahogany phenolic base weighted to prevent tipping. The unit is shipped fully assembled, with lead-in and instructions.

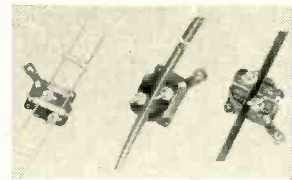
### U.H.F. PRODUCTS

**RMS (Radio Merchandise Sales, Inc.)**, 2016 Bronxdale Ave., New York 60, N. Y., has introduced a bow-tie antenna, a Yagi series, and a lightning arrester for u.h.f.

The bow-tie element and reflector section of the *Bo-Tenna* model BT-10 are standard fitted units, each of which is available separately. The reflector is made up of tuned elements instead of wire mesh, to minimize ghost pickup. Stacked models are designated BT-20.

The 6-element all-aluminum Yagis use a 3-wire folded dipole transformer.





The elements are of 3/16-inch aluminum rod, force-fitted to the crossarm. There are 6 models in this 6Y series. Stacked models are also available.

The model LA-UH3 lightning arrester has specially designed filter networks to isolate r.f. from ground potential. It accommodates all types of commonly used transmission lines and can be mounted flat or to the mast.

### SUBSTITUTION KIT

**Crest Laboratories, Inc.**, 84-11 Rockaway Beach Blvd., Rockaway Beach, N. Y., has introduced a variable-inductance, universal substitution kit. It consists of eight variable-inductance coils, covering a range from 1 to 590 μh, for video peaking, r.f., and i.f. circuitry. Full data sheets are

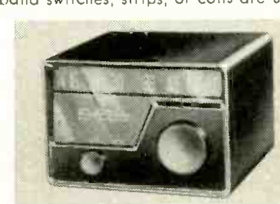

enclosed. Individual calibration charts permit adjustment to required inductance value without test equipment.

### OSCILLOSCOPE PROBES

**Precision Apparatus Co., Inc.**, Elmhurst, N. Y., is producing an oscilloscope test probe set, the series SP-5, which includes four probes for general purpose as well as specialized TV signal-tracing, alignment, trouble-shooting and waveform analysis. The four probes are (1) high impedance - low capacitance; (2) signal-tracing; (3) resistive-isolating; and (4) shielded-direct.

### UHF CONVERTER

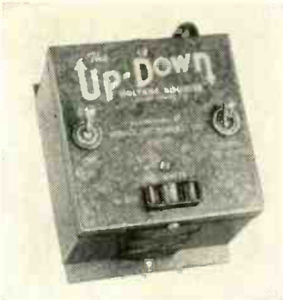
**Electro-Voice, Inc.**, Buchanan, Mich., has announced the model 3300 u.h.f. TV converter. Nonslip micrometer-type tuning mechanism provides continuous tuning of all u.h.f. channels 14–83. No band switches, strips, or coils are used.



The unit operates with either separate u.h.f. and v.h.f. antennas or on all channel (2-83) antennas. It uses channels 5 or 6 of v.h.f. TV as i.f. The model 3300 operates from 105–125 volts, 50–60 cycles a.c. and has input and output impedances of 300 ohms.

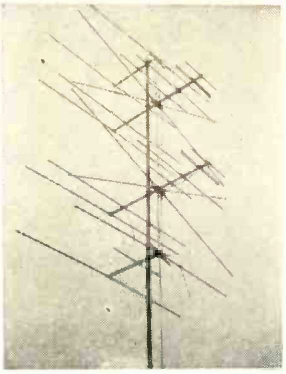
### VOLTAGE BOOSTER

**The Service Instruments Co.**, 422 S. Dearborn St., Chicago 5, Ill., has announced the *Up-Down* voltage booster. The unit increases or reduces line voltage and is usable with any TV set or appliance up to 300 watts. It eliminates inadequate picture width, insufficient height, and low picture brightness. An off-on switch adds or subtracts 10 volts from existing line voltage.




### V.H.F.-U.H.F. ANTENNAS

Kay-Townes Antenna Co., Rome, Ga., has announced its new BJU antenna series. They are assembled in kits of 2-, 3-, and 4-bay units for channels 2 to 83. They provide high gain.



Only one lead-in wire is required. No isolation filters, matching pads, coils, capacitors, or other boosters are used.

### TV CLARIFIER

Precision Electronics, 9101 King Ave., Franklin Park, Ill., has announced a new model of its *Television Clarifier*. It is designed to trap interference from FM, amateurs, short-wave diathermy, ignition, and adjacent chan-

nels, without disturbing the standing wave ratio of the antenna system.

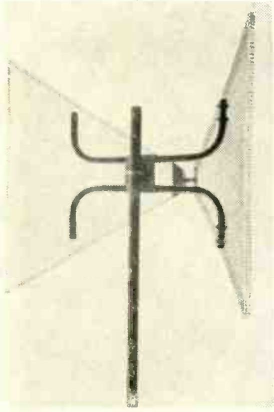
When installed, the receiver is tuned to the channel where interference is received, and the trimmers on the clarifier are adjusted one at a time until the interfering signal is removed.

### VINYL ADHESIVE

Chemical Development Corp., Danvers, Mass., has introduced CD Cement No. 203, for bonding vinyl film and molded articles or rigid sheets to metal, glass acrylics, ceramics, paper, cloth, cork, and many other surfaces. It produces a quick initial bond and is very fast setting. It consists of vinyl resins, plasticizers, tackifiers, stabilizers, and other ingredients. May be applied by brush or machine.

### ALL-CHANNEL ANTENNA

Payo Engineering Labs, 2834 Hampshire St., Quincy, Ill., has announced an all-channel antenna. Typical gain figures for u.h.f. are: channel 82, 12.5 db; channel 52, 11.0 db; channel 18, 11.6 db; channel 13, 4.3 db. The antenna is highly directional, free from minor lobes, and wind resistant.



### NEW VOLTMETER

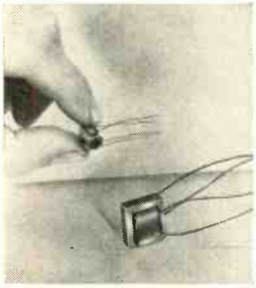
American Research Corp., 1504 11th St., Santa Monica, Calif., has developed a portable voltmeter which measures from 4,000 to 25,000 volts.

The *Voltprobe* is 10 inches long and needs no outside current to operate. To function, an alligator clip is connected to the chassis of the TV set. The probe end of the unit is connected to the second anode by piercing through the rubber protective cap. Measurements can be made without removing the tube or chassis from the cabinet.

### TINY TRANSFORMER

Standard Transformer Corp., 3580 Elston Ave., Chicago, Ill., has introduced an ultra-miniature transistor transformer.

Weighing less than 1/10 ounce, the units measure 1/4 x 3/8 x 3/8 inches and are no larger than the transistors they are designed to power. Intended primarily for transistor audio applications, the ultra-miniature transformers can be used wherever power is low. They are useful below the 1-mw level. Construction is of extremely fine wire wound on molded nylon bobbins with nickel-alloy steel laminations.



### RECTIFIER KIT

Federal Telephone and Radio Corp., Clifton, N. J., has designed a selenium rectifier kit with the necessary components for assembling any one of four selenium rectifiers—half-wave rectifier, full-wave center-tap rectifier, full-wave bridge type, and full-wave battery charger. Any one of 12 rectifier stacks for use in a wide range of a.c.-d.c. applications also may be built.

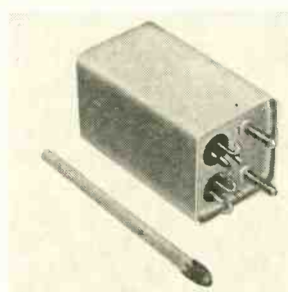

## LINE SPLICER

Mosley Electronics, Inc., 2125 Lackland Road, Overland 14, Mo., has designed a solderless transmission line splicer to provide a constant impedance splice of tubular-type 300-ohm line to flat-type. The new splicer (Catalog No. 29-S) is intended for use with any of the tubular or oval types used for u.h.f. television installations.

The polystyrene splicer is so designed that the ends of the polyethylene transmission line insulation are completely covered, thus providing minimum strain on the conductors and considerable protection from the weather.

## MINIATURE RELAY

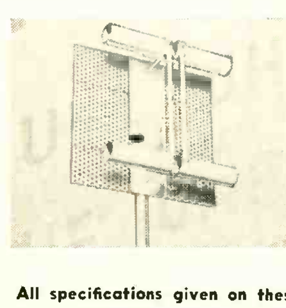
The Phaostron Co., Pasadena Ave., S. Pasadena, Calif., has announced a miniature double-pole, double-throw relay, weighing only 3½ ounces. The unit meets the shock requirements of MIL-E-5400.



Certain contact combinations can be furnished with a required coil power as low as 20 milliwatts and any relay in this series can be obtained with a coil resistance as high as 15,000 ohms.

## UHF ANTENNA

Cornell-Dubilier Electric Corp., South Plainfield, N. J., has added another



u.h.f. antenna, the U-4, to its present line. The manufacturer claims broad-band coverage with uniform gains over the entire u.h.f. spectrum, uniform gain with low vertical radiation and low standing wave ratio, and 300-ohm internal impedance. Units are 12 x 12 x 5 inches, and may be stacked.

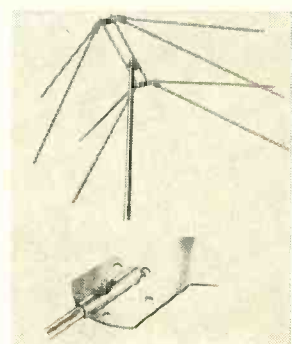
## ANTENNA MOUNTS

T-V Products Co., Springfield Gardens, Long Island, N. Y. has announced a new chimney and a new wall mount. Both are made of steel 1/8 inch thick and heavily plated to withstand corrosion. They are individually packaged with all necessary hardware.

## ALL-BAND ANTENNA

RMS (Radio Merchandise Sales), 2016 Bronxdale Ave., New York 60, N. Y. has announced an adjustable all-TV-band conical-V antenna, model AAV-100, a high-gain end-fire array.

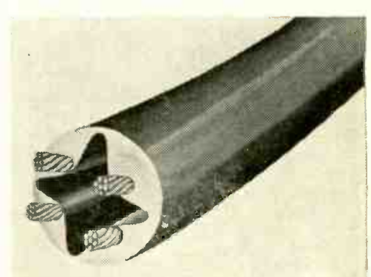
Its adjustable bracket arrangement permits positioning of any one or all of the 8 elements to 45° (u.h.f.), 60° (u.h.f.-v.h.f.), 90° (v.h.f.), and 180° (v.h.f. where stations come from widely separated points, but are in the same general direction). The pin bracket which retains the elements can be rotated so that the pin snaps into the hole positions giving the desired angle.



## TRANSMISSION LINE

All-Channel Antenna Corp., 70-07 Queens Blvd., Woodside 77, N. Y., is producing a 4-conductor tubular transmission line for use with their u.h.f.-v.h.f. all-direction antennas.

The line has an impedance of ap-



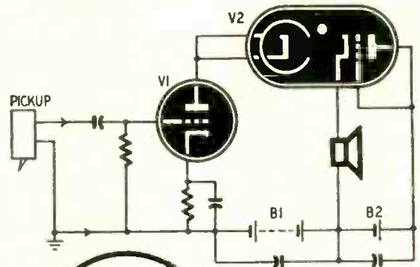
proximately 300 ohms between every 2 of the 4 conductors. It is about 3/8-inch in diameter. The 4 conductors each consist of 7 strands of No. 28 copper wire. Attenuation loss is claimed to be less than 4.1 db per 100 ft at 900 mc when wet. END

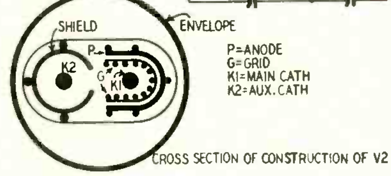
**All specifications given on these pages are from manufacturers' data.**

## GAS-TUBE AMPLIFIER

Patent No. 2,619,622
Edward Oscar Johnson, Princeton, N. J.
(assigned to Radio Corp. of America)

This amplifier is based on a recently designed gas tube with special characteristics. This tube is shown in the figure as V2. It has a triode section, as well as an auxiliary cathode which is surrounded by a shield. The auxiliary (shown at the left of V2) keeps the gas ionized. This element is isolated from the triode elements so it cannot affect the work circuit.




The circuit shown here is adapted for a.f. amplification. PICKUP is a phonograph or other audio source. The signal is first amplified by a vacuum tube V1. Then it flows into V2 to modulate the plate current of the gas tube. The control grid of V2 is not utilized in this particular circuit, so it is tied to the anode.

Two power supplies are shown, each suitably bypassed. B1 is the plate supply for V1 and also the ionization supply for V2. It keeps the gas tube filled with *plasma*, a mixture of electrons and positive ions. B2 energizes the work circuit of the gas tube. It can be quite small, considerably below the ionization potential.

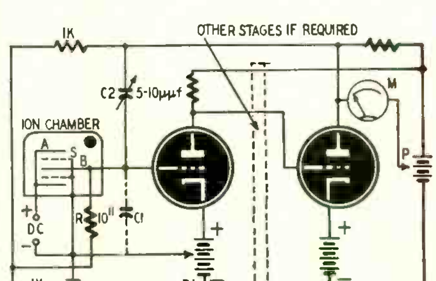
The input signal modulates the plasma density of V2 and controls the output voltage. Since the gas tube has low impedance, it is permissible to connect the speaker directly into its cathode circuit without a matching transformer. This improves the fidelity and reduces power loss. The tube can handle high power without difficulty. The plate current may be 150 ma or more. Efficiency is high since there is no filament. Furthermore, the tube drop between main cathode and anode is negligible.

Another audio circuit with this tube is shown in U.S. Patent 2,603,766, described on page 113 of our March issue.

## STABILIZED ELECTROMETER

Patent No. 2,617,946
Barton L. Weller, Richland, Wash.
(assigned to the United States of America as represented by the U. S. Atomic Energy Comm.)

This amplifier is stabilized against the effects of transient disturbances. It is shown here amplifying the output of an ion chamber (shown within the solid line). The chamber has a collector B surrounded by a cylindrical anode A, and is filled with gas. Between these elements is the grounded shield S. The chamber is energized by high-voltage d.c.



When gamma radiation acts on the chamber, the gas is ionized. Positive ions are attracted to cathode B and flow through the large resistor R. This generates a voltage drop which is amplified by direct-coupled stages. M indicates the radiation intensity, and P is the zero-set adjustment for balancing out the voltage drop across the meter due to the static plate current of the output tube.

Voltages on B and S are equalized by adjusting the contact on B1. Unless this is done, the signal charges and discharges capacitance C1 between the elements B and S. This slows the amplifier response because of the large time constant of R and C1.

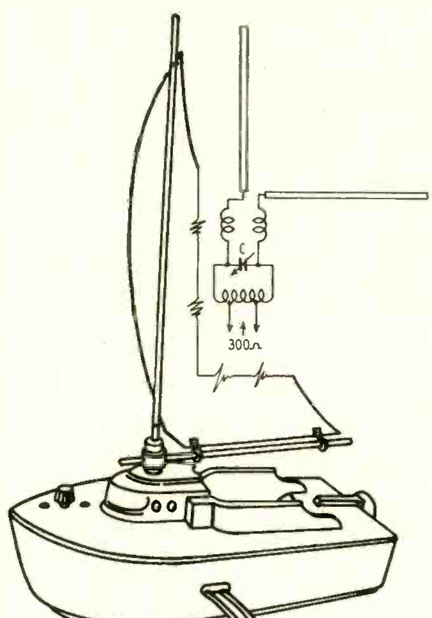
Feedback exists between the output and input of the amplifier. Each stage reverses phase by 180°, so the 3 stages provide *negative* feedback. This stabilizes the circuit against most circuit and power variations, but cannot act against transients. This is due to the large time constant of R, C1, which prevents the feedback from acting quickly enough. Lowering R is undesirable since it would kill some of the high gain. This invention utilizes an auxiliary capacitor C2 to neutralize the effect of C1.

C2 couples the input grid to the high end of the feedback circuit. Thus feedback is applied directly to the grid instead of having to pass through R. Speeding up the feedback action means that it can balance out the most rapid transients likely to occur in this type of circuit.

## ORNAMENTAL TV ANTENNA

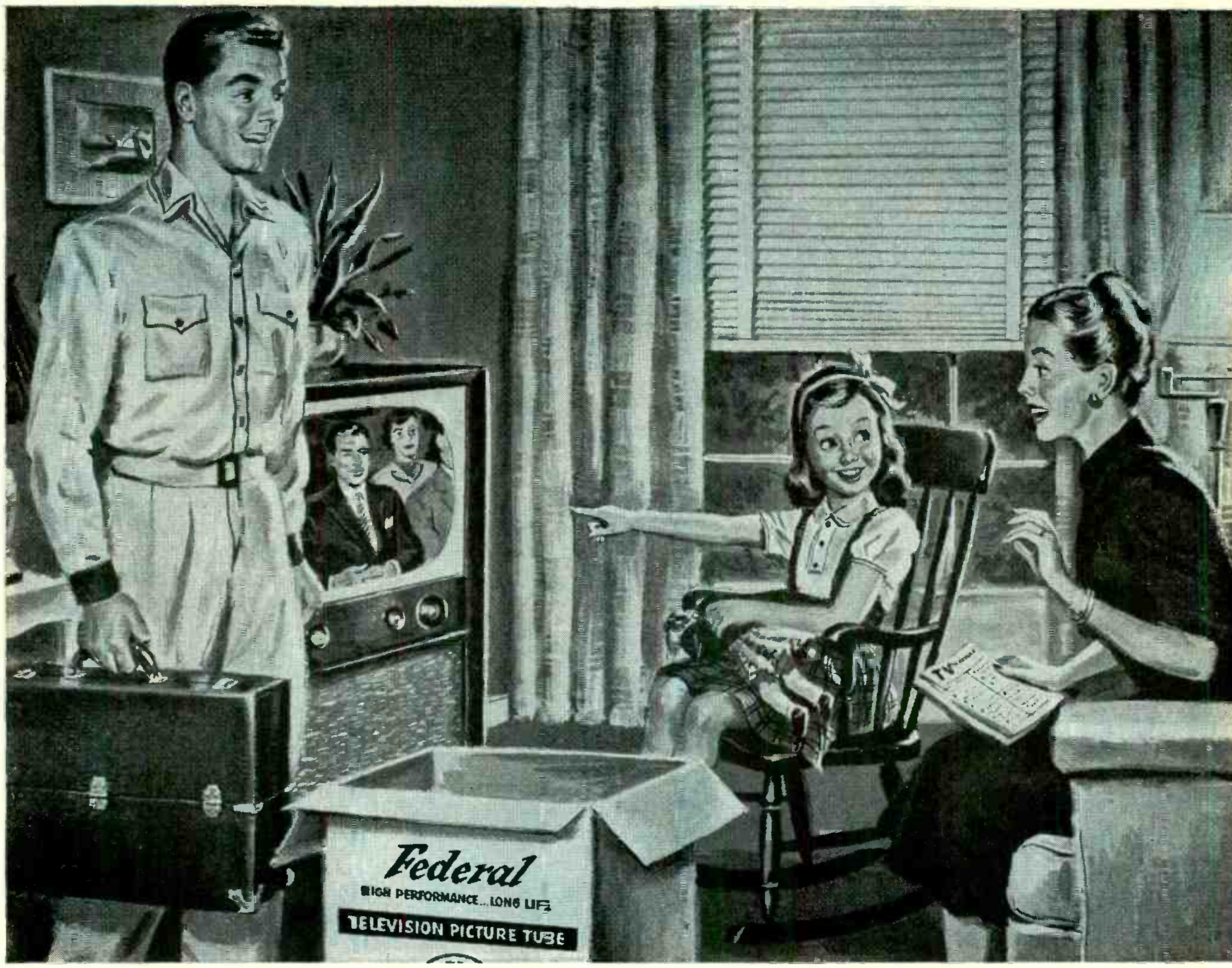
Patent No. 2,621,293
Elmer Guy Hills, Des Plaines, Ill.
(assigned one-half to J. N. Marks, J. Tunkl, I. Rosenthal, and E. Lichtenstein, doing business as Tricraft Products Co., Chicago, Ill.)

An outdoor antenna is usually better for TV, but sometimes an indoor installation is needed. Results will be good if there is enough signal strength. TV owners often object to an indoor antenna because it uses too much space and may clash with the living-room furniture. This invention is a compact antenna built for beauty as well as utility. It looks like an attractive model of a sailboat.




The mast and boom of the boat are the pickup conductors .The mast is 17 inches long, the boom 15½ inches. They are supported by a polystyrene sail. A knob on the forward part of the deck tunes the antenna. For optimum directivity, the boom may be rotated through any angle. The lead-in comes out through an opening in one side of the ceramic hull.

The insert shows the equivalent electrical network. The vertical and horizontal conductors are the mast and boom. They feed two coils which resonate the system on the low band. C, the tuning capacitor, shunts an autotransformer. This coil matches a 300-ohm transmission line which feeds the receiver. END




# The man who brought back a smile

EXCITED? Cynthia was practically bursting! Last thing Dad said was "Now you look close, Cindy. You'll see me right there in the audience tonight, and I'll wave to you." (They always do!)

Long about three o'clock Cynthia's mother turned on the set . . . "just to make sure." Well, there was a picture, if you could call it that . . . but so dim and fuzzy they'd never even recognize Dad that evening. And Cindy . . . disappointed? She was brokenhearted!

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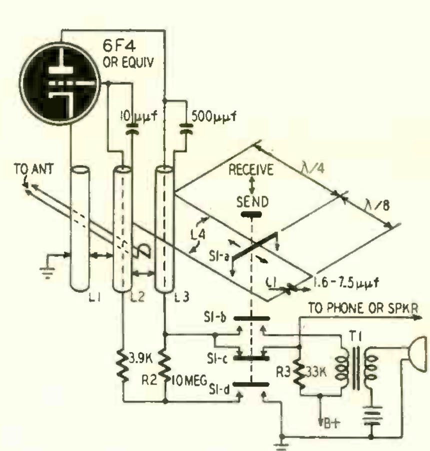
## ONE-TUBE TRANSCEIVER

The simplest form of v.h.f. or u.h.f. transceiver consists of a single-tube unit designed to receive and transmit on the same frequency. The tube is used as a superregenerative detector when receiving and as a plate- or grid-modulated oscillator when transmitting.

One particularly annoying characteristic of this type of equipment is that it is virtually impossible to maintain the same frequency for transmitting as for receiving. When the equipment is switched from one mode of operation to the other, the differences in circuitry and operating potentials cause the frequency to shift despite the fact that the same tuned circuits are used for receiving and transmitting.




Above is a transceiver circuit incorporating an invention (covered in patent 2,611,858 issued to Robert E. Samuelson) which permits the equipment to operate as a transmitter preset to one frequency and as a receiver tunable over a range of frequencies within a band.

L1, L2, and L3 are coaxial-line tuning elements. The grid-cathode circuit is tuned by the movable shorting bar between L1 and L2, and the plate-grid circuit is tuned by adjusting the shorting bar between L2 and L3. Feedback necessary for oscillation is obtained through the coupling between L2 and L3. The antenna is coupled to the transceiver by a hairpin loop placed close to L2 and L3.

L4 is a ⅜-wavelength parallel-wire transmission line shunted across sections of L2 and L3 with a variable capacitor C1 connected across its outer end. The combination of L4 and C1 acts as a type of bandspread tuning circuit connected across L2 and L3.

The SEND-RECEIVE switch S1 is a relay or a manually operated switch of any convenient type. It may be an insulated rod with metal flanges or rings which serve as S1-a, S1-b, S1-c, and S1-d. The switch is shown in the RECEIVE position. In this position, L4 and C1 form a parallel-tuned circuit which permits the receiver to be tuned over a range of frequencies.

R3 is the detector load. The audio

voltage may be taken off the plate side of the resistor and fed into headphones or a power amplifier for a speaker. R1 and R2 are connected in series as the receiving grid leak.

When S1 is switched to SEND, S1-a acts as a shorting bar connected across L4 at the quarter-wavelength point. C1 is now shorted out and the frequency is determined by the position of S1-a on L4 and by the tuning of the coaxial lines. S1-b and S1-c switch the secondary of the modulation transformer T1 into the plate circuit and disconnect R3. S1-d grounds the junction of R1 and R2, so R1 is used alone as the transmitting grid leak.

## SELECTIVE CRYSTAL TUNER

To increase the usefulness of my phono amplifier, I constructed a simple crystal broadcast tuner for receiving two local stations on 1230 and 850 kc. The stations were selected by switching preset trimmer capacitors across a coil. With this simple arrangement, the circuit was not selective enough to prevent both stations from being heard at the same time. The unwanted station could still be heard in the background even when separate coil and capacitor combinations were used for each station. Finally, the problem was solved by using the circuit arrangement shown in the schematic.

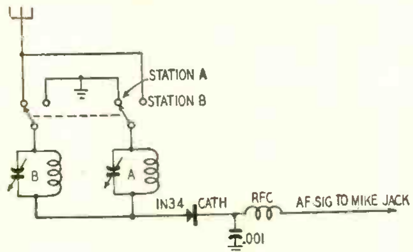



Fig. 1—Two-channel crystal tuner.

Circuit A is pretuned to station A and circuit B to station B. When station A is selected—as drawn in the schematic of Fig. 1—parallel-tuned circuit B is in series with the antenna circuit so it rejects station-B signals. Signals from station A pass through circuit B and are applied to circuit A and the detector. When station B is

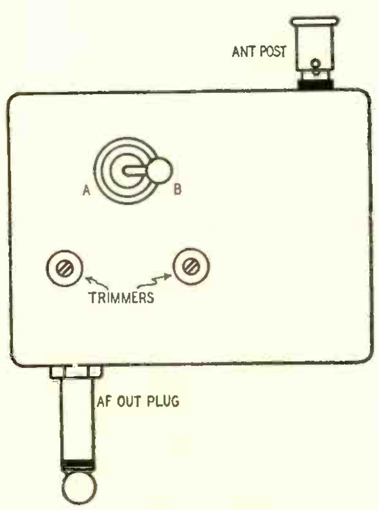


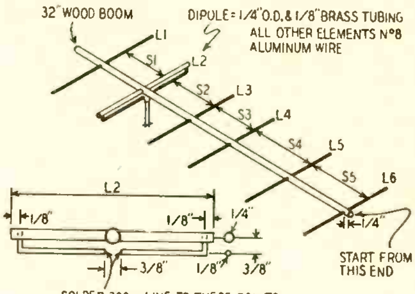

Fig. 2—Tuner assembly is compact.

selected, circuit A is switched in series with the antenna lead to reject signals from station A.

The circuit was built into the case of a surplus type MC-385 headset adapter as shown in the drawing at Fig. 2. I simply plug it into the microphone jack on the amplifier and connect an antenna whenever I want to receive either of the two predetermined local stations.
—*R. B. Dhuru*

### U.H.F. YAGI ANTENNA

Many TV set owners have had good results with v.h.f. TV Yagis and are now planning to construct similar ones for u.h.f. TV channels which have opened or are about to open in their localities.




A six-element Yagi designed for a forward gain of 9 db with a good front-to back ratio on u.h.f. TV channels is described in *Sylvania News*. Its construction and design constants are shown on the diagram. The table gives element lengths and spacings in decimal parts of the wavelength. On u.h.f. channels, one wavelength (in inches) at the center of a given TV channel can be derived from the formula:

$$\lambda\text{ (inches)} = \frac{11{,}800}{(6 \times \text{u.h.f. channel No.}) + 389}$$

Or refer to the chart on P. 38 of RADIO-ELECTRONICS, January, 1953.

The boom is a ¾ × ¾ × 32-inch piece

of wax-impregnated oak fastened to its support at the end beyond the reflector. The folded-dipole radiator provides a good match to a 300-ohm transmission line. It is constructed from ¼-inch and ⅛-inch brass tubing as shown in the diagram.

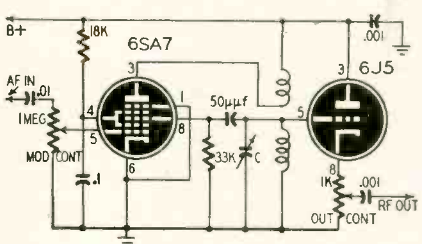
**Yagi Dimensions in Wavelength**

| Dimension | Wavelength |
|---|---|
| S1 | 0.215 |
| S2 | 0.240 |
| S3 | 0.200 |
| S4 | 0.290 |
| S5 | 0.285 |
| L1 | 0.495 |
| L2 | 0.450* |
| L3 | 0.430 |
| L4 | 0.430 |
| L5 | 0.420 |
| L6 | 0.415 |

*L2 is length of ¼-inch dipole element.

## STABLE TEST OSCILLATOR

I believe this test oscillator, despite its simplicity, is equal to many commercial ones, and perhaps even has some added features. The circuit consists of a 6SA7 oscillator with grid 1 used for modulation. A 6J5 cathode follower isolates the oscillator from the test circuit, preventing the external circuit from affecting the tuning or output. A 1,000-ohm potentiometer serves as an output control, while the 1-megohm potentiometer in the 6SA7 oscillator grid circuit is the modulation control.




The only components in the circuit which are at all critical are the coils. Even there a wide choice is possible. For example, a set of standard plug-in coils and a 140-μμf variable for C will give wide coverage without complex band-switching. Alternatively, a 365-μμf capacitor and a set of all-wave antenna coils can be used. Other components are not at all critical, and an extremely wide choice is possible. The oscillator tube can be replaced with any pentagrid type, provided the proper arrangement of grids is used, while almost any triode or triode-connected pentode can be used as the cathode follower.

For the audio source, you can use your audio oscillator externally, or wire a simple one into the set. Alternatively, you can connect the audio input terminal to the hot side of the 6-volt a.c. heater line.

Despite its simplicity, this circuit will fulfill all AM and many FM and TV assignments. Furthermore, it is an extremely well-behaved circuit, and, provided proper care is taken in construction, it should work the first time.—*Charles Erwin Cohn* END

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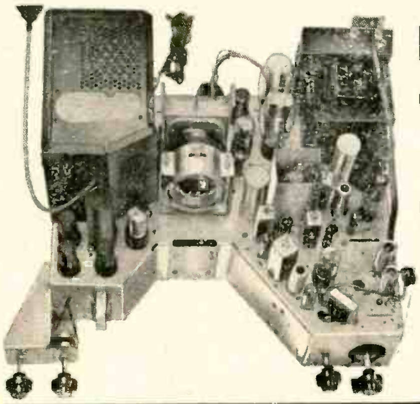

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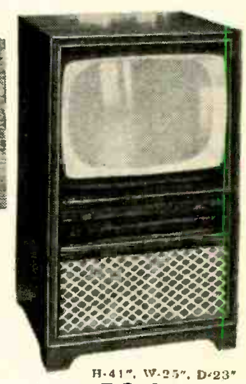

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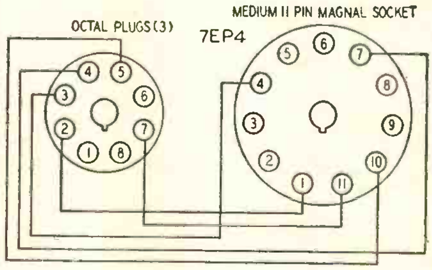
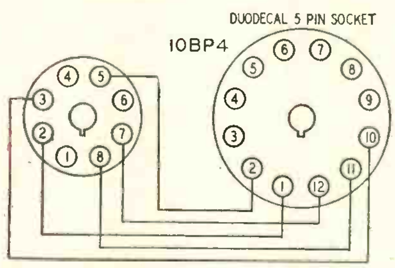
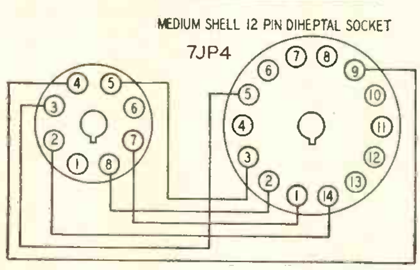
### C-R TUBE CHECKER ADAPTER

The three drawings show the wiring of harnesses which I use to check some common types of oscilloscope and television picture tubes in my Jackson model 636 and Precision 954-G tube checkers. The tube checker supplies the necessary voltages and the C-R tubes can be checked without removing them from the equipment in which they are installed.




The settings for the Precision 954-G are: 6—6—15—5—1—1—D and settings for the Jackson 636 are: Normal—6.3—30—4JKR. These settings are used for all types of tubes. The checkers will indicate low emission, shorts, and slow heating.

The adapter-harnesses are made from octal plugs and cathode-ray tube sockets. Tubes which use base connections and dimensions the same as the 7EP4, 7JP4, and 10BP4 can be checked with these harnesses.—*Hyman Herman*

### DIODE NOISE CLIPPER

One plate of the duo-diode-triode second detector and a.f. amplifier tube is grounded or left floating in many small receivers. This diode can be used as an effective noise clipper. The common procedure is to tie the unused diode directly, or through a switch, to the control grid of the audio output tube. Although the diode clips the noise peaks, this connection is often unsatisfactory because it causes severe distortion on peaks of the audio signal.

The diode may be used for noise clipping without distortion by modifying the circuit as shown by the heavy lines in the diagram. The effectiveness and smoothness of this circuit is the result of the addition of two inverse feedback loops. One loop feeds back some signal from the output plate to the cathode of the preceding stage. The other loop is connected between the

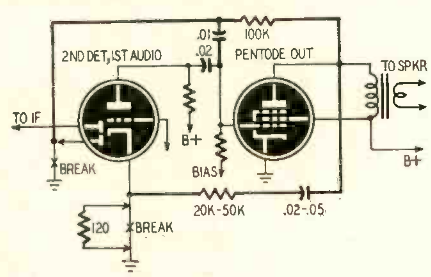
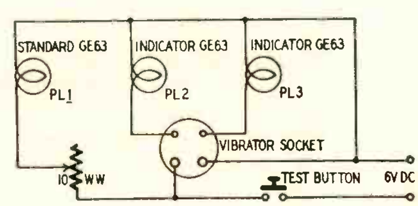



plate and grid of the output stage. The cathode of the triode is disconnected from ground and a 120-ohm resistor is inserted in series with the cathode return.—*George D. Philpott*

## VIBRATOR TESTER

The diagram shows the construction of a simple tester for 4-prong vibrators of either the shunt-coil or separate-driver types. The tester uses one 4-prong vibrator socket; three G-E type 63 automobile license-plate lamps; three single-contact bayonet sockets; a normally-open push-button switch; and a 10-ohm wirewound potentiometer (an ancient filament theostat will do).

To calibrate the tester, plug a new vibrator into the socket, press the test button, and adjust the variable resistor until the standard lamp PL1 has the same brightness as the indicator lamps PL2 and PL3. The tester is now ready for use.




To check a questionable vibrator, plug it in, press the switch, and watch the lamps. The brightness of the lamps indicates the condition of the vibrator. Indicators PL2 and PL3 should be just as bright as PL1. You can familiarize yourself with the operation of this unit by testing vibrators which you know are bad.

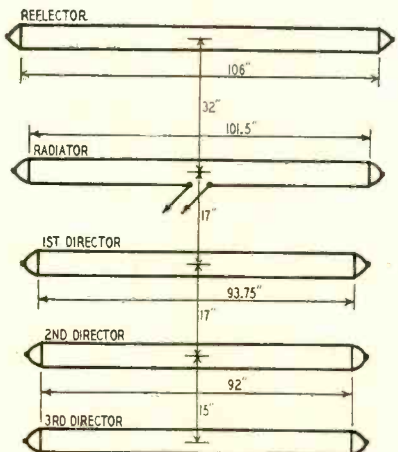
I've used this tester for more than a year. It spots defective vibrators in seconds.—*Benito Tan*

## BAD SPOTS IN TV CONTROLS

Sometimes you may run across a TV set in which a centering control or similar potentiometer on the back has a bad spot at the proper operating position. When a replacement is not available or the job does not warrant a replacement, you may be able to improve the operation of the defective control by reversing its two outside connections. This will switch the optimum operation to the opposite end of the range and eliminate the erratic operation which is usually caused by the bad spot on the resistance element.
—*Leonard Pfeiffer*

## INDOOR YAGI FOR TV

Recently, I moved into an apartment house where the landlord did not permit TV antennas to be attached to the roof or any other part of the building. Since I live in the deep fringe area—about 95 miles from the nearest TV station—it seemed that an indoor antenna would be entirely useless. In desperation, I installed a rabbit-ears antenna and a Regency booster. I received weak sound and no picture on channel 5 and a very weak picture and sound on channel 2.




ALL ELEMENTS ARE 300Ω RIBBON LINE SHORTED AT ENDS

The next step was to cut a folded dipole for channel 2, using 300-ohm ribbon line. After attaching a lead-in, I held the dipole as high as possible, moved it around the room until I found where the signal was strongest, and taped it to the ceiling at this point. This antenna (with the booster) provided a signal which was much stronger than the rabbit-ears but not strong enough to provide a picture which could be viewed comfortably.

Next, I decided to convert the antenna to a Yagi to obtain more signal with less interference. Shorted lengths of 300-ohm line were taped to the ceiling and used as parasitic elements. The diagram shows the dimensions which gave the best results. The optimum element spacing is the result of a lot of trial-and-error experiment in an effort to feed the strongest possible signal into the receiver. Reception was further improved by wrapping a tinfoil slider around the lead-in and positioning it for the clearest picture.

This antenna, together with the booster, provided a much stronger signal than was expected. The picture was not excellent but it was good enough to watch and enjoy. Late in the evenings the signal strength often increases to the point where the picture compares favorably with those received in primary service areas.

After completing the Yagi, I obtained permission to install an outdoor TV antenna in the back yard. I now have a 4-bay conical mounted 20 feet high on a pole. With this array, reception on channel 2 is only slightly better than that obtained with the indoor Yagi, but has the advantage of also providing fairly good reception on channels 5 and 8.—*G.N. Manning.* END



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## CONVERTING THE JFM-90

? *I have an old G-E JFM-90 FM tuner that I would like to convert to operate on the 88 to 108-mc FM broadcast band. I will appreciate any help that you can give me.—J. J. McG., Fitchburg, Mass.*

**A.** Fig. 1 shows the changes which may be made in the front-end of the JFM-90 tuner and similar G-E receivers to permit operation on the FM broadcast band. Coded components have the same values and occupy the same positions as in the manufacturer's schematic.

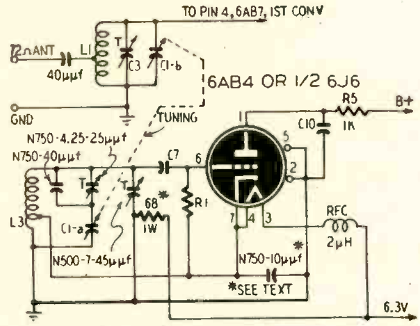



**Fig. 1—G-E JFM-90 circuit revisions.**

Replace the 7A4 oscillator with a 6AB4 or 6J6 to minimize drift. The 7-pin miniature oscillator socket connections permit the use of either type without change. Solder the 10-μμf N750 ceramic cathode capacitor directly between socket terminals 4 and 7 at one end, and 5 and 2 at the other. Ground terminals 5 and 2.

Rewind the antenna and oscillator coils L1 and L3 on a polystyrene or mica-filled rod the same length and diameter as the original form. L1 consists of 2 turns of No. 18 bare wire spaced to a winding length of 3/16 inch. L3 has 6 turns of No. 20 enameled wire closewound and spaced 1/8 inch from L1. Tap L3 at 1 3/4 turns.

Fig. 2 shows the method of mounting L1 and L3 and connecting one end of L1 to the 72-ohm antenna-input terminal. Instead of connecting the antenna to a tap on L1, connect it to a point on the ground lead which gives maximum signal and minimum noise. For a 300-ohm lead-in, the optimum tapping point will be somewhere on L1.

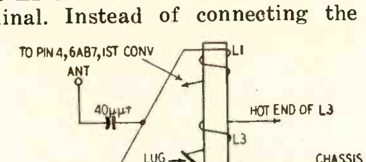



Fig. 2—New coil-mounting arrangement.

Connect the 40-μμf fixed and 25-μμf variable ceramic capacitors in series with the stator of the oscillator tuning gang C1-a. Connect a 7–45-μμf N500 ceramic trimmer across C1-a. Mount the 68-ohm resistor under and in direct contact with the 7-45-μμf trimmer so it will warm the trimmer.

Replace the r.f.-trimmer capacitors (C3 and C4 on the manufacturer's diagram) in the grid circuits of the first and second converters with 2–20-μμf NPO ceramic types.

Replace the first-converter plate coil with a National type AR-5 slug-tuned v.h.f. coil.

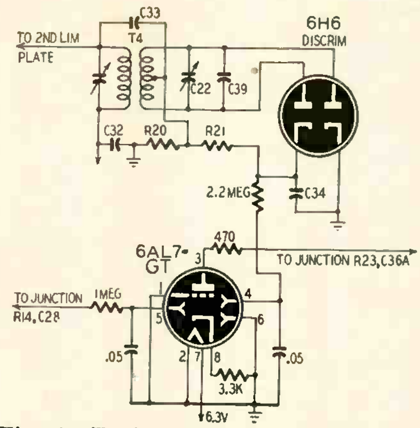



Fig. 3—Tuning indicator for JFM-90.

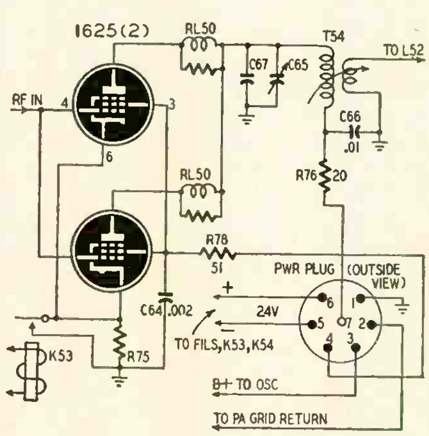
Fig. 3 shows the connections for adding a 6AL7 tuning-indicator tube.

## MODULATING SCR-274-N RIGS

? *I have converted several SCR-274-N and ARC-5 transmitters into 120-watt ham rigs. My trouble is that when I try to plate-modulate them, distortion is heavy when the modulation exceeds about 50%. The 80-watt modulator does not distort when operating into dummy load or when used with other rigs. Why do I get distortion with these rigs? How can I eliminate it? The final-amplifier B plus lead connects to the secondary of the modulation transformer.—N. C., Bronx, N. Y.*

A. Pentodes and beam-power amplifiers should be modulated by applying the audio signal simultaneously to the screen and plate. The diagram shows a simplified circuit of the power-amplifier stage in the SCR-274-N transmitters.

Disconnect the screen supply lead from pin 4 of the power plug on the rear of the chassis. Substitute a 50,000-




ohm, 20-watt resistor for R78 and connect the screen supply lead to pin 7 on the power plug. Substitute a 300-ma, 2.5-mh r.f. choke for R76 in the plate supply lead. Replace the plate bypass capacitor (C66) with a .002-μf, 2,000-volt unit. Connect pin 7 of the power *socket* to the top of the secondary on the modulation transformer.

The distortion was probably caused by failure to modulate the screens and by the fact that an appreciable portion of the modulating voltage was bypassed to ground by C66. Reducing the value of C66 and making the other changes indicated should enable you to modulate up to 100% without distortion. If you find that there is still some distortion, make sure that the taps on the modulation transformer are set for a good match between the modulator and final amplifier. If the impedance match is O.K., try bypassing the 50,000-ohm screen resistor with a mica capacitor having a value between 200 μμf and .002 μf.

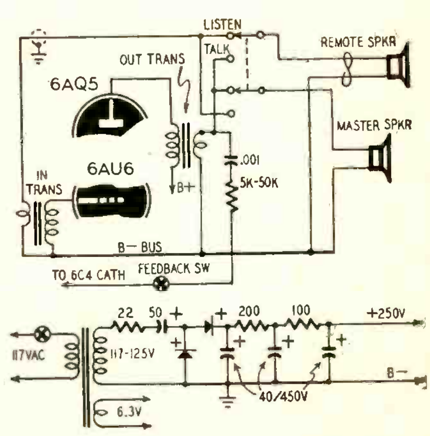
The ARC-5 transmitters are almost identical to those in the SCR-274-N series. The major differences are in the power-plug connections and in the method of feeding the amplifier plate circuit. Series feeding is used in the SCR-274-N units and shunt feeding is used on the ARC-5. The latter was designed for plate and screen modulation, so you won't have as many conversion problems as in the SCR-274-N, which was designed for screen modulation. On the ARC-5, power-plug connections are as follows: Pin 1 is not used; pin 2 is oscillator B plus; pins 3 and 5 connect the 24-volt line to heaters and relays; pin 4 is ground; pin 6 is the power-amplifier screen B plus; and pin 7 is B plus to amplifier plate.

When converting ARC-5 units, increase the screen-dropping resistor to 50,000 ohms and move the screen lead from pin 6 to pin 7. If you use a common power supply for the modulator and final amplifier, you may have trouble with r.f. feeding back into the audio circuits through the power supply. In this case, connect a .001-μf, 2,000-volt mica bypass capacitor between the B plus end of the plate r.f. choke and ground.

## INTERCOM FROM AMPLIFIER

**?** *In describing the multipurpose audio amplifier on page 64 of the February, 1953, issue, the author stated that the amplifier can be converted into a two-station intercom by adding a d.p.d.t. switch. Please show how this can be done. What type of transformer shall I use in the input circuit?—E. R., St. Albans, L. I., N. Y.*

**A.** The partial schematic shows how the TALK-LISTEN switch is connected be-



tween the input and output circuits. Use an anti-capacity type switch and shielding as indicated to minimize feedback within the amplifier. The input transformer may be a standard output transformer having a primary impedance of 20,000 ohms or more, or a standard intercom input transformer such as the Stancor A-4744.

Connect a switch in the feedback loop so that it can be opened for more gain when used as an intercom.

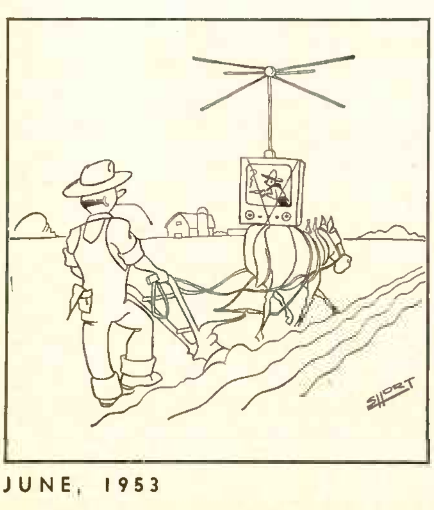
The original model uses a transformerless B supply. We recommend that you use a half-wave transformer, connected as shown to supply the B voltage.

### REPLACING 12WP4 TUBE

**?** *I have a Philco TV set with a burned-out 12WP4 picture tube. I could not get an exact replacement so I bought a 12JP4 which was recommended as a replacement. The new socket of the 12JP4 has five leads, the one for the 12WP4 has only four. Please tell me how to install my new tube in the receiver, a Philco 51-PT-1208.—C. F. B., St. Louis, Mo.*

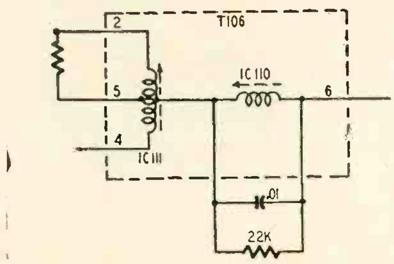
**A.** The local Philco representative has informed us that it is not practical to use any other tube as a replacement for the 12WP4. This is a special tube which has a thin neck which requires a special deflection yoke and associated equipment. A standard tube cannot be fitted into the assembly.

Circuits using this tube develop only about *one-fourth* of the deflection power required for standard tubes, and the boosted B plus voltage is only about 225—one-third to one-half less than that developed by sets using standard 12-inch tubes. Thus, in addition to the mechanical alterations, you would have to redesign the horizontal and vertical deflection circuits to operate from a higher B voltage and to supply the deflection power required for the larger tube. Many of the components would probably have to be changed to insure proper operation and freedom from breakdown. Considering these factors, we believe that it will be less expensive and far less trouble to use another 12WP4 as a replacement. You can obtain one through your local Philco distributor. END



## CROSLEY 1950-1953 TV SETS

If humidity is suspected as the cause of horizontal drift in Crosley 1950–1953 custom line of TV sets, replace the .01-μf capacitor which parallels the 22,000-ohm resistor connected between lugs 5 and 6 on the horizontal oscillator transformer T106 (see diagram). The new replacement capacitor is treated with a special glazed coating easy to identify, and has the part number 148813-2.




Replacement capacitors (parts 148813-1 or 148813-2 still in dealer's stock) which do not have the glazed coating may be used in less critical positions in the receiver circuits.—*Crosley Service Department*

## NOTES ON FRONT-END ALIGNMENT

The various leads to a TV tuner are often critical with respect to frequency. Even the power supply leads form loops which couple to the tuned circuits. If they resonate at any of the tuner frequencies, they may absorb power or cause feedback and difficulty. In receiver design, the undesirable resonant loops are shifted away in frequency to eliminate trouble. This permits reasonable latitude in components and physical arrangement.

When the r.f. unit is aligned in the receiver, there should be no trouble from resonant loops. However, if the unit is aligned external to the receiver, care must be taken that unwanted resonance does not cause errors during the measurement or alignment procedure.

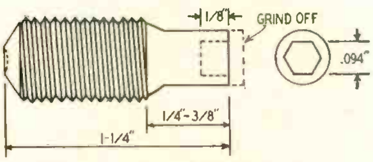
A resonant circuit can exist between the r.f. tuner chassis and the outer shield box. This causes coupling to the antenna and r.f. plate circuits. The resonant frequency depends upon the physical structure of the shield box and upon the capacitance between the tuner chassis and the front plate. In the RCA KRK8 units, this resonance should fall between 120 and 135 mc, and is controlled in this design by using insulating washers of different thicknesses (in the front plate to tuner chassis mounting).

The washers are installed to compensate for differences in the shield boxes of different models of receivers. The performance of the tuner—particularly on channels 7 and 8—will be impaired if the proper washers (for the particular shield box involved) are not used. If the r.f. unit is removed for service, the washers should be replaced in the correct order when the unit is replaced, to restore normal operation. —*RCA Service Data*

### CRYSTAL-PICKUP WRENCH

A convenient socket wrench for replacing the stylus of RCA *Silent Sapphire* crystal pickups can be made from a 1¼-inch long 10-32 Allen-type setscrew modified as follows:

1. Grind off the threads for a distance of approximately ⅜ inch from the hexagon socket end.




10-32 ALLEN SET SCREW ALTERED - SEE TEXT

2. Grind off the hexagon socket end so that the hole is only about ⅛ inch deep—or partially fill the hole so that the nut just goes in until its outer surface is flush with the end. Refer to the drawing for details.—*RCA Radio Phono TV Tips*

### INTERMITTENTS IN TV SETS

Many hard-to-find intermittents in TV sets are caused by unsoldered connections which slipped through factory inspections and by high-resistance riveted ground connections. When I run into a set which is particularly troublesome, I take time out to examine all connections and grounds. If any rivet grounds show the slightest trace of corrosion I clean and solder the chassis.

I use breadboard-mounted horizontal and vertical oscillators to drive the vertical and horizontal output tubes when checking intermittents in the sweep or high-voltage circuits. In this way, I save a lot of time localizing intermittents in the yoke, output transformers, and oscillator circuits.—*J. Perkinson, Jr.*

### 1B3-GT'S IN SENTINEL SETS

G-E 1B3-GT high-voltage rectifiers may have short life when installed in Sentinel models 462 and 463 TV receivers. All 1B3-GT's except those made by General Electric have pin 5 floating. G-E 1B3's have pins 5 and 7 internally connected.

Sentinel model 462 and 463 TV sets have an 8.2-ohm filament-current limiting resistor connected between pins 5 and 7 on the 1B3-GT socket. G-E 1B3's short out the limiting resistor, resulting in excessive filament voltage and reduced tube life.

G-E will soon be distributing 1B3's which do not have pins 5 and 7 internally connected. However, until these tubes are available and are definitely identifiable, always clip pin 5 off the tube base before using G-E 1B3-GT's in models 462 and 463.

Sentinel models 454, 455, 456, and 457 have a 2.2-ohm limiting resistor between pins 5 and 7 on the rectifier socket. Shorting out this resistor will not seriously affect tube life but it is recommended that pin 5 be clipped off the base of all G-E 1B3's before using them as replacements.—*Sentinel Bulletin*

### G-E MODEL 150

Parasitic oscillations on strong signals and distortion on high volume may be noticed on this portable receiver. This trouble is caused by overloading of the 1T4 i.f. amplifier.

To eliminate this trouble, locate the i.f. amplifier grid return lead which runs from lug 2 of the first i.f. transformer to pin 5 of the 1T4 i.f. amplifier. Remove this lead from pin 5 of the i.f. amplifier socket and run it to pin 5 of the 1T4 r.f. amplifier. This changes the i.f. amplifier bias from 0 to –1.4 volts and minimizes overloading and oscillations.—*Wayne Miller*

### A CURE FOR MOTORBOATING

If you have trouble with motorboating in an audio amplifier or receiver, it may be caused by the use of dual electrolytics as cathode bypass capacitors. Many of these dual units have a large amount of stray capacitance between sections. If the sections are used to bypass the cathodes of cascade stages, the stray capacitance may cause motorboating by introducing positive feedback between the cathodes. The solution is to eliminate the dual capacitors or use them an odd number of stages apart so the feedback will be negative rather than positive.—*Charles Erwin Cohn*

### NO HORIZONTAL DEFLECTION

The complaint was little or no horizontal deflection; there was a vertical line or band in the center of the screen; and second-anode voltage was low. This is a rather rare trouble which is likely to give you considerable difficulty. Trouble is probably caused by an open capacitor (0.1 µf or so) connecting one end of the horizontal deflection coil to B plus. The horizontal yoke aids in producing the kickback and boosted voltages used for supplying the picture-tube second anode and B plus to the horizontal output and other stages. When this capacitor opens, the yoke is effectively disconnected from the circuit and the anode and boosted voltages are too low. Replacing the capacitor clears up the trouble.—*DeLoss Tanner*

(In some sets, one side of the yoke connects directly to B plus and the linearity coil and the other end to the damper-tube plate through the capacitor mentioned above.—*Editor*) END


"All the time pick up crazy pattern."

## THE FUND REACHES $10,664.09

## HELP-FREDDIE-WALK FUND

When the Help-Freddie-Walk Fund was organized several years ago in an effort to give aid to little Freddie Thomason, five-year-old son of Herschel Thomason, radio technician of Magnolia, Arkansas, we anticipated the enthusiastic and friendly support of hundred of our readers whom it has been our good fortune to know. What we did not foresee, however, was that the keen interest and encouragement would continue, as the following excerpts indicate:

From W. L. Barth, York, Pennsylvania: "Enclosed is another 'Buck' for Freddie. . . . More later." And from Lt. Sammy J. Spiadlin, Ashland, Kentucky: "It has been quite some time since I sent my last contribution. In the meantime, I have been recalled to active duty with the Air Force. But I hope to continue my donations. Hope this will help."

Clevis T. Svetlik, of Cleveland, Ohio, writes: "This dollar and many others are the best use of money I can think of." Jack Goldstein, of Philadelphia, Pa., is a new contributor, who says: "I read your article in the March issue, pertaining to your noble effort in regard to the Help-Freddie-Walk Fund. I deem it a great privilege to offer my contribution and enclose my check for $10.00. May it help to make his future a bit brighter."

The Television Service Department of the Lee Wholesale Company (Admiral Distributor), of Kansas City, Missouri, donated $23.50, and sent along this letter: "Please add this to the Help-Freddie-Walk Fund. We hope that it will in some small measure help in the future struggle that Freddie will have, but with the courage that he must have along with that winning smile, we are sure that he will make the grade.

"Now that Freddie is about to start his education, please print more information about him."

We most certainly will print all the information we can get about Freddie's activities and progress, as long as his many friends continue to register their interest and encouragement, verbally as well as financially, thereby insuring the "life" of the Fund. And we hope to win more friends for Freddie, for we are certain there is no more worthy cause.

Throughout his life, Freddie, who was born armless and legless, will have to depend upon artificial limbs, and these will cost thousands upon thousands of dollars before the grown Freddie can be permanently fitted. Therefore, we urge each and every reader to send in his contribution, no matter how small, as soon and as often as he can.

No amount is too small to receive our sincere thanks and appreciation, as well as the appreciation of Freddie and his parents. *Make all checks, money orders, etc., payable to Herschel Thomason.* Address all letters to:

HELP-FREDDIE-WALK FUND
RADIO-ELECTRONICS
25 West Broadway
New York 7, N. Y

| FAMILY CIRCLE CONTRIBUTIONS | |
|---|---|
| Balance as of March 18, 1953 ..... | $590.50 |
| FAMILY CIRCLE contributions as of April 16, 1953 .............. | $590.50 |
| **RADIO-ELECTRONICS CONTRIBUTIONS** | |
| Balance as of March 18, 1953 ..... | $10,001.09 |
| W. L. Barth, York, Pa. .......... | 1.00 |
| Wesley Brittin, Audubon, N. J. .... | 2.00 |
| A Friend, Feeding Hills, Mass. .... | 1.00 |
| Van H. Ferguson, Tallahassee, Fla.. | 5.00 |
| Herbert Goldstein, New York, N. Y. | 5.00 |
| Jack Goldstein, Philadelphia, Pa. .. | 10.00 |
| Lee Wholesale Co., Television Service Dept., Kansas City, Mo. .... | 23.50 |
| Mr. & Mrs. E. Little, Toledo, Ohio . | 2.00 |
| Tony Maday, Chicago, Ill., on behalf of Ted Jablonski, Tony Maday, Joe Palacz, Ken Petersen, Al Zaccanti, Dave Ashley, Ted Rattmann, Steve Choma, Joe Jaltuch, Tom Gruszka, Ed Miller, Wilbur O'Leary, Andy Luberda, Nick Verallo, Herb LaRue, Chas. Menard, Ray Dati, who donated 1.00 each .................... | 17.00 |
| Lt. Sammy J. Spiadlin, Ashland, Ky. | 5.00 |
| Clevis T. Svetlik, Cleveland, Ohio.. | 1.00 |
| RADIO-ELECTRONICS contributions as of April 16, 1953 ....... | $10,073.59 |
| FAMILY CIRCLE contributions ... | 590.50 |
| TOTAL contributions as of April 16, 1953 .......................... | $10,664.09 |

## 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.

### JUNE 1919
### ELECTRICAL EXPERIMENTER

My Inventions, by Nikola Tesla
V. The Magnifying Transmitter
"Stove Pipe" Radio
Amateur Radio Restored, by H. Gernsback
E. F. W. Alexanderson's "Barrage" Receiver
Rogers Underground Aerial, by James Harris Rogers
Learning the Code, by Howard D. Wildman
Use of Contact Detectors in Radio Measurements, by Dr. L. W. Austin
Automatic Code Transmitter, by George Harrington
New Type of Transformer
The Evolution of the Stars, by Isabel M. Lewis
Hunting Submarines by Sound, by Brewster S. Beach

**Harry C. Crawford** was elected president of RADIART CORP., succeeding L. K. Wildberg. Mr. Crawford has been associated with Radiart and its parent company, Cornell-Dubilier, for the past eight years as works manager and comptroller and assistant

H. C. Crawford

**H. A. Triplett** joined LITTELFUSE, INC., Des Plaines, Ill., as research director.

Left—H. A. Triplett, Right—E. V. Sundt

He was formerly chief staff engineer for Pacific Oerlikon.

**Edward C. Hughes, Jr.**, was promoted to assistant to L. W. Teegarden, executive vice-president of the RADIO CORPORATION OF AMERICA. Mr. Hughes joined RCA in 1930 as a member of the staff of the Tube Advertising and Sales Promotion Department and has been associated with Mr. Teegarden since 1937. He was most recently assistant to Mr. Teegarden when the latter was vice-president in charge of technical products of the RCA Victor Division.

**Raymond C. Cosgrove** was named management consultant of NATIONAL CO., Malden, Mass. He was formerly executive vice-president of Avco Manufacturing Co., and for four terms president of the RMA (now RTMA). **William A. Ready**, until now president of National, was elected chairman of the Board and **Charles C. Hornbostel** was named president and treasurer. A new executive committee consisting of William A. Ready, Charles C. Hornbostel, Louis C. Lerner, Daniel V. McNamee, Jr., and Joseph H. Quick was also announced.

### Obituaries

**George Kenneth Throckmorton**, former vice-president of the RADIO CORPORATION OF AMERICA, died in Clearwater, Fla. He was at one time president of E. T. Cunningham, Inc., famed radio tube firm in the '20's, and executive vice-president of RCA-Radiotron, an RCA Victor affiliate.

**Bayard H. Clark**, Lombard, Ill., head of the advertising agency bearing his name, died of a heart ailment. He had been associated with the phonograph and radio industries for over 25 years as advertising manager of several prominent companies including MAGNAVOX and JENSEN MANUFACTURING.

### Personnel Notes

. . . **Robert C. Sprague,** chairman of the board of SPRAGUE ELECTRIC, North Adams, Mass., was elected a director of United-Carr Fastener Corp.

. . . **Brig. General David Sarnoff,** chairman of the Board of the RADIO CORPORATION OF AMERICA, received the first Founders Award of the IRE at its annual banquet in New York City.

. . . **Richard E. Hall** was named New York Industrial sales manager of AMERICAN PHENOLIC CORP., Chicago, with headquarters in the Amphenol offices in the Empire State Building, New York. He was formerly Boston district manager. William H. Rous, vice-president in charge of sales for Amphenol, also announced the appointment of **James Schaefer,** formerly of the General Engineering Section in Chicago, as Hall's successor in Boston.

. . . **Kenneth A. Hoagland** was named chief engineer of the Cathode-Ray Tube Division of ALLEN B. DU MONT LABORATORIES, Clifton, N. J. Formerly assistant engineering manager of the Tube Div., he succeeds **Alfred Y. Bentley** who was upped to chief engineer of the Television Receiver Division. **Eric Pohle,** formerly head of the division's Product Engineering Section, was named assistant engineering manager of the Cathode-Ray Tube Division.

. . . **Robert T. Rees** was appointed advertising manager of TRIO MANUFACTURING CO., Griggsville, Ill., manufacturer of TV antennas and rotators.

. . . **Glenn Clark** was appointed to the staff of K. F. Boldt, advertising manager of AMERICAN PHENOLIC CORP., Chicago.

. . . **Norman C. Owen** and **Herbert A. Gumz** were named vice-president in charge of sales and executive vice-president respectively of WEBSTER-CHICAGO CORP.

. . . **Hiram Prince** was named Fidelitone Division Sales Manager of PERMO, INC., Chicago, to handle the Fidelitone and Permo Point lines in Texas, Oklahoma, Arkansas, Nebraska, Iowa, Kansas City, Mo. Howard West, Fidelitone Southwestern Division sales manager, now takes over Louisiana in addition to his present territory

. . . **Charles E. Saltzman, John H. P. Gould, Henry Sears,** and **Henry L. Shepherd** were elected to the Board of Directors of LA POINTE ELECTRONICS, INC., Rockville, Conn., representing the additional 100,000 shares of common stock issued to Henry Sears & Co. and Bartram Bros., New York City investment bankers. END

## A REAL CONSTRUCTOR

*Dear Editor:*

I recently completed the "High Quality AM Tuner" described by John Potter Shields in the February issue. I found the circuit simple and easy to follow. The clear and concise text is a tribute to Mr. Shields.

I did not have a *Ferri-Loopstick* at the time, so used a standard antenna and coil, connected in the ordinary manner. Neither did I have a 6BD6, so I referred to the tube manual and found that a 6SK7 could be substituted. I replaced the potentiometer with a 100,000-ohm, 1-watt resistor, as I did not want a volume control in the tuner. I also placed an 8-μf capacitor between the plate of the 6C4 infinite impedance detector and ground, for further filtering and decoupling. I substituted a 1N35 for the 1N34 germanium diode. No apparent changes in a.v.c.

The 47,000-ohm, 1-watt resistor in the 6BE6 plate circuit tended to overheat, and was changed to 2 watts.

The 220,000-ohm swamping resistors in the i.f.'s were not used. I find the quality of reception has not suffered.

This tuner is feeding a home-built Williamson amplifier using 807's, which in turn feeds a Jensen 12-inch coaxial speaker in a bass reflex cabinet. The tuner fits my needs exactly.

I have only one difficulty. I pick up a continuous-wave signal I cannot eliminate. How can I get rid of it?

ROBERT H. DUNBAR
*Niantic, Conn.*

(Rather hard to clear up interference by remote diagnosis, but we'd try an i.f. trap for a start. Incidentally, Mr. Dunbar *is* losing highs by omitting his swamping resistors.

This letter is an example of what a skilled constructor can do with an article, and is a striking contrast to some sent in by would-be constructors, who complain that they can't go ahead because the article said an 8-μf filter capacitor was used, but one of the photos showed a 16-μf unit! Mr. Dunbar has adapted the circuit to his needs, to his stock-on-hand, and apparently even to his own musical tastes. Truly, as the author of one of the most popular articles printed in this magazine once stated, common sense is the most important component!—*Editor*)

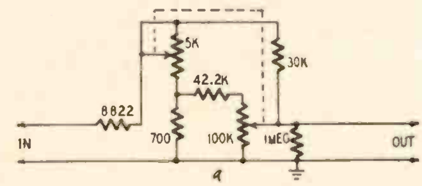

"OH SURE, a TEN-inch screen will be large enough, you said . . . . why do we need a TWENTY-ONE inch screen, you said . . . ."

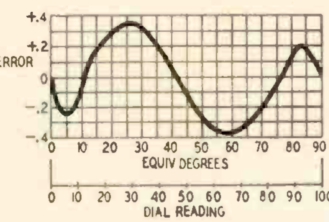


### A CORRECTION

*Dear Editor:*

May I call to your attention errors which, through no fault of yours, appeared in a patent announcement on page 113 of the November, 1952, issue of RADIO-ELECTRONICS, under the caption, "Sine Computer?" The error curve and circuit configuration are correct, but the actual resistance values are not




the ones for this curve. The correct values are shown in the accompanying diagram.

Unfortunately, I did not see a copy of the final application nor receive a copy of the patent. My attention was called to the errors by one of your readers, Mr. Ross M. Chiles of Northrup Aircraft, Inc., Hawthorne, Calif.

C. C. SHUMARD
*RCA Laboratories Div.*
*Princeton, N. J.*

### MORE ON TUBE KITS

*Dear Editor:*

The circuit below, an exact duplicate of one encountered while repairing the spasmodic glimmle of the heterodyne, with its special tube, has presented certain troubles to the expectant owners of "Tube Kits, Inc."

Though being the proud possessor of one of these extra fine kits, I have been unable to duplicate the above tube, due, perhaps, to its fly-back characteristics, plus the fact that the filament current has not been included with the kit.

Therefore, as a convenient means of clearing the good name of Tube Kits, Inc. why don't you, of RADIO-ELECTRONICS, have Prof. Adolph Glockenspiel market an advanced version of this remarkable phenomenon, a kit which includes component parts such as quarter-moon cathodes, saw-tooth grids, and plates with the low-mu already sprayed on them? If this were done, I firmly believe the qualified technician would encounter no further difficulties in the construction of radio tubes that would really do things, nor would I ever again run afoul of a circuit which in its entirety stumped me and the diversified abilities of the tube kit of Tube Kits, Inc.

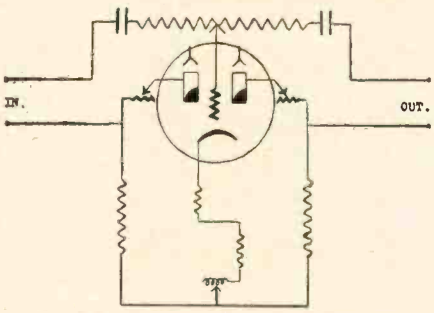
Gentlemen: Without qualms and quibbles, Tube Kits Inc. has shown the service technician and others, proof; proof not only that it is very possible to do it, but that sometimes even the man without previous experience tends





to wish he had.

In closing, may I ask that you of RADIO-ELECTRONICS, and of that great German Noisivelet outlet, in Krausekopf-f-f-f-f-f-on-the-Rhine, get together




and publish this documented circuit, along with the information necessary for me to construct the above-shown tube from the kit.

GEORGE D. PHILPOTT
*Columbus, Ohio*

## WATCH THAT BOOSTER!

*Dear Editor:*

This is not meant to discredit any make of television booster, but simply to point out how important it is—especially in fringe areas—to pick the right type for each job.

In my service work I run across many cases where full-time bricklayers picking up a little side money with alleged TV installations have hooked up 6J6 boosters to sets with cascode front ends. The results are generally pretty miserable.

The point is, the booster must be at least as good as the TV tuner if you expect to get decent pictures. If the set has a cascode front end it's a waste of time and money to hook up anything but a *cascode booster*. The higher noise level of a pentode or grounded-grid-triode booster stage cancels all the benefits of the cascode input stage in the receiver.

JOHN J. WHITE
*Lewes, Delaware*

## CORRECTION

A new video tape recorder is discussed in an item on page 16 of the April issue. In the discussion, 100 and 15 feet per second are given as comparative speeds for video and audio tape recorders, respectively. The standard of measurement should be inches per second instead of feet per second as stated. Our thanks to Mr. R. Waterstripe of Hattiesburg, Miss., for detecting the error and calling it to our attention.

WATCH FOR THE JULY ISSUE OF
RADIO-ELECTRONICS
ON THE NEWSSTANDS
JUNE 26

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.

### PRINTED CIRCUITS

*RCA Printed-Circuit IF Transformers, Coils, and Traps* is an 8-page booklet describing printed-circuit components designed for use in television receivers with intercarrier-sound systems and picture i.f. and sound i.f. carriers of 45.75 and 41.25 mc respectively.

*Copies free on request from Commercial Engineering Section, RCA Tube Department, Harrison, N. J.*

### RECEIVING TUBES

The RCA Tube Department has brought out a revised edition of *RCA Receiving Tubes for AM, FM, and Television Broadcast.* The 24-page booklet covers more than 495 RCA receiving tubes including 45 kinescopes. It provides quick and easy reference to the characteristics and socket connections for each tube type, as well as a classification chart which facilitates the selection of the proper tube type for a desired purpose.

*Request Form 1275-F from your distributor or send 15¢ to Commercial Engineering Section, RCA Tube Department, Harrison, N.J.*

### TV REPLACEMENT GUIDE

TV Replacement Guide No. 405 gives recommendations for replacing i.f.-r.f. coils and transformers in over 6,000 models and chassis, plus exact replacements where required.

*Available free of charge from Merit Coil & Transformer Corp., 4425 N. Clark St., Chicago 40, Ill.*

### ANTENNA TIPS

TV antenna installations are the subject of a booklet issued by Snyder. Edward M. Noll and Matt Mandl have prepared the 37-page *'Tenna Tips* which gives basic information on fundamental antenna types, includes hints on many phases of installation, and factors involving reception at the ultra-high frequencies.

*Copies can be obtained without charge by writing to Dick Morris, Snyder Mfg. Co., 22nd & Ontario Sts., Phila. 40, Pa.*

### PHONO FACTS

Audak's 1953 *Electronic Phono Facts* is a 20-page booklet by Maximilian Weil, answering more than 100 questions on audio-electronic music systems. Among the topics discussed in non-technical language are the pickup, stylus, tone arm, turntable, and other components, and care of records.

*Free on letterhead request to Audak Co., 500 Fifth Ave., New York 36, N.Y.*

END

**VACUUM-TUBE OSCILLATORS by William A. Edson. Published by John Wiley & Sons, Inc., New York, N. Y. 6 x 9 inches, 476 pages. Price $7.50.**

There has been much talk of transistors lately, but tubes will continue as oscillator elements for a long time. This volume presents an orderly and clear description of tube oscillators. It discusses not only oscillators, but also numerous topics related to them. It stresses design and is written for graduate engineers.

Nyquist plots are described early and used often. Feedback, negative resistance, resonators, and circuit elements are described. Crystal-controlled, relaxation, phase-shift, and bridge-type oscillators are among those included here. Among related topics treated are frequency multiplication (by tubes and magnetic circuits), tube noise, modulation (of oscillators), synchronization, a.f.c., and magnetostriction.—*IQ*

**REMOTE CONTROL BY RADIO, by A. H. Bruinsma. Published by Philips Technical Library. 6 x 8 inches, 95 pages. Distributed in U.S. by Elsevier Press Inc., 402 Lovett Blvd., Houston 6, Texas. Price $1.95.**

This book was written to describe two actually constructed ship models controlled by radio. Photos, diagrams and design data tell the whole story. The simpler model uses seven tubes and works through two independent channels. It is amplitude modulated. The second model uses 44 tubes and is supplied with eight different channels. It is pulse-modulated. It controls a rudder, screws, lifeboats, crane, catapult, and other equipment, all by remote control. Its engine room contains twelve relays and six motors!

This manual will, of course, interest experimenters who have made remote-controlled units or plan to do so. Aside from model building, it also contains valuable data and practical information on modulation, sync pulse circuits, crosstalk elimination, etc.

The tubes used in the models are all European types. However, the appendix contains data on them (14 different types).—*IQ*

**THE USE OF A.F. TRANSFORMERS by N. H. Crowhurst. Distributed by British Radio Electronics, 1 Thomas Circle, Washington 5, D.C. 5½ x 8½ inches, 63 pages. Price $1.00.**

Many technicians and music-lovers have been led to believe that a.f. transformers are obsolete and not adapted to hi-fi applications. A glance through the latest catalogs shows this to be untrue. Modern transformers (when properly used) are designed for excellent fidelity, efficiency and compactness. This book shows how to choose transformers for optimum results and how to test their performance.

The handbook is written in clear language with numerous diagrams and charts. It describes measurements for distortion, power handling capability, insertion loss and efficiency. It explains what happens to the "highs" and the "lows" when circuit values are varied. Charts help to calculate reactances, load impedances, response curves, etc.—*IQ*

## NEED ANY TUBES?

Barry for **FAST-DELIVERY** on all types. Tubes individually cartoned and carry Standard RMA GUARANTEE.

**Tube Orders Over $8.00 with full remittance Prepaid To You in USA.**

All tubes **INDIVIDUALLY** retested (not just spot-checked) on our Hickok Mutual-Conductance Tube-Testers to insure you 100% perfect merchandise. For your maximum money's worth, buy in full confidence from TUBE-SPECIALISTS. Here is a partial listing of our large stocks. You may order types not listed at approx. same savings. Phone REctor 2-2562 for fast delivery. Most of our Special-Purpose Types not listed.

| | | | | | |
|---|---|---|---|---|---|
| 0A2 | .90 | 6BH6 | .60 | 12BH7 | 1.15 |
| 0A4-G | 1.00 | 6BJ6 | .85 | 12SA7 | .75 |
| 0B2 | 1.00 | 6BK7 | 1.45 | 12SF5 | .70 |
| 0C3/VR105 | 1.10 | 6BN6 | 1.30 | 12SG7 | .80 |
| 0D3/VR150 | 1.05 | 6BQ6 | 1.20 | 12SJ7 | .69 |
| 0Z4 | .66 | 6BZ7 | 1.49 | 12SK7 | .70 |
| 1A7GT | .89 | 6C4 | .45 | 12SL7GT | .65 |
| 1AE4 | .90 | 6CB6 | .55 | 12SN7GT | .70 |
| 1AX2 | 1.10 | 6CD6-G | 1.50 | 12SQ7GT | .63 |
| 1B3GT | .80 | 6H6 | .60 | 12SR7 | .60 |
| 1L4 | .60 | 6F6-M | .69 | 14A7/12B7 | .90 |
| 1LA6 | .98 | 6F8-G | .85 | 14B6 | .90 |
| 1LB4 | 1.15 | 6G6-G | .85 | 14F7 | .80 |
| 1LN5 | 1.15 | 6J5GT | .45 | 14Q7 | .90 |
| 1N5GT | .87 | 6J6 | .60 | 19AP4-A | 44.00 |
| 1N23-A | 2.25 | 6J7 | .70 | 19BG6-G | 1.95 |
| 1N34 | .60 | 6K4 | 3.50 | 19T8 | 1.30 |
| 1N34A | .73 | 6K6GT | .59 | 25AV5 | 1.25 |
| 1N48 | .55 | 6K7-M | .70 | 25BQ6GT | 1.00 |
| 1N54 | .75 | 6L5-G | .49 | 25L6GT | .64 |
| 1R5 | .65 | 6L6-G | 1.19 | 25W4 | .82 |
| 1S5 | .65 | 6L6-GA | 1.19 | 25Z5 | .67 |
| 1T4 | .60 | 6L6-M | 1.95 | 25Z6 | .67 |
| 1U4 | .88 | 6L7 | .80 | 35A5 | .78 |
| 1U5 | .78 | 6N7-M | .80 | 35B5 | .40 |
| 1V2 | .67 | 6Q7GT | .80 | 35C5 | .40 |
| 1X2-A | .90 | 6S7-M | .98 | 35L6 | .69 |
| 2C43 | 13.95 | 6S8GT | 1.20 | 35W4 | .53 |
| 2E24 | 2.50 | 6SA7GT | .76 | 35Y4 | .73 |
| 2E30 | 1.95 | 6SC7 | .88 | 35Z5GT | .49 |
| 2X2 | .45 | 6SG7 | .72 | 42 | .65 |
| 3A4 | .59 | 6SH7 | .60 | 50A5 | .90 |
| 3AP1 | 9.00 | 6SJ7 | .69 | 50B5 | .82 |
| 3BP11 | 9.50 | 6SK7GT | .62 | 50C5 | .50 |
| 3C23 | 9.50 | 6SL7GT | .60 | 50L6GT | .55 |
| 3C24/24-G | 1.35 | 6SN7GT | .70 | 117Z3 | .66 |
| 3D6/1299 | .50 | 6SQ7GT | .68 | 117Z6 | 1.00 |
| 3E29/829B | 8.95 | 6T8 | 1.30 | 250-TH | 17.00 |
| 3Q4 | .90 | 6U5 | .87 | 274 A & B | 2.95 |
| 3Q5GT/G | .99 | 6U8 | .78 | 304-TH | 7.00 |
| 3S4 | .60 | 6V6GT | .85 | 304-TL | 8.75 |
| 3V4 | .85 | 6W4GT | .55 | 310A | 5.50 |
| 4X150A | 25.00 | 6W6GT | .85 | 311A | 6.50 |
| 5D21 | 16.75 | 6X4 | .65 | 371-B | .85 |
| 5R4GY | 1.25 | 6X5GT | .55 | 717-A | .88 |
| 5U4G | 55 | 6Y6-G | .88 | 725-A | 5.50 |
| 5V4-G | .95 | 7A4 (XXL) | .82 | 805 | 3.25 |
| 5Y3GT | .42 | 7A7 | .79 | 807 | 1.59 |
| 6A8 | .88 | 7A8 | .69 | 866-A | 1.55 |
| 6AB4 | .75 | 7B5 | .76 | 955 | .35 |
| 6AB7 | .98 | 7B7 | .80 | 1613 | .75 |
| 6AC7 | .77 | 7B8 | .80 | 1616 | .75 |
| 6AF4 | 1.40 | 7C5 | .80 | 1622(6L6M) | 1.95 |
| 6AG5 | .65 | 7C6 | .69 | 1625 | .35 |
| 6AG7 | 1.25 | 7C7 | .80 | 1626 | .22 |
| 6AH6 | 1.00 | 7F7 | .69 | 1631 | .70 |
| 6AJ5 | 1.30 | 7F8 | 1.35 | 1632 | .70 |
| 6AK5 | .70 | 7H7 | .72 | 2050 | 1.35 |
| 6AK5-W | .85 | 7N7 | .90 | 2051 | 1.10 |
| 6AK6 | .98 | 7Q7 | .87 | 5514 | 4.50 |
| 6AL5 | .50 | 7Y4 | .76 | 5608-A | 3.95 |
| 6AN5 | 2.25 | 7Z4 | .76 | 5646 | 8.25 |
| 6AQ5 | .60 | 12A6 | .50 | 5654 | 2.00 |
| 6AQ6 | .78 | 12AT6 | .65 | CK-5744 | 2.25 |
| 6AT6 | .60 | 12AT7 | .75 | CK-5886 | 3.00 |
| 6AU6 | .59 | 12AU6 | .76 | 5814 | 2.95 |
| 6AV6 | .50 | 12AU7 | .62 | 5910 | .75 |
| 6AX4GT | 1.00 | 12AV6 | .49 | 8020 | .98 |
| 6AX5GT | .70 | 12AV7 | 1.35 | 9002 | .85 |
| 6BA6 | .70 | 12AX7 | .85 | 9004 | .35 |
| 6BE6 | .59 | 12B4 | 1.00 | 9006 | .25 |
| 6BC5 | .75 | 12BA6 | .57 | | |
| 6BG6-G | 1.35 | 12BE6 | .57 | | |

**CBS—HYTRON CATHODE-RAY PICTURE TUBES**

First Quality in factory-sealed cartons. Full Year Warranty Card on each tube. Remember . . . no seconds; no rebuilts . . . Prices include Fed. Tax. C.R. Tubes via Express Collect.

| | | | | | |
|---|---|---|---|---|---|
| 7JP4 | 18.75 | 16KP4 | 28.75 | 17HP4 | 25.50 |
| 10BP4A | 21.00 | 16RP4 | 30.00 | 20CP4A | 38.50 |
| 12LP4A | 21.50 | 16TP4 | 30.00 | 21EP4A | 38.95 |
| 14CP4 | 24.00 | 17BP4A | 24.75 | 21FP4A | 36.00 |
| 16AP4 | 31.00 | 17CP4 | 25.25 | | |

**SELENIUM RECTIFIERS**
**Full-Wave Bridge Types**

| Current (Continuous) | 18/14 Volts | 36/28 Volts | 54/42 Volts | 130/100 Volts |
|---|---|---|---|---|
| 1 Amp. | $1.35 | $2.15 | $3.70 | $7.50 |
| 2 Amps. | 2.20 | 3.60 | 5.40 | 10.50 |
| 2½ Amps. | .... | .... | 6.00 | 13.00 |
| 4 Amps. | 4.25 | 7.95 | 12.95 | 25.25 |
| 6 Amps. | 4.75 | 9.00 | 13.50 | 33.00 |
| 10 Amps. | 6.75 | 12.75 | 20.00 | 40.00 |
| 12 Amps. | 8.50 | 16.25 | 25.50 | 45.00 |
| 20 Amps. | 13.25 | 25.50 | 39.00 | 79.50 |
| 24 Amps. | 16.25 | 32.50 | 45.00 | 90.00 |
| 30 Amps. | 20.00 | 38.50 | .... | .... |
| 36 Amps. | 25.00 | 48.50 | .... | .... |

**• New, Selenium Rectifier Transformers**

PRI: 115 V., 60 cycles in.
SEC: 9, 12, 18, 24, and 36 volts

4 Amps. . . . . $ 8.75
12 Amps. . . . . 16.75
24 Amps. . . . . 35.75
50 Amps. . . . . 59.75

**● New Selenium Rectifier Chokes**

4 Amps.—.07 hy.—.6 ohm . . . . . $7.95
12 Amps.—.01 hy.—.1 ohm . . . . . $14.95
24 Amps.—.004 hy.—.025 ohm . . . . . $29.95
For other types of rectifiers, Xfmrs & Chokes—write.

**CARTER DYNAMOTORS**

600 Volts out. @ 170 MA. from your 6 Volt battery. Compact. Only . . . . . $28.00

Trimm. Model 100 "Featherweight" Headsets & Band. New. in orig. mfr.'s carton . . . . . $4.95

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Terms: 25% with order, balance C.O.D.—Send a few cents for postage—All merchandise guaranteed. F.O.B. N.Y.C. "Please, minimum order $2".

## ADVERTISING INDEX



RADIO SCHOOL DIRECTORY

PAGE 119

Candler System Co.
Indiana Technical College
Indianapolis Electronic School
Milwaukee School of Engineering
RCA Institutes
Tri-State College
Valparaiso Technical Institute
Western Television Institute



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**RADIO SPECTRUM CONSERVATION, A Report of the Joint Technical Advisory Committee of the IRE and RTMA. Published by McGraw-Hill Book Co., Inc., New York, N. Y. 5½ x 8 inches, 221 pages. Price $5.00.**

Radio channel assignments are as important to the general public as traffic control is to a large city. Whether you run a ham shack, watch TV, listen to the radio, send radiograms, rely on navigation and aircraft safety signals, or utilize diathermy, you need intelligent allocation that permits a maximum of services with minimum interference. This report covers past allocations, offers a critique of present assignments, and presents an ideal plan for the future.

Aside from material pertaining directly to allocations, the volume also contains an excellent exposition of propagation characteristics. Almost 100 pages are devoted to this subject. It discusses such topics as receiver and atmospheric noise, maximum usable frequencies, skip distance, mechanism of propagation, and effects of rain. Hams, engineers, and the general public will find interesting and important data here.

An extensive bibliography is provided.—*IQ*

**STORAGE TUBES AND THEIR BASIC PRINCIPLES, by Max Knoll and Benjamin Kazan. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 6 x 9 inches, 143 pages. Price $3.00.**

This is the first book on a new and important field: charge-controlled storage tubes. These are used in TV, radar, computing, and communications.

The first part describes generation of potentials under the action of light or electron bombardment. This is followed by a chapter on "writing" (establishing a charge pattern) and "reading" (interpreting the pattern). Succeeding chapters describe the principles of various conversion tubes: electrical-electrical; electrical-visual; visual-electrical. A bibliography completes the volume. —*IQ*.

END


"That reminds me—our television set needs fixing."

## SOCKET ASSEMBLIES

**PILOT LIGHT SOCKET**, Bayonet with 1/2" jewel. As shown .......35¢; 5 for $1.25

**PILOT LIGHT SOCKET 1"** Jewel. Hi-Polish Finish. "TAB" Special...59¢; 10 for $4.50

**1" PILOT, 1" LIGHT SOCKET**, w/115V 6 Watt Bulb ...............79¢

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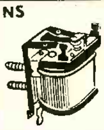

**SPST** mini size 115VAC 3A cts......98¢; 3 for $2.75
**SPDT** min. size 115VAC 3A cts ..$1.39; 3 for $3.75
**SPDT** 24V DC, 5A CTS 98¢
**SPNO** 115 V AC, 15A CTS S'Dunn ..$1.98; 2 for $3.50
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**DPDT** Clare SK 5010, Octal Base 18-28V 2Amp Cts, Nitrogen Sld. $1.25; 3 for $3.25
**DPNC & SPNO** Clare Telephone Type 115VAC. Octal Base....$3.25; 3 for $8.95

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SPST GE 3A/250V......29¢; 4 for $.98
SPDT AHH 3A/250V.....35¢; 4 for $1.00
SPDT BKLT CSD Momentary.49¢; 5 for $2.00
DPST BKLT CSD 15A/125V.89¢; 3 for $2.50
DPST 20A/250V .....$1.25; 3 for $3.25
DPDT Center Off ................ 75¢
SPDT Momentary Both Sides....... 85¢
DPDT Center off Mom. 98¢ @ 6 for $5.00

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**PUSH TO RESET**

Amps 5—7—10—15—20 Ea. 27¢; 4 for $1.00; 25 for $5.; 100 for...$18. Circuit Breaker Fuse W/2 Mounting Clips ......39¢ 3 for $1.00; 20 for $5.98; 100 for $25. Fuse is 3AG Size. Operates up to 24 Volts Please State Current (Amps) Desired

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**Sq. D & CH Toggle Sw Brkrs, Amps;** 5, 10, 15, 20, 25 98¢....10 for $8.98

**Klixon Thermal Push Button Bkrs Amps;** 5, 10, 15, 20, 25, 30 89¢..10 for $7.98

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**Navy Type Xtal Mike $3.98**
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**HS18** Rcvrs no band .. .98
**P20** Head set 24000 ohm 3.95

## T2FD ANTENNA RESISTOR

**For T2FD Antenna CQ Feb 53,** Globar Non-Inductive "RF" 400 Ohm Resistor & Mtg Clips ..........................$2.49

## 100 WATT SEC PHOTOFLASH KIT

Includes DX Flash Lamp Rated 150 Watt Sec. Flash Lamp Holder & 8" Reflector & Cable, Power Transformer & CD Flash Capacitors. (5) 200 Mfd Each W/Output of 100 Watt Sec. All Resistors, Capacitors, Rectifiers & Sockets ...........$29.98

**Extra Flash Lamp Holders** W/8" Reflector & Cord $3.98; with Lamp DX.......$12.98

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|---|---|
| 100MFD/500WVDC | $1.98 |
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| 300MFD/450WVDC | 4.39 |
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| 16MFD/600VAC/2800VDC Intermit't. | 6.95 |
| 16MFD/660VAC/3000VDC Intermit't. | 7.95 |
| 32MFD/1.2KVDC/23W. Sec. | 7.49 |
| 27MFD/1.2KVDC/2KVDC Int.54W.Sec. | 8.95 |
| 26MFD/330VAC/1.5KVDC Intmnt | 6.98 |
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| U10 | GE FT114 | 100 | 7.25 |
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| 23ST | GE FT 210 | 200 | 9.98 |
| 53GT | GE FT 403 | 500 | 13.50 |
| VA | SYLV. 4330 | 200 | 9.98 |
| 23MT | FT 214 | 250 | 9.98 |
| 22ST | FT 110 | 200 | 9.98 |
| 353GTQ | FT 503 | 5000 | 49.98 |
| V4X4 | X400 | 200 | 10.98 |
| DX | SPRGFA100 | 150 | 9.00 |

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(4) 36V Batteries w/acid..........$3.35
2V/20AH Willard PLUS 2V. Vibrator. 2.98
2V/20AH w/vib & acid........... 3.59
6V/6AH Willd NT6/BB214U ....... 2.98
6V/6AH Battery w/acid .......... 3.25
6V/40AH Battery ............... 6.98
6V/40AH Battery w/acid ......... 9.25
Hydrometer 1.06 to 1.24 Sp Grav.... 1.98
We ship acid in bottles. R'exp only

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"Weller" 115VAC/100 Watt ..........$8.69
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"Primax" 115VAC Korodless Tip .... 7.69
Philips "Versa-Tool" 115VAC/250W & 4 Tips "TAB" Special ..10.83

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55 Watt/3/8 Tip/11 1/2 Lng/.38 lbs...1.25
60 Watt/1/4 Tip/12" Lng/.38 lbs... 1.91
100 Watt/3/8 Tip/12" Lng/.5 lbs.... 2.55
130 Watt/1/2 Tip/12" Lng/.75 lbs... 3.17

**ESICO IDUSTRIAL IRONS 120 VAC/DC**

Similar to American Beauty types as shown
61A60/60W/1/8 Tip/7" Lng/2.5 oz.. 3.20
#38/Am. Beauty 3138/100W 3/8 Tip 5.29
#58/Am. Beauty 3158/200W/5/8 Tip 6.30
#78/Am. Beauty 3178/300W/7/8 Tip 8.18
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Esico Temp Regulating Stand...... 4.20

**"JACKSON" VULCAN IRONS**

#230/25W/1/4 Tip/7" Lng/3 ozs.... 1.30
#231/40W/1/4 Tip 8" Lng/4 ozs.... 1.90
#230C/Craftsman/25W/5 Tips/7"... 2.20
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Kester Solder one lb. 062 Roll Regular 1.29
With any soldering iron Special 90¢
**WRITE FOR QUANTITY PRICES**

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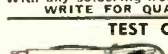

**Precision Feeler Gauge TL147** Ideal Setting Cont. Pts, Spark Gap, Individ. Removable Gauges .012/.018/.025/.035/.037/.055" .............98¢; 6 for $5.00
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|---|---|---|
| .5MFD | 1500VDC | 95¢; 2 for $1.50 |
| 2MFD | 1000VDC | 55¢; 4 for 1.95 |
| 5MFD | 600VDC | 1.50; 3 for 4.00 |
| 10MFD | 400VDC | 95¢; 2 for 1.50 |
| 3MFD | 330VAC 1000VDC | .49¢; 3 for 1.20 |
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| 2MFD | 600VDC | 49¢; 5 for 2.00 |
| 4MFD | 50VDC | 29¢; 4 for 1.00 |
| .1MFD | 2000VDC | 1.05; 5 for 4.50 |
| 2x.1MFD | 400VDC | 49¢; 5 for 2.00 |

WRITE FOR ADDITIONAL LISTING

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2500V for Crt 6.3V/.6A. 2.5V/1.75A csd Hvins 4/BC412 replmnt ...$7.98
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770VCT/200MA, 5V/6A, 12.6V/5.5A 6.95
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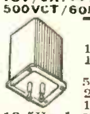
## FILTER CHOKES



12Hy/80ma/H'Sld/3KVins 2.25
10Hy/125ma/UTC/Csd/H'Sld/1Kvins ........ 1.49
50Hy/125ma/Csd/H'Sld .. 2.89
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12.6VCT/1.25A CSD HMSLD........ 1.49
24V/1.25A CSD @ $1.98. Two for.. 3.49
2X12V/2A or 24V/2A @ $3.98. Two for 6.98

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110V to 220V 50 Watt...........$2.95
110V to 220V 100 Watt..........$3.95
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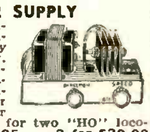
High Quality Forged, Tempered Tool Steel. 6 1/4" Adj Wrench. 5 1/2" Long Nose Pliers, 5 3/4" Cutters. With Carry Case .......$2.25
**8 Screw Drivers.** Assorted High Quality, Magnetized, Tool Steel. Hammer-Proof, Unbreakable Plastic Handles. 12" & smaller, incld Philips Type..............$1.25
**6 Pcs Set, as above**..............$1.10
**Write for Tool Sheet**

## DC POWER SUPPLY



0 to 12 VDC/2 Amp. Variable DC supply, uncased and completely built—inpt. 115v/60 cy. Usable LAB supply, filament D. C. plating, battery charging, model railroad, includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives ........$10.95 2 for $20.00

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**"FEDERALS"—All Purpose Selenium Rectifier Kit.** You can make 24 different Rectifiers 1/2 Wave/FW/CT/or Bridge. 8 Plates Rated 18V 12Amp each. All Hardware & Lugs. & instructions. **SPECIAL**.....$19.59

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We specialize in Rectifiers, Power supplies to specifications. Immediate delivery.

| Current (cont.) | 18/14 Volts | 36/28 Volts | 54/40 Volts | 130/100 Volts |
|---|---|---|---|---|
| 1AMP | 1.35 | 2.15 | 3.70 | 7.50 |
| 2AMP | 2.20 | 3.60 | 5.40 | 10.50 |
| 4AMP | 4.25 | 7.95 | 12.95 | 25.25 |
| 6AMP | 4.75 | 9.00 | 13.50 | 33.00 |
| 10AMP | 6.75 | 12.75 | 20.00 | 40.00 |
| 12AMP | 8.50 | 16.25 | 25.50 | 45.00 |
| 20AMP | 13.25 | 25.50 | 39.00 | 79.50 |
| 24AMP | 16.25 | 32.50 | 45.00 | 90.00 |
| 30AMP | 20.00 | 38.50 | | |

Full-Wave Selen Rect & Trans. in Kit Form. All 115V/60 cy inputs
up to 14VDC at 12 amps.........$23.98
up to 28VDC at 12 amps......... 31.98
up to 28VDC at 48 amps.........129.00

## RECTIFIER XFMRS

18—12—9—CT—9—12—18V/4Amp... $8.75
18—12—9—CT—9—12—18V/12Amp.. 16.75
18—12—9—CT—9—12—18V/24Amp.. 35.75
18 Volt 2Amp ........$1.98; 3 for $5.49

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**10-0-10V (CT) 100 Amp.**, fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL....$11.98

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2 Tubes, Sckts, xmfr, 115v60cyc Inpt, outpt 2.5vct/10A/Hivins ...... $4.98

**DIODE PROBE TUBE** Unexcelled for No-Loss **VHF** testing. Ultra-sensitive subminiature-envelope. New. w/data VR92 ...........25¢; 5 for $1.

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**Hivoltage** Condenser 500MMF 20KV .69
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**300 Ohm** Twinex Hvy duty 65mil all copper ....100 ft $1.39, 1000 ft $11.95
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Check these newly reduced prices

6 ohm 25W Model LH ..1.49; 2 for 2.49
15 ohm 25W w/knob ....1.49; 2 for 2.49
20 ohm 50W Model J ...1.98; 2 for 3.50
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100 ohm 50W Model K ...1.98; 2 for 3.50
200 ohm 25W Model D 1.49; 2 for 2.49
250 ohm 25W ........ea. 1.19; 3 for 2.98
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350, 500, 5000 ohm Slotted shaft. 25 watt ...............79¢; 3 for 2.00

# TABOGRAM

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50mf/350vdc FP ......5 for 1.00
30-15-10mf/250vdc ....5 for 1.00
40-20mf/250-25vdc ....6 for 1.00
30-2x20mf/450-25vdc FP 3 for 1.00
2x20mfd/450vdc ...69¢; 3 for 1.69
3x15mfd/450vdc ...98¢; 3 for 2.50
3x20mfd/400vdc ...79¢; 2 for 1.29
80mfd/450vdc .....79¢; 2 for 1.29
25mfd/450vdc .....69¢; 3 for 1.69
45mfd/450vdc .....79¢; 2 for 1.29
2x20mfd/450&25vdc.69¢; 3 for 1.69
We Ship Mtg & Type in Our Stock. Write for Additional Listing.

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**SEE-IN-DARK TUBE**

Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—data & tube, ea.......$4.98; 2 for $9.49

**SNOOPERSCOPE PWR SUPPLY**

**1800VDC/35MA**, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram..............$6.

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**PM 12"** GE S1201D Speaker........18.69
**PM 8"** Blue 8T18-1 Permflux.......13.00
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**Crystal** Mike & Cable............ 2.98
**Crystal** Mike Cartridge (Lapel Type).. 1.98
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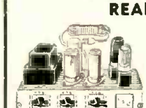
## ULTRA FIDELITY AUDIO

**PHILMORE** 20-30000cy Hi-Fi 20W Kit. Complete Ready to Build. Incld Pre Amp & Tubes. With Altec-Peerless Output.$51.00
**TECHMASTER TM-15A** 15 Watt Hi-Fi "Williamson Kit". **SPECIAL** .........$48.95
**TECHMASTER TM-15P** Pre Amp Kit.$19.55
**MEISSNER** Hi-Fi, Radio FM/AM & Phono Complete All Built System. Includes 10 Watt Hi-Fi Amp, 7 Tube AM/FM Tuner, 12" Hi-Fi Electro Voice Tweeter Woofer 12B Speaker & 3 Speed Webster Changer. **SPECIAL** Prepaid .............$199.95

## AUDIO AMPLIFIERS READY TO GO



**Model 305MP** 5 Watt Ampl, as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Ctnrls. Latest Compensated Tone Cntrl Design. Complete with Tubes ........$14.98
**Model 200MO** Mike OSC. Broadcasts Through Your Radio with No Direct Connection. W/Tubes ...................$6.98
**Model 100PO** Phono OSC Phonograph Broadcasts Through Your Radio. No Direct Hookup. W/Tube ................. $4.98
**Model 302PA** 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph. W/Tubes ......................$4.98

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Can be used as field phone of control of transceiver from a distant point. 15 mile, 2 wire operation, good for TV antenna installation. New ................$10.95

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Remote control of transmitter or Intercom. Less Relay, cable & plugs. Includes condensers, switches, jacks & matching trans mike to grid, line to line, line to grid, in metal box approx 7x4x4 ......$1.25

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**29PCS CHROME VANADIUM SPEED STEEL.** Top Quality for Machinists for all purpose use. Standard Full Length 1/16" to 1/2" by 64th's. With Huot Drill Index .........$9.69
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**60 PCS DRILLS** #1 to 60 with Index ..........$7.98
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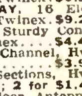
**SHARP CUTOFF HiQ CASED & SHIELDED** 60, 90, 150 cys ea....$1.75; 2 for $3.00
**UTC 854**, 1024, 1250 cys. ea. ...$1.50 2 for $2.50

## KITS AND COMPONENTS

**SILVER & MICA CNDSRS**.....30 for 2.50
**CONTROLS**, 50 ohm to 2 Meg ..10 for 2.50
**Resistors**, 1/2 & 1W, to 2 Megs 100 for 1.98
**VITREOUS WW RESISTORS**...10 for 1.00
**SOCKETS**, Asstd. 8, 7, 5 4P...25 for 2.49
**CERAMICON CNDSRS**, Asstd...12 for 1.00
**Electrolytic Condensers**, Asst...25 for 4.98
**OIL CONDENSERS**, Asst.......25 for 4.98
**RESISTORS**, 2 Watt, Asst. ....25 for 2.49

## REDUCED METER SPECIALS



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**0-60 ADC "AN"** Type Less Shunt...2.95; 2 for 5.00
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| 6AH5G | 1.49 | 6L6GA | 1.35 | 12SQ7GT | .63 | CK5678 | 1.89 |
| 6AH6 | 1.22 | 6L6GAY | 2.29 | 19T8 | 1.09 | 5687 | 5.49 |
| 6AJ5 | 1.40 | 6SA7GT | .69 | 19V8 | 1.62 | CK5702 | 3.49 |
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| 6AL5 | .54 | 6SF5 | .77 | 25Z6GT | .99 | 1N21B | 2.89 |
| 6AL7GT | 1.29 | 6SF7 | .73 | 28D7 | 1.95 | 1N21C | 21.50 |
| 6AN5 | 2.90 | 6SG7 | .72 | 35Z5GT | .59 | 1N22 | 1.25 |
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| 6AQ5W | 3.98 | 6SJ7 | .70 | 80 | .69 | 1N23A | 2.20 |
| 6AQ6 | .81 | 6SK7GT | .69 | 81 | 1.69 | 1N23B | 3.49 |
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| 6AR6 | 2.98 | 6SN7GT | .70 | 82V | 1.39 | 1N26 | 8.75 |
| 6AS5 | .79 | 6SN7WGT | 2.25 | 83 | 1.15 | 1N27 | 1.55 |
| 6AS6 | 2.43 | 6SQ7GT | .63 | 83V | 1.79 | 1N34 | .64 |
| 6AS7G | 4.65 | 6SR7 | .65 | 84/6Z4 | .99 | 1N34A | .90 |
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| 6AU5GT | 1.10 | 6ST7 | .98 | 117N7GT | 2.15 | 1N38 | 1.43 |
| 6AU6 | .59 | 6V6 | 1.39 | 117P7GT | 1.39 | 1N38A | 1.15 |
| 6AV5GT | 1.29 | 6V6GT | .57 | 117Z6GT | 1.19 | 1N41 | 8.95 |
| 6AV6 | .49 | 6W4GT | .57 | 117Z7GT | 1.49 | 1N42 | 6.95 |
| 6AW6 | 1.89 | 6X4 | .59 | CK501X | 1.26 | 1N43 | 1.45 |
| 6B4G | 1.23 | 12AH7GT | 1.45 | CK501AX | 2.20 | 1N46 | .69 |
| 6BA6 | .63 | 12AK5 | 1.98 | CK502AX | 1.49 | 1N47 | 4.00 |
| 6BA7 | 1.27 | 12AK5W | 2.98 | CK503AX | 1.29 | 1N48 | .55 |
| 6BC5 | .63 | 12AL5 | .75 | CK505AX | 1.79 | 1N51 | .45 |
| 6BC7 | 1.23 | 12AT6 | .52 | CK506AX | 1.49 | 1N52 | 1.39 |
| 6BD5GT | 1.65 | 12AT7 | .81 | CK509AX | 1.79 | 1N54 | .89 |
| 6BD6 | .83 | 12AU6 | .72 | CK512AX | 1.45 | 1N54A | 1.15 |
| 6BE6 | .59 | 12AU7 | .63 | CK522AX | 1.29 | 1N57 | .89 |
| 6BF5 | .98 | 12AV6 | .49 | CK525AX | 1.29 | 1N58 | 1.19 |
| 6BF6 | .65 | 12AV7 | .98 | CK526AX | 1.49 | 1N58A | 1.15 |
| 6BF7 | 2.55 | 12AW6 | 1.79 | CK528AX | 1.49 | 1N60 | .60 |
| 6BG6G | 1.39 | 12AX4GT | 1.20 | CK529AX | 1.79 | 1N61 | 2.07 |
| 6BG7 | 1.98 | 12AX7 | .79 | CK531DX | 1.89 | 1N63/K63 | 2.49 |
| 6BH6 | .63 | 12AY7 | 2.95 | CK532DX | 1.89 | 1N64 | .69 |
| 6BJ6 | .69 | 12AZ7 | 1.49 | CK533AX | 1.29 | 1N69 | .98 |
| 6BK7 | 2.15 | 12BA6 | .59 | CK534AX | .99 | 1N86 | 1.15 |
| 6BL7GT | 1.45 | 12BA7 | .79 | CK536AX | .99 | 1N87 | 1.15 |
| 6BN6 | 1.49 | 12BD6 | 1.23 | CK537AX | 3.04 | 1N88 | 1.15 |
| 6BN7 | 1.69 | 12BE6 | .59 | CK538DX | .98 | | |

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