LATEST IN TELEVISION · SERVICING · AUDIO

# RADIO-ELECTRONICS

K

NEW TV TUBES HAVE ELECTROSTATIC FOCUS

5-TUBE POCKET SUPER

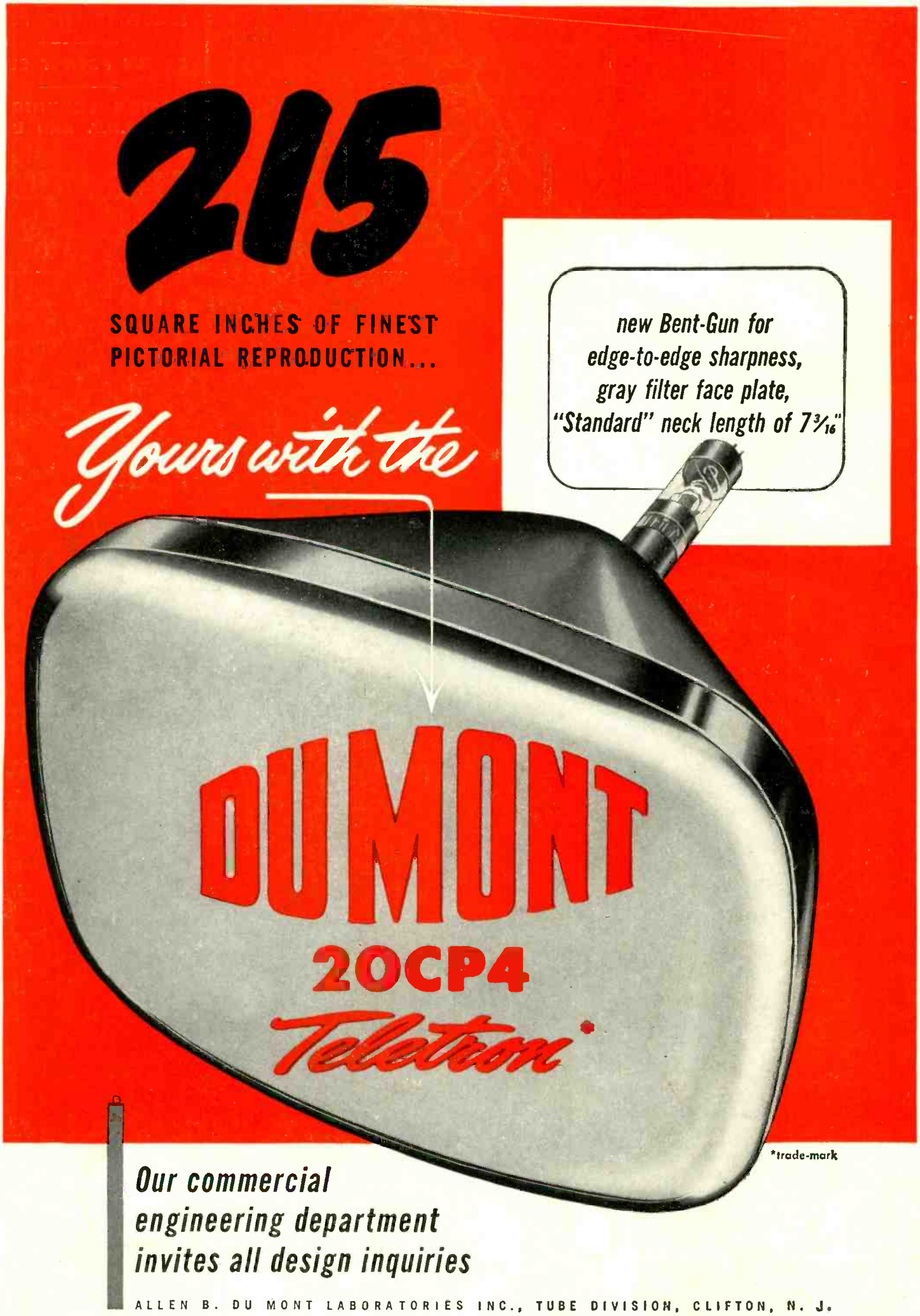
DESIGN TECHNIQUES FOR V.H.F. AND U.H.F.

HUGO GERNSBACK, Editor

MAY 1951

30¢ U. S. and CANADA

CONVERTING TO BIGGER TV TUBES — SEE TELEVISION SECTION


215
SQUARE INCHES OF FINEST PICTORIAL REPRODUCTION...
Yours with the
DUMONT
20CP4
Teletron*
new Bent-Gun for edge-to-edge sharpness, gray filter face plate, "Standard" neck length of 7 3/16"
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Our commercial engineering department invites all design inquiries
ALLEN B. DU MONT LABORATORIES INC., TUBE DIVISION, CLIFTON, N. J.

# NEW

## I'LL TRAIN YOU FOR YOUR FCC LICENSE

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.

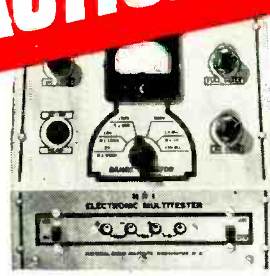
## YOU BUILD THIS TRANSMITTER

with parts I send. With this Transmitter you practice how to put a station "on the air." You perform procedures demanded of Broadcast Station Operators, conduct many experiments, make many practical tests.

# LEARN COMMUNICATIONS by PRACTICING at Home in Spare Time

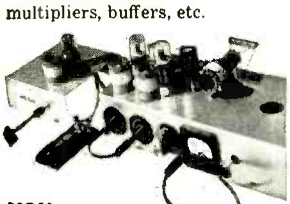
## *with* MANY KITS *of* RADIO EQUIPMENT I SEND

**YOU BUILD** this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.

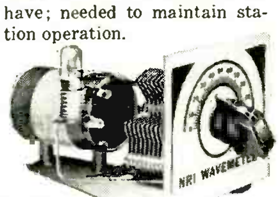




**YOU MEASURE** current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.



**YOU PRACTICE** setting up code, amplitude and frequency modulation circuits (put voice, music, etc., on "carrier signals" you produce). You learn how to get best performance.





**YOU BUILD** this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you?

Look at these facts. In 1946 only 6,000 Television sets were sold. In 1950, over 5,000,000. By 1954, 25,000,000 Television sets will be in use, according to estimates. 100 Television Stations are operating in 35 states. Authorities predict there will be over 1,000 Television Stations. This rapid growth means new jobs, more jobs, good pay for qualified men all over the U. S. and Canada. Then add development of FM, Two-way Radio, Police, Marine, Aviation and Micro-wave Relay Radio! Think what all this means! New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

Are you a beginner who wants steady work in this growing field? My NEW course can help you get an FCC License and prepare for the job you want. Are you a man with some training in Radio or Radar, or a Licensed Operator? My NEW course modernizes, increases the value of your knowledge and experience!

## MY COURSE INCLUDES TELEVISION

### Course Is New! Different!

Mail coupon now for facts about my NEW, intensely practical course in Radio-Television Communications. Let me send you FREE book. Read outlines of 78 lesson texts written by leaders in Communications and edited for you by my practical staff. See the nine big Kits of Parts I send that "bring to life" theory you learn. Read about the Transmitter you build and operate, about the Electronic Multitester you get. All equipment yours to keep. My NEW course covers Theory thoroughly and you get Practical Experience building units like those shown at the left. It's backed by N. R. I.—the world's oldest and largest home study Radio-Television school.

### Servicing Training Also Offered by N. R. I.

If you prefer a good-pay job in Radio-Television Servicing . . . or your own money-making Radio-Television Sales and Service Shop, I'll train you at home. My famous Servicing Course also includes many Kits of Radio Parts. You use them to get PRACTICAL EXPERIENCE with circuits common to Radio and Television. I also show you how to make $5, $10 a week or more EXTRA MONEY fixing neighbors' Radios while training. Full information in my 64-page book. . . . Mail coupon.

### Mail Coupon For Book FREE

Send today! See what my NEW course is like. Find out how I get you ready for a brighter future, better earnings, more security in Radio-Television. Send coupon now in envelope or paste on a postal. NO OBLIGATION. NO SALESMAN WILL CALL! My book, sent to you FREE, tells the full story. J. E. SMITH, President, Dept. 1EF, National Radio Institute, Washington 9, D. C.

# VETERANS

Get this training under G. I. Bill

# MAIL COUPON!

## I TRAINED THESE MEN

"N.R.I. has been my stepping stone from a few hundred to over $4,000 a year as a Radio Engineer."—ALTON B. MICHAELS, Trenton, Georgia.

"I am employed by WKBO as transmitter operator. Have more than doubled salary since starting in Radio full time!"—A. HERR, New Cumberland, Penna.

"Am Broadcast Engineer at WLPM. Your NEW Communications course shows the kind of equipment we use."—J. BANGLEY, JR., Suffolk, Virginia.

"4 years ago, I was a bookkeeper with hand-to-mouth salary. Am now Radio Engineer with ABC network."—N. H. WARD, Ridgefield Park, N. J.

## MAIL NOW-BOOK FREE

**MR. J. E. SMITH, President, Dept. 1EF**
**National Radio Institute, Washington 9, D. C.**

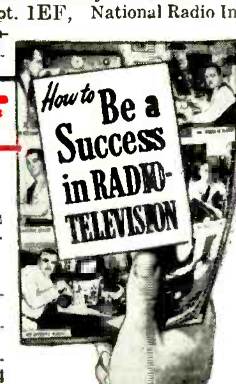
Mail me your 64-page Book about Radio and Television Communications opportunities and training. (No salesman will call. Please write plainly.)

Name.................................................Age..........

Address.................................................

City.............................Zone.........State..............

☐ **Check if Veteran** **Approved Under G. I. Bill**



# RADIO-ELECTRONICS

Incorporating
SHORT WAVE CRAFT* TELEVISION NEWS*
RADIO & TELEVISION
*Trademark registered U. S. Patent Office

formerly RADIO-CRAFT

MEMBER
AUDIT BUREAU OF CIRCULATIONS




## CONTENTS — MAY, 1951



**ON THE COVER:** In this very typical scene in Dave Krantz' Philadelphia Television Service Corporation Frank Krantz is aligning a completed job and Pete Maugeri is touching up an installed combination unit which has just been converted. *Kodachrome by Avery Slack*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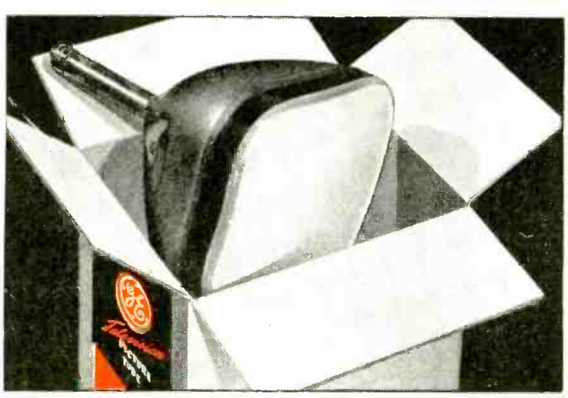
# "OUR CALL-BACK EXPENSE SCARED US!"

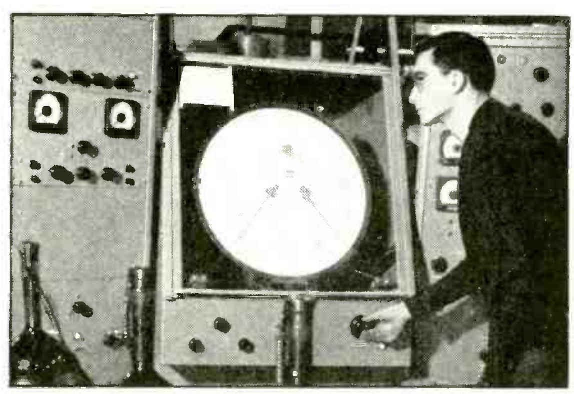

***"Customers' sets kept giving us trouble. That was before we standardized on quality tubes . . . G-E tubes!"***

Says **MIKE FILDERMAN,** ***Vice-President***
**Phillips Radio Company**
**2012 Shannon Place, S. E.**
**Washington, D. C.**

"Today we don't worry, as we did once, about call-back expense endangering profits. Quality tubes, which we use 100 percent, have done away with our most common cause of receiver trouble—tube failures. When our men finish one service job, they can go on to another knowing it's unlikely the first customer will ask for a return visit. Believe me, that saves plenty when you're servicing TV sets on yearly contract—and Phillips has about 15,000 contracts in the Washington, D. C., area . . . Quality and G-E mean the same thing to us! We feature G-E tubes; we find they keep our call-backs down, our men productive, our profits up."



**It's a habit with customers,** to ask to see the G-E label on tube cartons . . . so Phillips Radio and other service dealers have discovered. No name excels General Electric in public acceptance—means more quality-wise, builds greater user confidence.



**Every G-E picture tube** is carefully tested for electrical and screen characteristics. Here brightness is being measured, and the screen area inspected for any blemishes. Many other tests follow. G-E tubes are *pre-checked* for superior performance!

**FOR QUALITY TUBES TO CUT DOWN YOUR CALL-BACKS, SEE YOUR G-E TUBE DISTRIBUTOR!**

**GENERAL ELECTRIC**

181-KA5

# TV Exec Cites Need for More Skill in TV Servicemen

### *Military Needs Also Growing . . . Service Manager for Chicago Firm Warns "Old-Timers" that Youngsters are Better Prepared*

*Adequate test equipment and knowledge of its use are as important to TV technicians as X-ray machines are to surgeons.*

AT a meeting of the Philadelphia Radio Servicemen's Association, Tim Alexander, service manager of Motorola, Inc., Chicago, and chairman of the Radio Manufacturer's Association Service Committee, as quoted in *Radio & Television Weekly,* warned the old-timers among the radio servicemen that the "youngsters" coming into the business, fresh out of colleges and technical schools, would be taking their jobs away from them unless they take the necessary steps to make themselves as "competent as their new competition."

He pointed out that the "screwdriver and plier" serviceman has no permanent place in television, and that adequate test equipment and knowledge of its use are as important to the television technician as the X-ray machine is to the surgeon.

Mr. Alexander said, "If you are a mediocre television man who can repair a set only by slow, plodding, tenacious work—watch out. Pretty soon one of those 'youngsters' will open a store across the street from you. By virtue of his better training and greater skill, he will be able to do the job in one-quarter of the time. He will be paid twice as much per hour as you get, but the customer will still get off at half-price."

He advised the men to go to school again for latest methods and servicing information.

* * *

CREI offers just the specialized home study training you need. It's a streamlined course—fast, accurate, and complete—for men in the top third of the field. It gives practical answers to the technical problems you run into while servicing today's intricate TV and FM equipment. It is kept up-to-date through constant checking with CREI's affiliate, one of Washington's largest retailers of TV sets and home appliances. Maintenance problems encountered by this retailer's TV technicians are used as a practical lab to test the precision of CREI training.

CREI, an accredited technical institute founded in 1927, invites your investigation. CREI graduates today fill important radio-TV posts throughout the industry. During World War II CREI trained thousands of technicians for the Army, Navy and Coast Guard. Special CREI technical texts were used in the Navy's own training program. Leading industrial firms—RCA Victor, United Air Lines, TWA, Pan American Airways—to name only a few—use CREI's group training programs.

As one well-informed industry spokesman puts it, *"Technicians are becoming as scarce as certain tubes."* Growing military needs are cutting into the available supply of skilled personnel. The electronics industry, already a giant with normal civilian demands, is expanding rapidly to take care of military orders. Opportunity exists for *qualified* men—in essential industry as well as TV servicing.

Are you *qualified?* Start preparing now—while there is time to cash in on a well-paid technical job. Write today for complete FREE information. The cost of this famous home-study training is nominal, the terms easy.

**The Three Basic CREI Courses:**

Television and FM Servicing (streamlined course for men in "top third" of field); Practical Radio Engineering (fundamental course in all phases of radio-electronics); Practical Television Engineering (specialized training for professional radiomen).

*Also available as Residence School Courses.*

**NOTE TO MEN WHO EXPECT TO BE IN UNIFORM SOON:**
If you expect to enter the armed services, why not prepare *now* to qualify for a top job at good pay. TV-electronics training is excellent background for vitally important radar, communications, and navigation work.

**CAPITOL RADIO ENGINEERING INSTITUTE**
**Dept. 145C, 16th & Park Rd., N. W., Washington 10, D. C.**

*Gentlemen:* Send me complete details of the TV and FM Servicing home study course. Also send brochure that explains the CREI self-improvement program and gives complete details and outline of course. I am attaching a brief resume of my experience, education and present position.

Check the Field of Greatest Interest:

- ☐ TV, FM & Advanced AM Servicing
- ☐ Practical Television Engineering
- ☐ Practical Radio Engineering
- ☐ Aeronautical Radio Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Radio-Electronics in Industry

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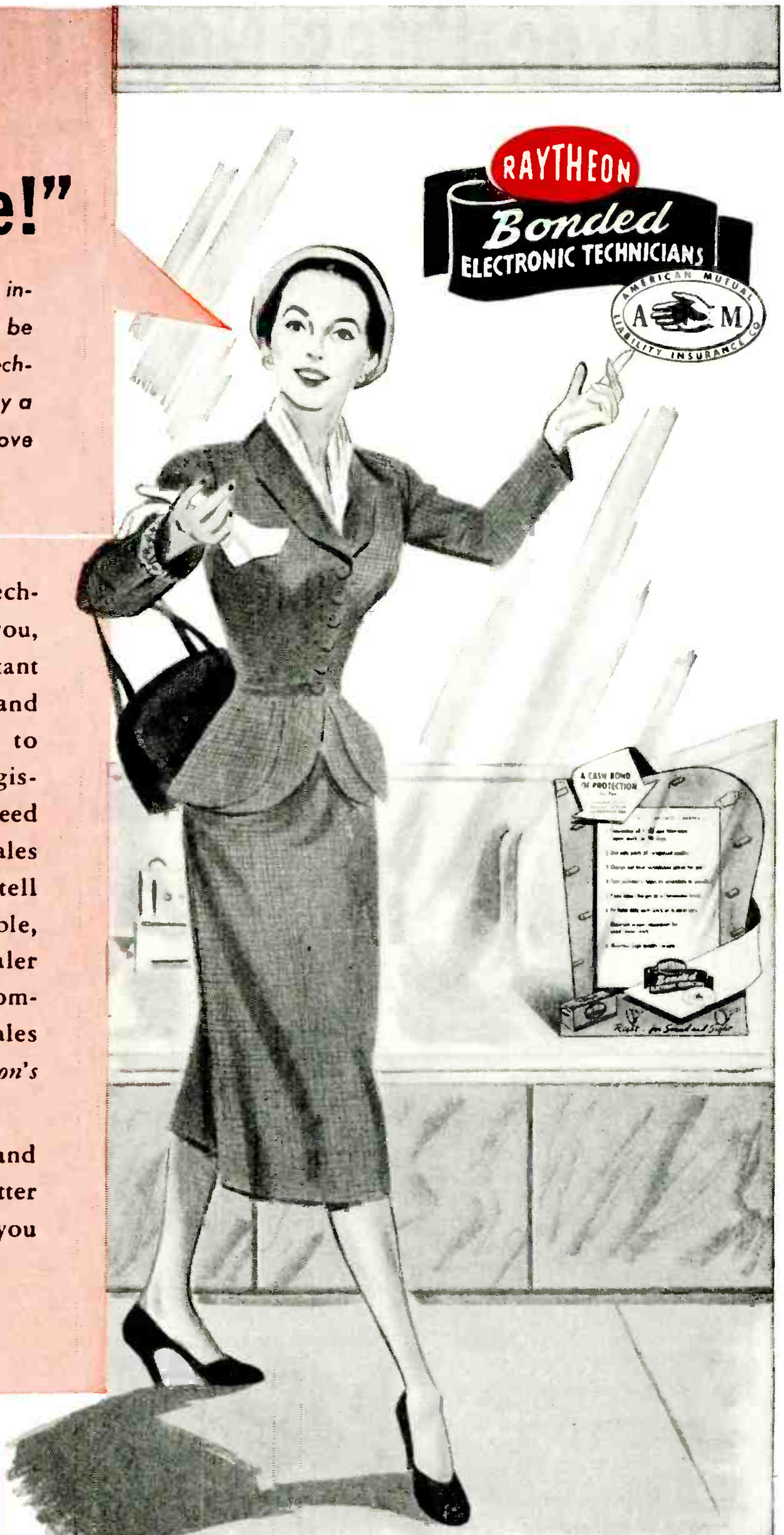
IF RESIDENCE SCHOOL IN WASHINGTON, D.C., IS PREFERRED, CHECK HERE ☐

# "This Seal means a 'Good Deal' to me!"

*"My Television and Radio sets are pretty big investments to me. That's why I insist that they be serviced by a Raytheon Bonded Electronic Technician — a technician whose work is backed by a cash bond — whose skill and integrity are above reproach."*




The RAYTHEON *Bonded* Electronic Technician Program means a *good deal* to you, too. If you can qualify for this important honor, your 90-day guarantee on TV and Radio repairs is cash-protected up to $400.00 by a *bond.* You receive a Registered Certificate, Identification Cards, Creed Displays and Decals and a host of other sales helps and shop aids — all designed to tell the world you're a completely capable, thoroughly reliable service dealer—a dealer with whom customers can deal with complete confidence. And yet, this great sales stimulator *costs you nothing — it's Raytheon's investment* in *your* future.

If you're interested in getting head and shoulders above your competitors, better ask your Raytheon Tube Distributor if you can qualify for this exclusive sales asset.


**RIGHT . . . for SOUND and SIGHT**

**RAYTHEON**

**RAYTHEON MANUFACTURING COMPANY**

Receiving Tube Division

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

*Excellence in Electronics*

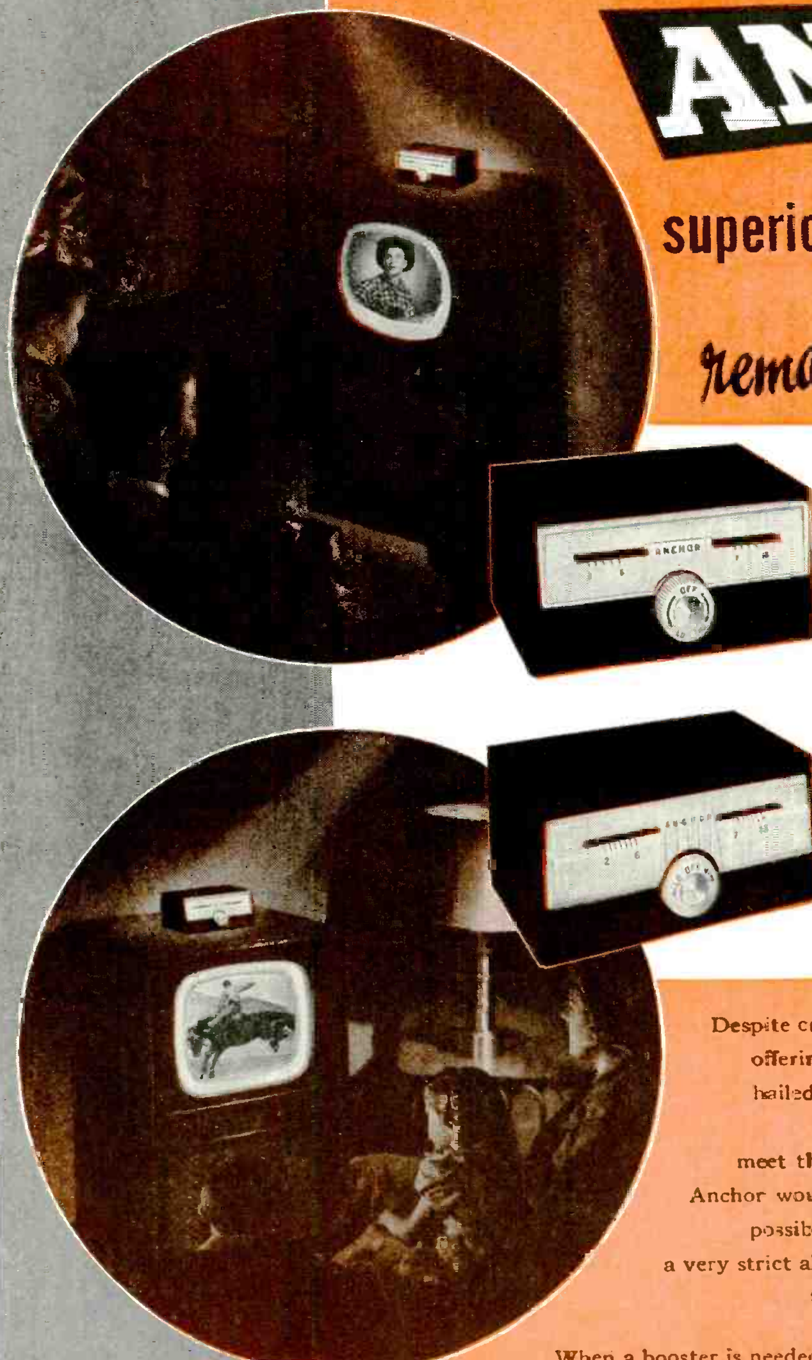
RADIO AND TELEVISION RECEIVING TUBES, CATHODE RAY TUBES, SPECIAL PURPOSE TUBES, SUBMINIATURE TUBES, MICROWAVE TUBES

# PERFORMANCE IS WHAT COUNTS!

## ANCHOR'S

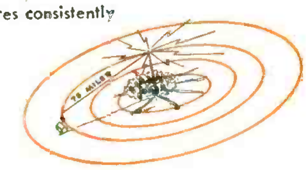
**superiority of performance**

*remains unchallenged!*



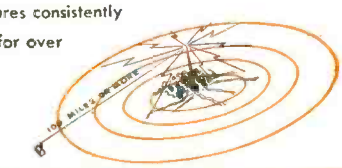
**THE ANCHOR *Suburbanite***

Single-Stage Booster—for low signal areas in or near cities. Assures consistently good reception up to 75 miles.



**THE ANCHOR *Granger***

Two-Stage Booster—recommended for distant rural areas. Assures consistently good reception for over 100 miles.



Despite critical material shortages, Anchor not only is offering the same high quality standards so widely hailed by the TV set industry, itself, but it is still making as many boosters as a year ago. To meet the current unprecedented demand, however, Anchor would have to expand, which is naturally not possible now! Therefore they have had to institute a very strict allocating system. No preference on deliveries to anyone has been or ever will be practiced.

When a booster is needed to complete a perfect installation, Anchor's outstanding performance under all conditions has made it the first choice of those who buy and sell. So always buy the *best*—first!

ANCHOR ENGINEERING ALWAYS A YEAR AHEAD!

**ANCHOR RADIO CORP.**
2215 SOUTH ST. LOUIS AVENUE • CHICAGO 23, ILLINOIS

*See us at Booth 131 at the Radio Parts Show*

**A NEW WALKIE-TALKIE** about half the size and weight of its World War II counterpart and with about twice the range is now being delivered to the U.S. Army Signal Corps by RCA. Using the latest in subminiaturization techniques, the set has complete subassemblies such as the FM discriminator scaled down to fit in metal cylinders no larger than a miniature tube. It also boasts the smallest tuning coil of its type ever manufactured. The coil is smaller than a dime in diameter and about ½-inch thick, but has a Q of over 100.

Old walkie-talkie, left, and new model.

The transmitter-receiver section of the walkie-talkie is only 3 inches deep, 9½ inches high, and 10½ inches wide, and it weighs only 9 pounds. The battery power supply is about the same size, and the complete equipment, including carrying harness, antennas, spare parts, and handset, weighs about 25 pounds. The set has 16 tubes and provides two-way voice communication over a range of about 5 miles on frequencies in the v.h.f. band. Provision is made for remote operation and unattended relay operation, using two sets, to facilitate communication over hills or other obstacles.

**TWO NEW LABORATORIES,** one for applied research in electronics and the other for student electrical engineering activities, will be built at Stanford University in California, according to an announcement by President Wallace Sterling. The new facilities will represent an outlay of $250,000, and the student laboratories will be in the form of a wing adjoining the applied research center.

The student laboratory is made possible by a gift from the Hewlett-Packard Company, electronics equipment manufacturing firm headed by two Stanford graduates, William Hewlett and David Packard. The company's gift was made in appreciation of the training these men received while attending Stanford and for the opportunity they had to carry on their own experiments in the old radio laboratory. Mr. Hewlett's thesis was the oscillator which later became the basis of the Hewlett-Packard business.

**RADAR SCREEN** to guard the continental United States against a sneak air attack will be completed within the year, according to a statement by Air Force Secretary Thomas K. Finletter. An additional network to guard Alaska will be completed within another year. The protective system will include all-weather interceptor aircraft to go after attackers which the radar picks up, and the radar itself will be augmented by thousands of civilian volunteer observers.

**TUBES FOR COLOR TV** have been in production at the rate of 100 per month at the RCA's Tube Division, it was reported in March. The production had been going on for three or four months, and the tubes were being shipped to set manufacturers for experimental use. RCA sources said that the tubes are hand made and could not be mass-produced at the present time. The company also made known that the April production schedule for the new chassis using the electrostatically focused black-and-white tubes would be postponed a few months.

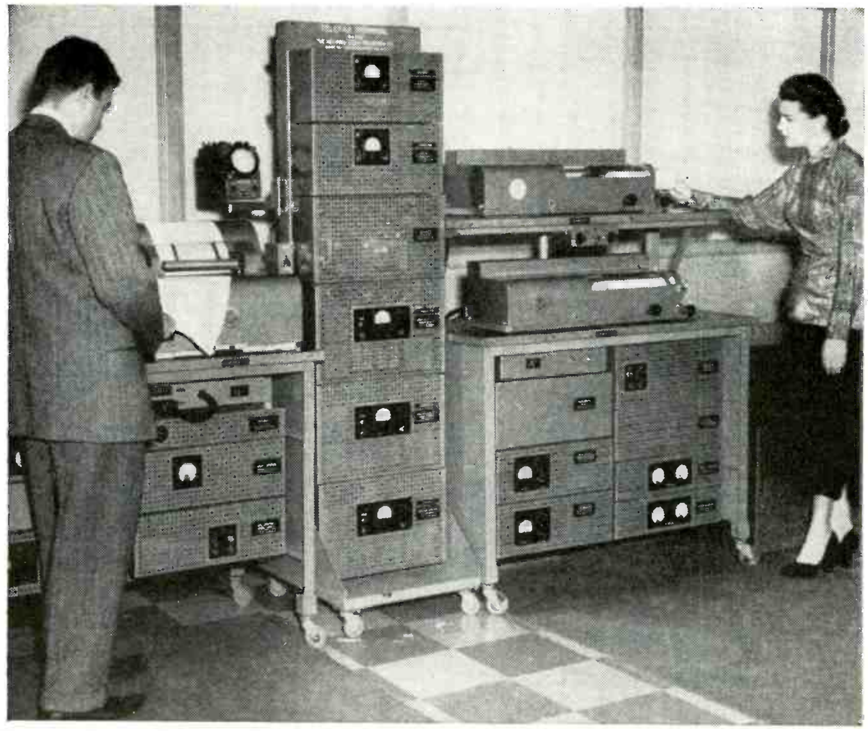
**THE UPPER ATMOSPHERE,** already the subject of much prodding and probing, will undergo more probing by National Bureau of Standards scientists whose object is to improve long-range radio communications. They will use a mobile sending and receiving station, located directly under the predicted point where a radio beam between Sterling, Virginia, and St. Louis, Missouri, is bent back toward the earth.

By very careful study of this and other bending points, the scientists hope to get an accurate map of the path of radio waves through the ionosphere.

**ELECTRONIC PARTS** manufacturers will be allowed to make more parts for television and radio sets than are now being produced. The Office of Civilian Requirements in the National Production Authority approved the principle of making certain that parts enough are turned out to keep existing equipment operating.

Distributors had requested that scarce metals be allotted to parts manufacturers in sufficient quantity to allow them to operate at 50% above present levels. OCR approved of the basic policy, but said that actual percentages would have to be worked out in line with the requirements of essential industries. Steps are also being taken to recover scarce metals from scrap and from low-grade ores.

**LATEST ELECTROSTATIC** focus picture tube operates with a focusing voltage from 350 down to 150 volts or less, working off the receiver's regular low-voltage supply. Engineers of the Rauland Corp. used an entirely new approach to design the electron gun. Provisional number for the 17-inch rectangular tube is 17HP4. Fourteen- and 20-inch rectangular models will also be made.



New high-speed facsimile equipment. The transmitter is at right, receiver at left.

**HIGH-SPEED FACSIMILE** equipment just perfected by the Western Union Telegraph Company will process message material ten times as fast as present apparatus.

The scanning rate is about 127 square inches per minute, or the equivalent of some 3,000 words of newspaper text.

Material to be transmitted is put into a transparent cylinder. When the end gate of the cylinder is closed, the machine starts automatically, the centrifugal force keeping the copy against the cylinder wall. The drum speed is 1,800 r.p.m. as against 180 revolutions in older equipment. A pin point of light is focused along a track paralleling the spinning cylinder, and a photocell reacts to the light and dark portions of the page. The scanning is 120 lines to the inch.

At the receiver, the signals are fed through a moving stylus to an electrosensitive recording paper (*Teledeltos*) developed especially for this machine. Instantly a permanent reproduction of the material transmitted appears ready for use. The paper feeds automatically from a 9¼-inch wide roll, and signal from the transmitter causes a knife to cut the facsimile copy from the roll at the end of the message. No processing of any kind, either before or afters transmission is needed.

The equipment uses a bandwidth of 31 kc and a carrier of 25 kc. The carrier is modulated up to 15.5 kc by the scanner and both sidebands are used, so that the full spectrum is 9.5 to 40.5 kc.

**ELECTRIC RAZORS,** garage-door openers, diathermy machines, and other such devices should be controlled or shut down, if necessary, to keep them from aiding enemy bombers in finding their target. This point was brought out by the Defense Department in asking Congress to give the President greater control over the air waves. Present law gives the President authority over broadcasting, but the Defense Department is seeking to make the laws more specific, especially those concerning periods of emergency.

**ADVERTISING BY RADIO** in streetcars and buses was banned some weeks ago by the City of Minneapolis. A temporary injunction to stop the ban was sought by Broadcast Services, Inc., but the city filed a demurrer claiming that there was no cause for legal action because it had a right to stop the music and advertising. A county court judge overruled the demurrer and the city must now prove that the ban was not unreasonable.

**FCC PROPOSALS** for vast expansion of television service through opening channels for 2,000 additional television stations were announced March 22. Three-quarters of the new stations would be in the u.h.f. region, though 500 v.h.f. stations were planned as well. These would be allocated on 12 v.h.f. and 65 or 70 u.h.f. channels. Increased power for existing stations, especially in the v.h.f., was proposed.

Co-channel v.h.f. stations will have minimum separation of 180 miles (about the same as at present) by requiring use of offset carrier operation.

The FCC stated that it intended to consider lifting the freeze immediately on new v.h.f. station construction in Alaska, Hawaii, Puerto Rico and the Virgin Islands, where operation cannot cause interference to existing services.

Roughly 10% of the allocations are reserved for educational television.

Broadcast networks and television manufacturers joined in hailing the announcement as a preliminary to an early end of the television freeze.

—end—

### Merchandising and Promotion

**Littelfuse, Inc.** has developed a new compact transparent plastic package for holding its TV "Snap-On" fuse holders.

The box, which holds 10 fuses, has many other uses once the fuses have been sold.

**General Electric** has issued a new TV Replacement Parts Catalog to distributors, which lists the parts for G-E sets produced from 1945 to December 1, 1950. The 144-page, loose-leaf catalog includes a cross reference which makes it possible to determine all the information about any part.

**Electro-Voice, Inc.**, Buchanan, Mich. launched a promotional campaign on its phono-cartridge, using advertisements and selling aids. The company has also

issued a complete replacement chart which gives comprehensive data on phono-cartridge replacements, including the products of other manufacturers. The chart is available free from Electro-Voice distributors, or directly from the company.

**Philco Corp.** has issued a new phonograph needle display merchandiser to help service technicians and dealers sell its needles. It is available from the company's distributors.

**Simpson Electric Co.** released its new 16-page bulletin illustrating all the Simpson test instruments. This bulletin, No. 51, includes a complete listing of the company's test equipment.

### Servicing Business

**Sylvania Electric Products, Inc.** is sponsoring a number of meetings for radio and TV service technicians, in cooperation with authorized distributors. The first meeting was held in Baltimore where more than 300 attended a two-hour talk by Clarence L. Simpson, service engineer for Sylvania's Radio Tube and Picture Divisions.

**RCA Service Co.** was commended by Albert M. Haas, president of the Philadelphia Contractors Association, for its efforts in making available to TV service technicians, up-to-date information on changes and improvements in receiver engineering. Mr. Haas spoke at the conclusion of the RCA Service Co. training course, sponsored by the Raymond Rosen Co., RCA Victor's Philadelphia distributor.

E. C. Cahill, president of the RCA Service Co., said that the TV servicing industry could see its way through the problems facing it today by pooling its ingenuity. As his company's contribution to such a pool, Mr. Cahill made available to the industry a comprehensive conservation program.

**The American Distributing Co.**, Baltimore subsidiary of the American Television Co., has inaugurated a promotion plan to sell TV conversions on a wide scale. The initial meeting was attended by 95% of all TV service dealers in Baltimore.

### Production and Sales

**Philco Corp.** has announced a new nation-wide program of factory-supervised service assuring Philco customers of good service. The plan keeps the responsibility for service with the dealers and service technicians. More field service engineers have been added to assure closer supervision of each area. Additional servicing technical data is also being supplied.

The **RTMA** reported that 18% of all home radios and 10% of all TV sets produced in 1950 contained FM reception facilities. An estimated 1,471,900 radios with FM circuits were made during 1950, as compared with 1,000,000 in 1949.

### Parts Situation

The **National Better Business Bureau** reported that its 13-city survey among dealers, distributors and service technicians indicated that the scarcity of parts had increased considerably during the past six months. Estimates range from 0 to over 200%. A joint committee of the Better Business Bureau and RTMA is working on a series of recommendations to alleviate this condition.

The **Association of Electronic Parts & Equipment Manufacturers** hailed the announcement that the NPA had established a priority system for critical materials for maintenance and repair parts as a "tremendous help" for radio-TV industry. The order, in general, followed the suggestions presented by the mobilization committee of EP&EM and a committee of the Sales Managers Club, Eastern Group.

The **RTMA** urged the heads of all member-companies to cooperate in an industry-wide program to conserve materials. Dr. W. R. G. Baker, director of the RTMA Engineering Department held a meeting of the engineers to implement the conservation program.

The **International Resistance Company** announced a plan to support distributors who go into manufacturing or assembling of equipment for defense order production contracts. IRC will offer them manufacturer's prices and engineering assistance on all its products whenever needed.

**Jensen Mfg. Co.** is under way on a drive to salvage Alnico V, the permanent magnet material from discarded loudspeakers, in an effort to maintain a supply of speakers for the replacement industry. Service technicians and dealers are urged to turn discards over to cooperating distributors. A special allocation for such distributors will be made, determined by the jobber's scrap contribution. Display and mailing pieces are being used to back up the campaign.

### New Plants and Expansions

**Sylvania Electric Products** has purchased a new factory at Woburn, Mass., which will be used for the production of electronic tubes and equipment for national defense. Construction on the million-dollar 100,000 square-foot factory will be started this spring.

The **Centralab** division of **Globe-Union** has established an additional manufacturing plant in a six-story building in Milwaukee, Wis. The 65,000 square feet of additional space will be used by Centralab to make a new line of electronic devices which have both defense and peacetime applications.

**Jensen Industries, Inc.** recently acquired an interest in Orradio Industries, Opelika, Ala. The move was made to permit Jensen to broaden its line of phono-products.

**Hallicrafters Co.** has purchased for $225,000 a building in Chicago which it had been occupying on lease since January 1, 1950.

**Insuline Corp. of America** has acquired a third factory in Long Island City, N. Y. It provides 50,000 square feet of floor space and will be equipped with $100,000 worth of new machines.

## Annual Financial Reports

| | 1950 | 1949 |
|---|---|---|
| **Allied Electric Products, Inc.** (Parent Company Sheldon Electric, 6 mos. to 12/31/50) | | |
| Earnings | $552,634 | $34,490 |
| Sales | $6,502,451 | $1,571,140 |
| **Clarostat Mfg. Co.** | | |
| Earnings | $407,908 | $102,113 (loss) |
| Sales | $5,985,240 | $2,331,970 |
| **Cornell-Dubilier** (December, 1950, Quarter) | | |
| Earnings | $333,709 | not given |
| Sales | $8,049,393 | not given |
| **Gabriel Co.** (Parent Company Ward Products) | | |
| Earnings | $824,271 | $325,674 |
| Sales | $12,670,250 | $9,751,412 |
| **General Electric** | | |
| Earnings | $173,424,000 | $125,639,000 |
| Sales | $1,960,429,000 | $1,613,564,000 |
| **Radio Corp. of America** | | |
| Earnings | $46,249,865 | $25,144,279 |
| Sales | $586,393,450 | $397,259,020 |
| **Tung-Sol Lamp Works, Inc.** | | |
| Earnings | $3,058,151 | $867,469 |
| Sales | $29,425,022 | $15,530,969 |

**Dividends**

**General Electric** voted a 75¢ dividend, an increase over the previous 60¢ quarterly dividend.

**Allied Electric Products** (parent company Sheldon Electric) declared a quarterly dividend of 20¢ on common stock and 11¼¢ on preferred stock.

RCA has announced an 87½¢ dividend on preferred stock.

**Sprague Electric Co.** has declared a quarterly dividend of 50¢ a share on common stock.

## Business Briefs

. . . RCA released the details of the development of its three-color TV picture tube to manufacturers to further experimental work in color TV.

. . . **Zetka Television, Inc.**, Clifton, N. J., has acquired the right to purchase an interest in Sightmaster's patents on cathode-ray tubes for color.

. . . Howard J. Rowland, chief electrical engineer of **Workshop Associates** was granted a patent for developments incorporated in the company's "Dubl-Vee" TV antenna.

. . . Boland & Boyce and Norman J. Trought, industrial designer, joined under the name of **Trought, Boland & Boyce**, Newark, N. J.

. . . **Clarostat Manufacturing Co.** announced that jobber sales had doubled during 1950.

. . . RCA announced that it is proceeding with full-scale production on its instantaneous theater TV system.

. . . **Central Transformer Co.** was recently formed in Chicago under the direction of Morton R. Whitman, president, and Lloyd G. Shore, secretary-treasurer.

. . . RCA **Institutes** announced a Home Study TV Course for working technicians in a move to combat the increasing shortage of trained TV service technicians.

. . . **The Workshop Associates** announced a 60% increase in sales for 1950 as compared to the previous year.

. . . The **RTMA** FM Policy Committee met in Washington, D. C., with the FM Committee of the National Association of Broadcasters to discuss problems facing FM manufacturers and broadcasters.

. . . **Burgess Battery Co.** received a certificate of merit for 1950 from the New York Hall of Science, for its pioneering of artificial electrolytic manganese dioxides and its founding of the industry of reserve type cells.

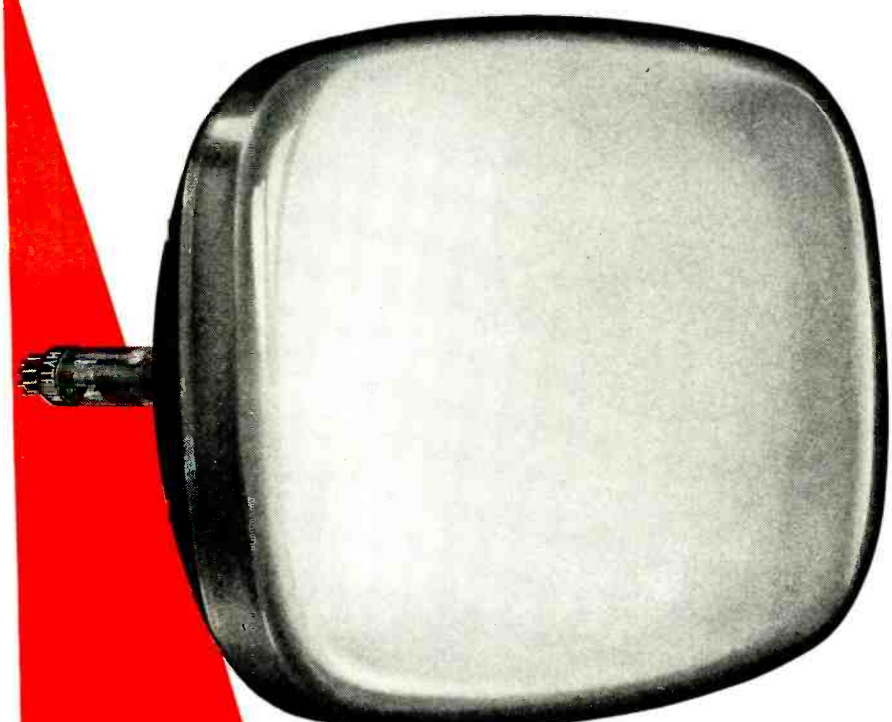
## Show Section

The 1951 Parts Distributors Conference and Show will be held at the Hotel Stevens in Chicago May 21 to 23. Distributor registrations have already set an all-time record. About 175 manufacturers have either reserved booths in the Exhibition Hall or display rooms in the hotel. As innovated last year, attendance in the Exhibition Hall and display room area will be restricted to distributors and manufacturers' representatives.

The educational program of the 1951 show will include a complete clinic on selling. It will feature an hour-long demonstration of visual selling by the "three flying horsemen of sales"—Jim Dornoff, Les Falk, and Al Herr, Milwaukee sales executives.

Helen Staniland Quam, of Quam-

# NEW ELECTROSTATIC RECTANGULAR 20FP4



ANOTHER

**HYTRON FIRST**

FOR YOU

To its logically designed original *studio-matched* rectangular, Hytron now adds new advantages: the cobalt-and-copper savings of electrostatic focus.

The original Hytron electrostatic type 20FP4 eliminates the magnetic focus unit. Uses a single-field ion-trap magnet. Yet the 20FP4 gives you unsurpassed, clear, sharp pictures . . . despite economies in associated components enforced by defense needs.

Seeing is believing. Watch for this newest Hytron first from the world's most modern picture-tube plant. You'll be seeing it, buying it soon. You'll marvel at its sharp pictures, even at lower line voltages.

Again you'll say it pays to stay out front in picture tubes. It pays to insist on Hytron's original *studio-matched* rectangulars . . . choice of 9 out of 10 leading TV set makers.

MANUFACTURERS OF RECEIVING TUBES SINCE 1921

**HYTRON**

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

**HAVE YOU GOT YOUR COPY?**

The new 5th edition of the Hytron Reference Guide for Miniature Electron Tubes is out. See your Hytron jobber. Get your free copy of this old friend brought up to date today.

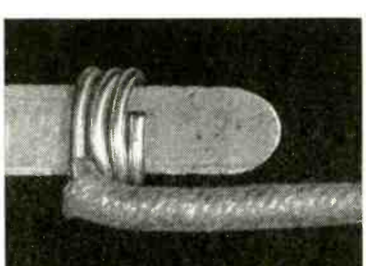
Nichols, chairman of the Trade Names Display Committee, announced that this year's "Aisle of Trade Names" will be nearly double the size of last year's display. Nearly 200 names, a virtual Who's Who of the replacement parts industry, will be exhibited.

List of Exhibitors in
THE 1951 PARTS DISTRIBUTORS
CONFERENCE & SHOW

| COMPANY | EXHIBITION HALL BOOTH NUMBER ASSIGNED | DISPLAY ROOM NUMBER ASSIGNED |
|---|---|---|
| Aerovox Corporation | 411 | |
| Alliance Manufacturing Co. | 322 | |
| Alpha Wire Corporation | 420 | |
| Altec Lansing Corp. | 302 | 607 |
| American Microphone Co. | 671 | |
| American Phenolic Corp. | 207 | 550A-551A |
| American Radio Hardware Co. | 125 | |
| American TV & Radio Co. | 419 | |
| Amperite Co. | 311 | |
| Anchor Radio Corp. | 131 | |
| Approved Electronic Instrument Co. | 107 | |
| Astatic Corp. | 216 | 542A-544A |
| Atlas Sound Corp. | 213 | 553 |
| Audak Company | | 523 |
| Audio Devices | 315 | 602A |
| Barker & Williamson, Inc. | 321 | |
| Belden Manufacturing Co. | 405 | |
| Bell Sound Systems | 223 | 613A-615A |
| David Bogen Co., Inc. | | 610-611 |
| British Industries Corp. | 301 | |
| Brush Development Co. | 678 | |
| Burgess Battery Co. | 587 | |
| Bussman Manufacturing Co. | 113 | |
| Camburn, Inc. | 119 | |
| Centralab Division | 573 | |
| Channel Master Corp. | | 547 |
| Chicago Transformer Division | 676 | 535A-536A |
| Clarostat Mfg. Company | 580 | |
| Clear Beam Antennas | 24 | |
| Columbia Wire & Supply Co. | 204 | |
| Consolidated Wire & Assoc. Companies | 117 | |
| Copperweld Steel Co. | 108 | |
| Cornish Wire | 683 | |
| Crest Transformer Corp. | 205 | |
| Drake Electric Works | 222 | |
| Allen B. Du Mont Laboratories | | 521-522 |
| Duotone Company | 210 | |
| Eicor, Inc. | | 700-701A |
| Electronic Instrument Co. | 202 | |
| Electronic Measurements Corp. | 6 | |
| Electro Products Laboratories | 418 | |
| Electronic Publishing Co. | 609 | |
| Electro-Voice, Inc. | 320 | 658A-659A |
| Electrovox Co., Inc. | 120 | |
| Erie Resistor Corp. | 318 | 512-513 |
| Espey Manufacturing Co. | 579 | |
| Federal Tel. & Radio | | 620-621 |
| Freed Transformer Co. | 305 | |
| Gee-Lar Manufacturing Co. | 102 | |
| General Cement Manufacturing Co. | 416 | 507 |
| General Electric Co. | 590 | 521A |
| General Industries | 219 | 619A-620A |
| Graybill | 309 | |
| Guardian Electric Co. | 414 | |
| Halldorson Company | 114 | |
| Hallicrafters Co. | 576 | 605A-607A |
| Hammarlund Mfg. Co. | 417 | |
| Hickock Electrical Instr. Co. | | 515A-517A |
| Hi-Lo TV Antenna Corp. | 112 | |
| Hytron Radio & Electronics Corp. | 408 | |
| Illinois Condenser Co. | 130 | |
| Illinois Transformer Co. | 122 | 639-640 |
| Indiana Steel Products Co. | 412 | 509A |
| Insuline Corp. of America | 406 | 556 |
| International Resistance Co. | 677 | |
| Industrial Precision Prods. | | 658 |
| Jackson Electrical Instrument Co. | 421 | |
| James Vibrapowr Co. | 208 | |
| J-B-T Instruments | 410 | 657 |
| Jensen Industries | 316 | 616 |
| Jensen Manufacturing Co. | 402 | 504-505 |
| Jersey Specialty Co. | 25 | |
| J. F. D. Manufacturing Co. | 313 | 534 |
| E. F. Johnson Co. | 133 | |

—end—


*Bell Telephone Company craftsman wraps a wire to complete a connection. Wire is inserted into the nozzle and a rotating spindle whips it around terminals.*



*Close-up of connection made with new tool—neat, tight windings.*

IT DOESN'T take long to wrap a wire around a terminal and snip off the end. But *hundreds of millions* of such connections are being made each year to keep up with America's growing demand for telephone service.

Now this job is done much more efficiently with a new wire wrapping tool invented at Bell Telephone Laboratories. This "gun" whirls wire tightly around terminals before solder is applied. The connection is better and there is no excess wire to be clipped off—perhaps to drop among a maze of connections and cause trouble later.

The new tool is being developed in different forms for specialized uses. The hand-operated wrapper in the illustration is for the telephone man's tool kit. Power-driven wrappers developed by Western Electric, manufacturing unit of the Bell System, are speeding the production of telephone equipment. The gun's small nozzle reaches where fingers couldn't—a big advantage these days when efforts are being made to produce telephone system parts smaller as well as better.

Bell Telephone Laboratories scientists devise many special tools that help your telephone system to keep pace with service demands economically—keeping your telephone service one of today's best bargains.

**BELL TELEPHONE LABORATORIES**

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST


# DON'T LET HIM "PITCH" YOU BLACK IS WHITE...

# INSIST ON Sheldon "Telegenic" Picture Tubes

## where BLACK IS BLACK - WHITE IS WHITE - and between ALL THE NATURAL INTERMEDIATE SHADING!

This FULL RANGE of picture tones seen only on Sheldon "Telegenic" Picture Tubes, makes possible MAXIMUM CONTRAST with CLARITY . . . with NO EYE STRAIN and NO GLARE . . . whether on a Velour Black or clear face screen . . . whether viewed in daylight or under artificial light.

Superior picture quality is the reason why Sheldon Picture Tube production has been stepped up to 5,000 daily! This production increase is made possible by another recent installation of the most modern in-line exhaust unit in the industry.

**SHELDON ELECTRIC CO.**

*A Division of ALLIED ELECTRIC PRODUCTS INC.*

**68-98 Coit Street, Irvington 11, N. J.**

*Branch Offices & Warehouses:*

CHICAGO 7, ILL., 426 S. Clinton St. • LOS ANGELES 26, CAL., 1755 Glendale Blvd

Sheldon NATURAL IMAGE SOFT GLOW Picture Tube

*Manufacturers of*

SHELDON TELEVISION PICTURE TUBES • CATHODE RAY TUBES • FLUORESCENT LAMP STARTERS AND LAMPHOLDERS • SHELDON REFLECTOR & INFRA-RED LAMPS • PHOTOFLOOD & PHOTOSPOT LAMPS • TAPMASTER EXTENSION CORD SETS & CUBE TAPS • SPRING-ACTION PLUGS • RECTIFIER BULBS

**WRITE FOR VISUAL PROOF OF SHELDON'S SUPERIOR PICTURE QUALITY!**

**MAIL COUPON TODAY**

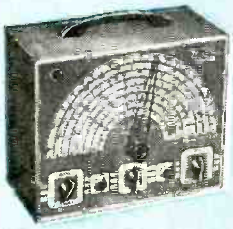
Sheldon Electric Co., 68 Coit St., Irvington 11, N. J. B

Send ☐ Proof of Picture Quality
☐ "Characteristics and Dimensions" Wall Chart
☐ "Television Mis-Information"
☐ "Ion Burns—How to Prevent Them" Brochure
*(They're free — but PLEASE PRINT)*

Name__________ Title______
Company__________
Street__________
City__________ Zone____ State____

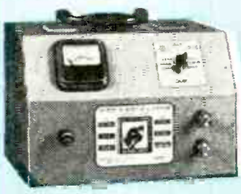
**VISIT BOOTH NO. 201, PARTS DISTRIBUTOR SHOW, STEVENS HOTEL, CHICAGO, MAY 21-23.**

## EICO KITS and INSTRUMENTS

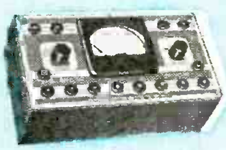


320K SIG. GEN. KIT $19.95
Wired $29.95

**New** 950K COND.-RES. COMP. BRIDGE KIT $19.95 Wired $29.95

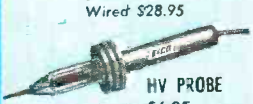


**New** 1040K BATTERY ELIM. KIT $25.95 Wired $34.95

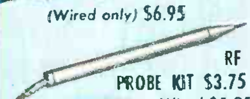


511K VOM KIT $14.95
Wired $17.95

145K SIG. TRACER KIT $19.95
Wired $28.95



HV PROBE
(Wired only) $6.95



RF PROBE KIT $3.75
Wired $5.95

C-5 5MC CRYSTAL $3.95

**New** 315K DELUXE SIG. GEN. KIT $39.95 Wired $59.95

# EICO TEST EQUIPMENT Guards Emerson HIGH STANDARDS OF PRODUCTION QUALITY

Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 425 Oscilloscope and Model 221 Vacuum Tube Voltmeter at one of the important alignment positions on the Emerson television production line, New York plant.

## *For Laboratory Precision at Lowest Cost—the Leaders Look to EICO!*

FOR electronics test equipment, there's no tougher proving ground than the factories where TV sets are made. There's where the pace is fastest, precision requirements the highest, costs the tightest—and day-after-day dependability an absolute *must*.

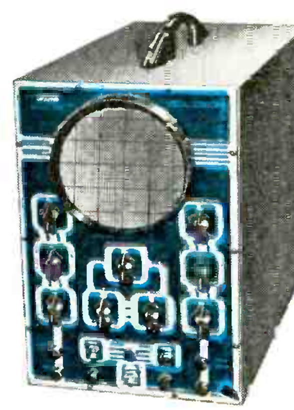
In both the giant New York and New Jersey television plants of the Emerson Radio & Phonograph Corporation — at the many critical constant-duty testing positions along the production line—EICO instruments stand guard. For Emerson has found that for speed, accuracy and trustworthiness, at lowest cost, EICO instruments always deliver the fullest measure of value.

From coast to coast, in one leading TV factory after another, this is the experience—*this is the proof of EICO superiority*—that is repeated again and again. The top-flight TV set makers have discovered—and over 50,000 servicemen have learned—that *for the industry's greatest instrument values, at the industry's lowest costs—it's EICO!*

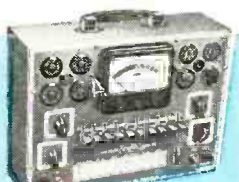
Be sure you look at the *EICO* line *before you buy any higher-priced equipment!* Each *EICO* product is jam-packed with unbelievable value. *YOU* be the judge—*compare EICO at your local jobber today*—and *SAVE!* Write *NOW* for free newest Catalog 5-C.

**FOLLOW THE LEADERS . . . INSIST ON EICO!**

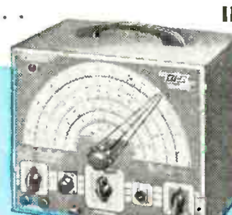
**New** 221K VTVM KIT $25.95
Wired $49.95



**New** 425K 5" SCOPE KIT $44.95
Wired $79.95



**New** 625K TUBE TESTER KIT $34.95
Wired $49.95



360K SWEEP GEN. KIT $34.95
Wired $49.95

EICO

ELECTRONIC INSTRUMENT CO., Inc.
276 NEWPORT STREET, BROOKLYN 12, NEW YORK

Prices: 5% higher on West Coast. Due to unsettled conditions, prices and specifications are subject to change without notice.

# Needed Electronic Inventions

*. . . Much remains to be invented in electronics . . .*

By HUGO GERNSBACK

ELECTRONICS is still comparatively young. We stand at the mere beginning of the art and our so-called vast accomplishments of the past will be trifling compared to what we will achieve during the next few decades. There will never be an end to invention and progress, as long as our present civilization continues. What seems fantastic in one age becomes commonplace to the next.

At present there are many gaps to be bridged by new developments and there is hardly any field of endeavor in which electronics cannot improve existing deficiencies. Here are a few random thoughts among the thousands of possibilities for needed improvements:

**Double-Check Circuits.** Early last March a Constellation plane with 22 passengers and crewmen enroute from Venezuela circled New York's Idlewild Airport for 38 minutes before making a safe landing. During this time of extreme tension for all on board, the crew tried to determine whether the big ship's nose wheel had locked into place. The plane's indicator lights showed that the wheel gear was down but not locked. A crash landing was prepared for, but the landing proved uneventful because the wheel gear *was* locked. Here again is the old story of something gone wrong either with the circuit or with a mechanical part of it.

When life and property are dependent upon circuits, as they often are, circuits ought to be completely trustworthy. For this reason, on important circuits of this type, the operator should never have to depend on a single circuit. For want of a better name, we should have double-checked circuits or duplicated circuits, or some type of electronic safety circuits, duplicated or even triplicated so that misfunctions of this type could not occur as they now often do. This is especially important where the operator cannot see what is happening with vital parts.

**Multiple-View Aircraft Television.** Here, the thought of a modified television arrangement comes to mind, so that the airplane's pilot can make sure by looking that everything is in order before going ahead with the next step, such as, in the above case, landing.

In airplanes where weight is a very important consideration it will be difficult to use television in its present state. When television has been simplified, such a scheme will be feasible, though this may be many years in the future.

Remotely controlled instruments in atomic plants today are monitored by television because weight of equipment and cost is of no great importance when so many lives are at stake.

The problem applying to aircraft is eventually soluble by electronics alone, at not too great a cost and embodying reasonable weights.

**Airplane Collisions.** The more planes we operate, the more the chances of mid-air collisions increase. Aerial collisions are by no means a rarity nowadays. They happen right along at great cost of life and property.

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

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

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

**Blackened Bulbs.** Ever since the advent of incandescent lights electrical bulbs have blackened on the inside with use. While this condition was much worse when we had carbon filaments, even the present metallic ones still give off a vast amount of particles which in time make a dense deposit inside the glass bulb, cutting off useful light. Incandescent lamp manufacturers have improved this condition through the years, but even the best bulbs today still blacken badly if used long enough. Often it is necessary to discard badly blackened bulbs that still light.

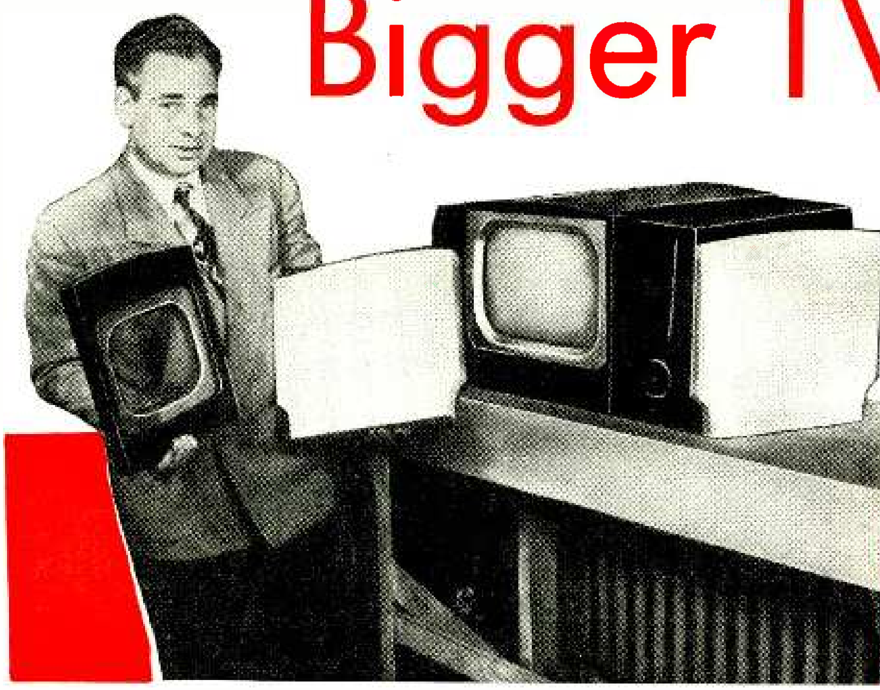
Here is an important electronic problem that is not impossible to solve. It is purely electronic in nature and sooner or later someone may make a fortune inventing a remedy.

**Electronic Telautograph.** The present-day telautograph is not sufficiently flexible for many uses, for instance, in signing a check by remote control. The reason is that the signature does not come out with sufficient fidelity. Electronic improvements might correct this.

In many large corporations, government agencies, etc., where thousands of checks or bonds must be hand-signed each day, mechanical gadgets are now used whereby a multiplicity of checks can be signed simultaneously. A mechanical device of this type, however, has limitations. Usually not more than 30 signatures can be made at the same time.

An electronic telautograph check signer could be devised whereby 100, 200 or more checks could be signed at the same time. This would only be one application of such a telautograph. There are hundreds of other uses, in business, in banking, in government, etc., where such a machine would be highly welcome. It should not be too difficult to devise.

# Converting to Bigger TV Tubes



The author with a completely converted set. He holds the original front panel and a blank which is cut to fit the larger kinescope.

By LARRY OEBBECKE*

**Plan with care, and profit from this added servicing business**

THE business of converting small-screen television receivers to use bigger tubes is a practical and profitable business which can be added to your present servicing organization without too great an investment. This additional business can be profitable if you know what you are doing. We have been in this phase of the business for about one year, and our shop at the present time is handling an average of 25 to 35 picture tube conversions a week.

The first models of any make require more than normal time to design and engineer a perfect conversion so that its looks are equal to that of a commercial product. The research and effort devoted to these first models will eventually pay off as a number of these particular sets enter the shop, but an intelligent survey beforehand can take most of the risk out of such work and make it profitable.

It is necessary to be practical and to turn down sets which cannot be converted with a reasonable amount of work. For example, we never attempt to convert electrostatically deflected receivers. Too many parts would have to be added and too much redesign done. This of course eliminates a large number of the 7-inch sets, most of which are electrostatic. The cost of converting such a set would practically buy a new large-screen set.

Most 10-inch sets are convertible. An exception is one of the Belmont receivers, which uses the electrostatically deflected 10HP4. All receivers require roughly the same amount of work; some, like the RCA 7 and 8 series, are a little easier. Philco chassis possibly require a little more thought than others due to the mechanical mounting and electrical circuit changes. Admirals and Emersons are much like the RCA's as far as part changes are concerned. The Admirals do not present any more difficulty than RCA's or Philcos except that, because of cabinet limitations, we convert to 14-inch tubes only and do not go to 16 inches on this brand.

## Typical shop procedure

The procedure on all sets coming into the shop is:

1. A complete check of the set's operation on all local receiving channels to determine if there are any defects in the set before it is converted. If such defects are found they must be corrected before the set is converted, to forestall any difficulty that may arise in the process of conversion.
2. Chassis are removed from cabinets for all electrical work.
3. To install a new C-R tube, mounting brackets must be made where it isn't possible to remake the present brackets on the chassis. We find it practical to redesign most of the mountings. Advanced stocking of such mountings for each popular model has saved us a great deal of time and money, as all conversions in our shop are to rectangular tubes.
4. The cabinet work for each model requires a great deal of planning before any cutting can be done. We make it our business to know in advance the amount of cabinet work required on any particular model. A pattern is made of each cabinet front panel which permits us easier operation when converting other sets of the same model. Each model is converted in a standard fashion so we will know that what we put into the cabinet will fit. At no time in the process of converting do we permit the end of the cathode-ray tube to project through the back of the set. We do not approve of that type of work in our shop.

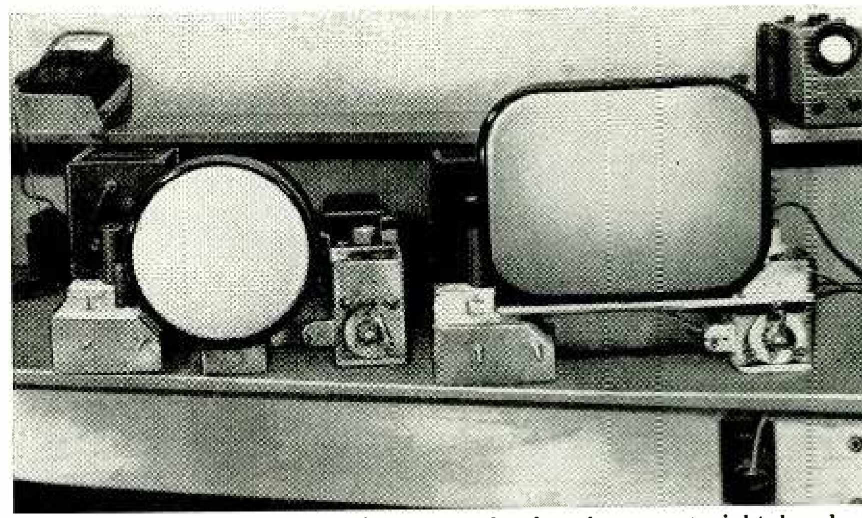
The tubes we use for 14-inch conversions are the standard 14BP4, 14CP4, and 14EP4. These are all short-neck, 70° deflection rectangular tubes. For 16-inch we use the 16RP4 and the 16KP4, and for larger sizes the 19EP4 and the 20CP4. These tubes are of standard makes.

In a typical conversion the deflection coil is removed and a new 70° yoke is

*Manager, Philadelphia Television Service Corp.

used in its place. The focus coil in most cases is not changed. Philco 12-inch models can be converted to 14-inch without changes in the power supply. In conversions where the high-voltage transformer is changed, the width coil and the horizontal linearity coil are also changed. Philco parts for these various changes are usually obtainable; also other available makes can be used. We have to a great extent standardized on RCA parts for all sets, simply because we found them most convenient from a viewpoint of quick availability. We use the RCA 206D1 or Merit MD70F deflection coil, the RCA horizontal linearity coil 209R1 and the width control 208R1. At least two high-voltage transformers can be used, the G-E 77J1 and the Merit HV06. Another approach is to use the RCA 218T1. Since it is used in a voltage-doubling circuit, it requires an extra 1B3-G and a few capacitors and resistors.

With the installation of the new components such as the yoke, linearity and width coils and transformer changes where necessary, we then proceed with the mounting of the C-R tube brackets. With the completion of these two steps, we are ready to turn on the set and start checking for any other changes to be made.



The set at left still has its original round tube, the one at right has been converted to take a large rectangular tube. Both sets have the same chassis.

## Philco conversions

Slightly different tactics are required on different Philco circuits, and the results obtained will also vary somewhat. For instance, the Philco 1001 can be converted to a 14-inch rectangular tube only. The cabinet is too small to house a 16-inch tube. The 10-inch models 1040 and 1076 can be converted to use either 14- or 16-inch tubes. The 12-inch Philco models 1240, 1278, and 1280 can be converted to use either 14- or 16-inch tubes.

Photos of the Philco 1076 indicate that the cabinet opening had to be enlarged to accommodate the larger tube. The same is true of the 1278, another simple conversion job. In the Philco 1280, we had to change the left-side pulley arrangement, since the chassis gives you no room to work with to the right.

A Philco 1050 was converted as an experiment. The job was satisfactory, but in general the conversion is too expensive to be worth while to the customer. The difficulty is in the cabinet. There are two side sections covered with grille cloth. It was necessary to build a new front panel right across the top of the cabinet to make this conversion.

## RCA receiver conversions

Some of the easiest RCA sets to convert are the 730TV1 and 730TV2, the 8TV321 and 8TV323, and the 9TW333. Some differences in procedure in these sets are necessary since the tubes are cabinet-mounted. All RCA sets mounted their tubes through the front of the cabinet until very recently.

The above sets can be easily converted to the 14-inch tube. Since the tube is supported by the deflection coils, etc., the bracket assembly which holds the yoke and focus coil must be lifted three-quarters of an inch to give the necessary additional height for the bigger tube.

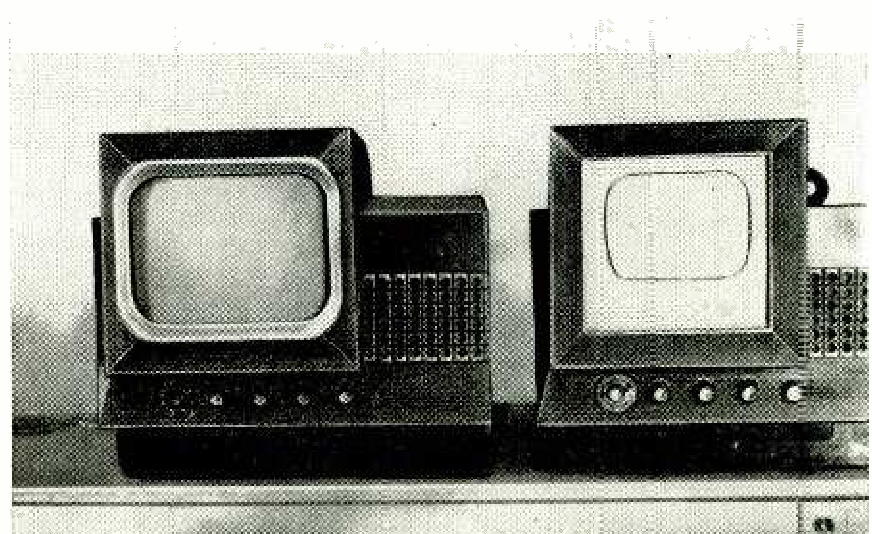
Other work on these sets is to replace the deflection yoke and make a few minor changes in the horizontal output and high-voltage power supply. These changes consist mainly in changing values of capacitors and resistors—the values depending on what we find in the sets. There is quite a bit of variation and no rules can be laid down. All the above sets have the same transformer, which does not have to be changed. We get up to 10,500 volts, which is quite satisfactory on a 14-inch tube designed for 12,000.

The RCA 700 series (721TS and TCS) have electromagnetic ion traps. We discard them and replace with a 39-ohm high-wattage resistor. A PM ion trap is placed on the neck of the tube.

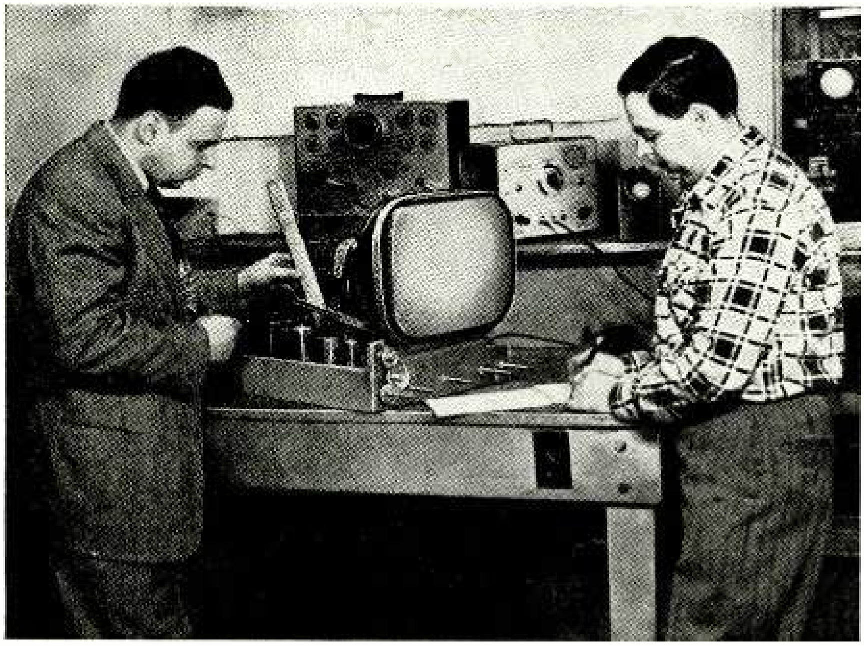
When converting the 8T241 from a 10- to a 14-inch tube, take off the set section of the front panel. In every set we have seen, we have found underneath it a completely finished front. This simplifies the problem of enlarging the opening. Only slight retouching on the lower panel is required to make a professional looking job.

The 8T244 is covered with a grille cloth. The danger of fraying or tearing it is the difficulty here. If you wet the grille cloth and cut it with a razor blade along the line you are going to saw, it will not fray. Due to lack of space, the mask has to be notched at the bottom to clear the knobs.

The 8TV323 can be converted to 14 inches with no trouble. It can also be converted to 16 inches because of the long door which goes all the way down to the decorative part. The whole chassis is moved down two to three inches, and a new front panel installed, etc. In this model the customer pays for extra cabinet work. The similar 321 can be converted to 14 inches only. If the chassis were moved down on this model, the knobs would be below the door on the cabinet.



Another pair of sets. The one at left is converted, the one at right is not.



Carefully recording the problems encountered when converting the first of a given set model is effort well spent and will save much time in future jobs.

The 730TV1 and 730TV2 can also be converted to 16 inches. We have adequate cabinet room because of the shallowness of the chassis. We move the chassis back 3½ inches, which makes room for the front of the tube. The problem is what to do with the controls which are in front. A subchassis is built and fastened to the front of the regular chassis. All the controls, with the exception of the channel selector and fine tuning control, are moved forward to it. We do not move the channel selector mechanism, so an extension shaft has to be built. This is a delicate piece of work, since it is a shaft within a shaft, but we have been successful. This shaft extension has been designed by our shop and is produced in quantities in advance to fit all RCA models requiring 16-inch conversions. For models 630, 830, and 641 a special wooden mask has been designed by our shop to convert these sets to 14-inch rectangular tubes. This mask replaces the mask which is standard equipment on these models. The fronts used by us are made of unfinished wood by a local cabinet maker and after being put in place and cut to receive the new tube are finished to match the set. The 630, 8TS30, and 641TV can be converted to 12-inch round tubes with this new front mask and without electrical changes. The new tube is a 52° type, and will operate satisfactorily on the old high-voltage supply. These sets can be converted to 14 inches by making the same electrical changes as in other sets, but require very careful measurements in the cabinet work, as space is limited. Larger tubes require a new cabinet.

## Some other aspects

Time spent in making a conversion varies from six to ten hours (one man). This includes the bracket assembly. Notes and patterns are made on first conversions and all difficulties and peculiarities carefully recorded. *This is one of the things that must be done to make conversion profitable.* When the same type set comes into the shop again, the technician only has to refer back to the notes. Also patterns should be made of all the plastic masks that are used in various cabinet models. Some may require rounding or shaping of the corners, the cutting of height and width on a mask, the reshaping of the top of the mask frame, or the notching to be placed over some of the knobs. To prepare such patterns will save you a lot of time and make all of one model look uniform.

All brackets, mountings, and subpanels or chassis are made of aluminum, which makes handling and drilling easier. All manufacturers' name plates are replaced on the panel, and when controls are moved they are relabeled for the customer's use. Keep an eye on the possibility of future service on these conversions whether you service them or someone else does. All mountings and changes should be made so that the next man can work easily with the chassis. This not only is for your advantage but it will help maintain quicker service for the customer.

We find it unnecessary to make a survey of each receiver before taking a conversion job. Quotations are given over the phone, if the set and model number is known. However, the man who picks up the set makes a careful check of the TV-Radio-and-Phono receiving conditions, and any faults found are noted right on the back of the customer's receipt.

If any repairs are required in any of the above units, the customer is advised that there will be an additional charge for this service.

If there are any peculiarities in the receiving conditions, such as ghosts, FM interference, ignition noises, or interference, they are called to the customer's attention and he is told that any defects that are there now will be blown up and made more conspicuous along with the rest of the picture. A larger tube cannot cure reception troubles.

All sets before delivery to the customer's home are set up and adjusted on a pattern generator, assuring perfect linearity. If the instrument isn't available it is then advisable to check each set out on a test pattern. This will save many recalls.

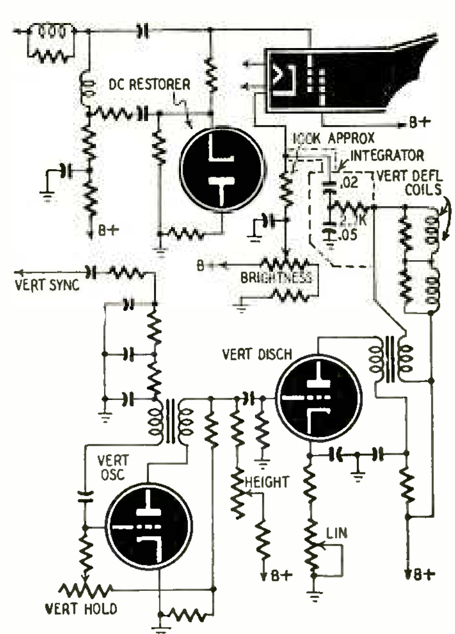
Our warranty covers our work for a period of 90 days. The picture tube is guaranteed for a year. Guarantee does not cover those circuits in which we have done no work but only to the converted circuits.

—end—

## ELIMINATE RETRACE LINES

Vertical retrace lines may not prove objectionable to TV viewers in areas of moderate signal strength when contrast and brightness levels can be properly adjusted. However, in fringe areas the vertical retrace lines become visible with low contrast and high brightness control settings. This difficulty may be more noticeable in some of the cheaper receivers where economy is the ruling factor in construction.

It is not too much trouble or expense to remedy this difficulty in your present receiver. The circuit shown within the dashed lines in the figure, may be similar to the vertical sweep circuit in your set. Although a blocking oscillator is shown for the example, this idea can be applied to a receiver with a multivibrator sweep oscillator also. The portion shown in dotted lines is an integrator whose purpose is to take some of the positive pulse voltage appearing in the vertical oscillator output and reshape it for application to the picture tube cathode which biases it to cutoff during the retrace time.—*Wilbur Hantz*



# Electrostatic Focus Kine Uses Simple H.V. Supplies

By ROBERT B. GARY

UNTIL recently all large-screen picture tubes have used electromagnetic deflection and focusing, requiring a deflection yoke and a focus coil or a PM focus magnet. To overcome present shortages of copper and PM material, a new type of picture tube has been developed which uses magnetic deflection, but electrostatic focus. As in the 7-inch electrostatic picture tubes, a high d.c. voltage (usually about 22.5% of that on the second anode) is applied to a special "focusing element." The electron beam passes through this element and is formed into a fine stream, just like the one the magnetic focus coil produces. The focusing occurs because of electric lines of force between the first anode—usually at about 350 volts—and the focusing element, at about 2,700 volts.

Electrostatic focusing will be used in 14-, 17-, and 20-inch rectangular picture tubes at present and is meant for new production sets rather than as replacement for magnetically focused tubes. It is not practical to install these electrostatic focus tubes in receivers using magnetic types, since a source of focus voltage as well as a suitable control system must be added. In addition, the focus coil in most receivers is part of the B-plus voltage divider and its removal may upset the operation.

In Fig. 1 are shown the socket connections which will apply for all electrostatic focus tubes. At the time of this writing only the 17FP4 has received an RMA designation and is in production, but other types will follow shortly. In addition to a deflection yoke the new tubes will also require a single-magnet ion trap.

To center the picture a centering control like that in the 630 type receiver is required. This varies the amount of d.c. through the deflection yoke. In place of such a control some manufacturers are using a centering device consisting of two magnetic rings which are mounted concentrically on the neck of the tube, close to the deflection yoke. By varying the position of the air gap of each ring, the picture is centered.

Fig. 2 shows a simple method of obtaining the voltage needed for electrostatic focusing. A high-resistance bleeder is connected across the 12,000-volt supply, furnishing the second anode voltage. Part of the bleeder is a potentiometer from which the focusing voltage is brought to the focusing element. To use such a bleeder in present high-voltage sections appears simple at first glance, but it has some very serious disadvantages. First, the extra current in the bleeder will lower the second anode voltage by as much as 1,000 to 1,500 volts, causing a reduction of brightness and uneven focus on the entire screen. Second, to use only 100 microamperes, the total bleeder resistance must be about 120 megohms. To avoid internal arcing, no single ordinary resistor should have more than 1,000 volts across it. A large number of resistors will therefore be required. For practical reasons, 10-megohm, 1-watt resistors would be most suitable. The Rauland Corp. recommends somewhat lower values in the bleeder of this circuit, with R1 at 30, R2 at 5, and R3 at 10 megohms.

Of course the wiring of this bleeder and all its connections on the "hot" side are very much liable to corona and arcing. One solution might be a specially designed carbon-paint resistor, similar to those used in some h.v. multiplier probes, but at the time of this writing, no suitable and inexpensive resistor is available. Another drawback of this bleeder is that any change in brightness, and therefore h.v., would result in a change in focusing voltage.

A more practical solution is shown in Fig. 3. A separate h.v. rectifier is used which rectifies the high positive pulses at the plate of the horizontal output amplifier. Since these pulses are in the order of 5,000 volts, this system will not have much corona and arcing. The voltage divider, as can be seen from Fig. 3, is also much simpler and it is quite practicable to use ½-watt resistors here. A variation in brightness will have little effect on the focusing voltage. One drawback of this system is that it requires an additional tube, but since any of the miniature types such as the 1X2 or 1V2 can be used, neither price nor space limitation present a great problem. Because the output of this circuit is not pure d.c. but varies as the electron beam moves from left to right, the focusing voltage varies in the same manner, giving good focus on both sides of the screen.

The high voltage on the focusing control makes it necessary to insulate it from the chassis. Most manufacturers mount it on a bakelite plate and use a fiber shaft. To avoid use of this control it is possible to vary the focusing voltage with a trimmer capacitor which is part of a series-capacitance arrangement from the cathode of the focus rectifier to ground. Varying the trimmer affects the regulation of the focus supply and therefore also the focus voltage. Various circuits are now being designed to provide effective and inexpensive control over the focusing voltage. One of these is shown in Fig. 4, a circuit supplied through courtesy of the Rauland Corporation. The 8-25 μμf capacitor serves as the focus control.

From the samples we have seen to date it appears that the electrostatic focus tubes, born of necessity, are going to make an improvement in performance in TV receivers.

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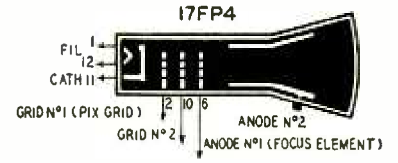



Fig. 1—Connections for the new tube.

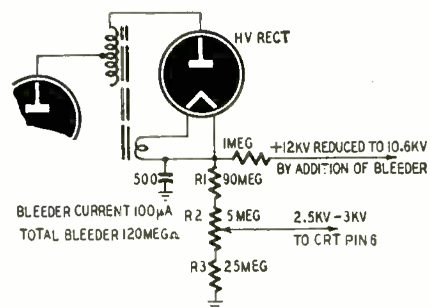



Fig. 2—Focusing voltage bleeder circuit.

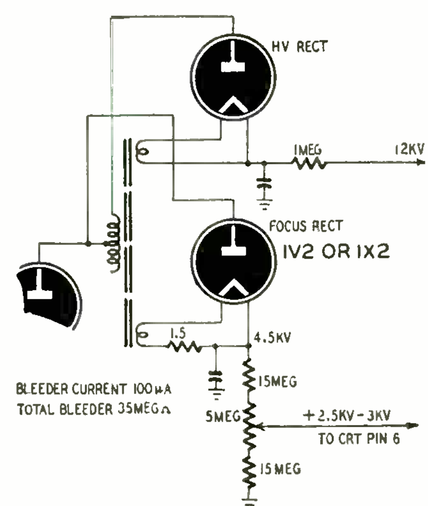



Fig. 3—Hookup using separate rectifier.

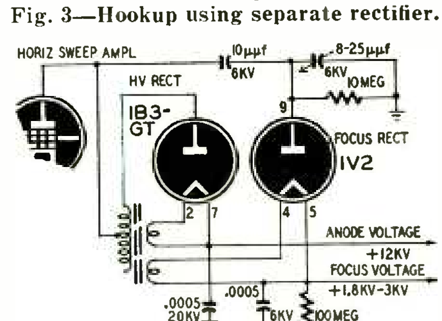
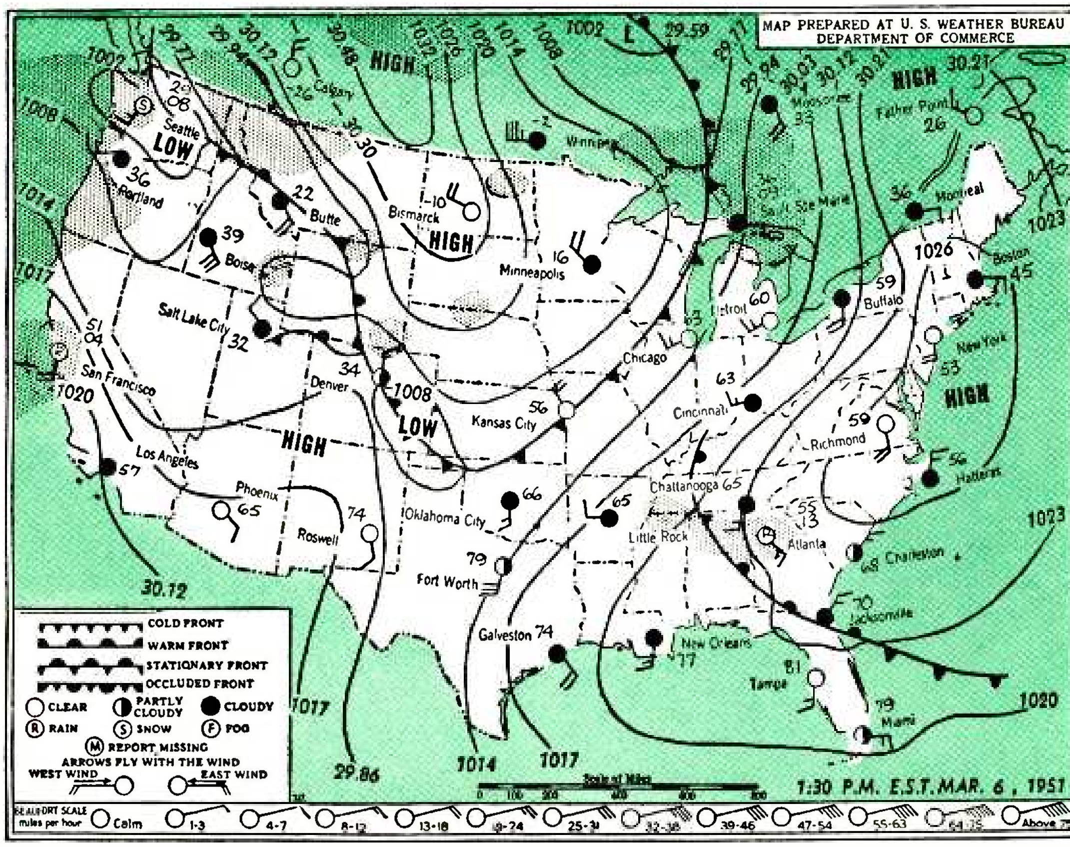



Fig. 4—Simple focus control circuit.




Large air masses, as those shown on this weather map, affect TV reception as they sweep the country.

# WHAT'S THE MYSTERY BEHIND TELEVISION DX

By E. P. TILTON, W1HDQ*

THE TV viewer is often astounded and sometimes annoyed by pictures from distant stations on his TV screen. Sometimes they come in with such strength as to drown out local programs. Television viewers are divided into two camps—the dx hounds who are pleased and proud to receive programs from 1,000 miles or more away, and the local-station televiewers who object to the interference. The first group is much the larger, and many people are inquiring as to the whys and wherefores of long-distance television propagation.

As the first service to use the frequencies above 30 mc, the radio amateurs have contributed much to our knowledge of v.h.f. propagation. Amateur activity on 56-60 mc in the 10 years before the 1941 shutdown, and more recently in the new band at 50-54 mc, provided data on the lower TV channels. The high band is similar to the amateur 144-148 mc assignment, where thousands of hams have been working since 1945.

Long-distance propagation is considered a nuisance by commercial services. The ham, on the contrary, jumps at every opportunity for work beyond his normal communicating range.

There are many ways by which a 50-mc or higher-frequency signal can reach points beyond the normal working radius. Only two are important in TV reception. One is closely allied with weather phenomena and can be predicted with considerable accuracy 24 to 48 hours in advance. The other is the result of spotty concentrations of high ionization density in the E-layer region of the ionosphere, some 50 miles above the earth's surface. Its causes are not well known and consequently it is predictable only in a general way.

These two phenomena, *tropospheric bending* and *sporadic-E skip*, account for all the TV dx reported in recent issues of this magazine.

*V.h.f. Editor, *QST* Magazine

## Tropospheric Bending

V.h.f. waves leaving the transmitting antenna take off into space in straight lines, so a television station's service area is a somewhat irregular circle of a diameter of perhaps 80 miles, depending on antenna height, transmitter power, nature of the terrain, receiver sensitivity, and other variables, including the weather at the time. The weather exerts an influence because the speed of radio waves varies with the dielectric constant of the medium they travel through. The temperature and humidity of air affect its dielectric constant, so our v.h.f. wave is bent slightly when it passes through a boundary between air masses having different temperature and moisture content.

Large masses of air are constantly moving across our country from west to east in fairly well-defined and predictable patterns. Modern weather forecasting methods are largely based on plotting of this air-mass movement[1]. Under stable weather conditions the boundary between two very different air masses may remain well defined for up to several days.

If this boundary lies along the path between a TV station and a distant receiver, a station may be received far outside its normal coverage. (Air-mass boundary bending can work the other way, too, reducing the coverage to below normal.)

The bending of radio waves by atmospheric stratification increases with frequency, but it is negligible below about 25 mc. The amateur 50-mc band is noticeably more responsive to tropospheric effects than is the 28-mc band, and the 144-mc band often shows strong signals from points several hundred miles distant, while 50 mc is only slightly affected. The distance over which refracted signals may be heard increases with frequency, *other things being equal*. 50-mc signals are seldom heard beyond 300 miles by tropospheric means (troposphere: the atmosphere between the stratosphere and earth, in which our weather occurs), but the 144-mc band often supports communication over distances up to 500 miles in the warmer months, and 700 to 800 miles is not uncommon. The current record for two-way amateur communication on 144 mc is nearly 1,200 miles.

From this we can see that the high-band TV channels, 7 to 13, should provide more tropospheric dx than the lower ones, channels 2 to 6. Why this is not borne out in current TV experience is easily understood when we consider the difference in performance of most receivers between the high and low channels. Most antenna installations favor the low band, and there is a preponderance of low-band stations. Channel 4 alone has almost as many stations on the air as all seven channels of the high band combined. (But we don't get as much dx on all seven channels combined as on channel 4. Perhaps there are a few propagation factors affecting 200-mc signals that are still not understood?—*Editor*)

Tropospheric bending occurs in all seasons, but is most pronounced in warm or mild weather, reaching its peak in most sections of the country during the fair calm weather of September and October. Large-scale air-mass movement is only one cause. Another is atmospheric convection that develops any warm sunny day along our coastlines, causing seaside locations to head the list of desirable homesites for the v.h.f. enthusiast, whether he be a communicating amateur or a TV set owner. The favorable season is longer in the more southern regions. The Gulf Coast, the Lower Mississippi Valley and the California coastal areas enjoy a considerable advantage in this respect. At the peak of the season, however, the broad reaches of the nearly flat Middle West states are favored with tropospheric bending hardly equalled elsewhere.

In addition to variations induced by weather changes, tropospheric bending follows a regular daily cycle. Early morning, when the sun heats the air aloft before the earth's surface temperature is affected, may be the best part of the day for v.h.f. propagation. (This knowledge is of little use to the TV enthusiast, transmitting schedules being what they are.) Of more practical value is the repetition of the temperature inversion in the period around sundown, when the earth cools more quickly than the layer of air immediately above it.

This daily cycle may be observed the year around, but when it is combined with other factors already enumerated we may have a truly phenomenal degree of bending on the frequencies above about 100 mc or so. This happens frequently along our coasts in May and June and September and October, and somewhat less often over inland areas. The turbulent weather of midsummer tends to dispel the air-mass boundary conditions most favorable to long-distance propagation, and cold weather discourages the coastal convection and diurnal factors. Tropospheric bending over distances beyond 300 miles is rare in winter.

The reports of observer Glaub of East Moline, Ill., of reception of WHIO-TV, Dayton, Ohio, channel 13, and WKRC-TV, Cincinnati, channel 11, on September 5, are typical examples of tropospheric bending on the high channels. Observer Swanson, Rockford, Ill., saw WSPD, Toledo, channel 13, on September 6 and 7[2] by the same air-mass condition. This period of three nights is of particular interest, as it was the occasion of the 144-mc work over nearly 1,200 miles mentioned earlier. Beginning just before midnight on the 6th an amateur in eastern New York worked several stations in Iowa, Missouri, and Kansas, and was heard in Oklahoma, more than 1,400 miles away!

Reception on October 30 of WJAR-TV, Providence, R. I., channel 11, by observer Canning[3] of Halifax, Nova Scotia, is an example of the coastal type of opening. This sort of thing could be done much more often than is generally appreciated if the 144-mc experience of Halifax and Yarmouth amateurs is any indication. A Yarmouth man has found it possible to work as far south as Norfolk, Va., fairly often, and his best dx, Fayetteville, North Carolina, about 900 miles, was worked with signals of tremendous strength. Even though the power level of amateur stations is far below that of the most modest high-band TV station, signals over such distances are often well above that required to provide a good TV picture on a reasonably sensitive receiver. There is little doubt that high-band TV dx could be logged much more often if viewers knew when to be on the lookout for it.

The practical receiving range for low-band stations can be extended appreciably by the use of properly designed r.f. amplifiers and antenna systems, as demonstrated by observer Dubreuil[4] of Lavaltrie, Quebec, who has succeeded in receiving WRGB-TV, Schenectady, and WSYR-TV, Syracuse (channels 4 and 5) consistently, over a 260-mile path.

## Sporadic-E Skip

Practically all low-band TV dx beyond 400 miles is the result of reflections in the E-layer region of the ionosphere. As such it is markedly different from tropospheric bending. The experienced observer should have no trouble in distinguishing between the two phenomena. Because the reflection takes place many miles above the earth there is a *skip zone* of several hundred miles in which the signal is not ordinarily heard. Sporadic-E skip reception is most common over distances of 600 to 1,300 miles, though exceptionally intense ionization may bring the minimum skip down to as low as 300 miles, and multiple-hop effects can extend the coverage to 2,500 miles or more.

At times there appears to be a tie-in with observable weather effects, but the correlation is not well established, nor is the exact cause of the phenomenon completely known. After years of observation by amateurs and scientists, prediction of sporadic-E is still only

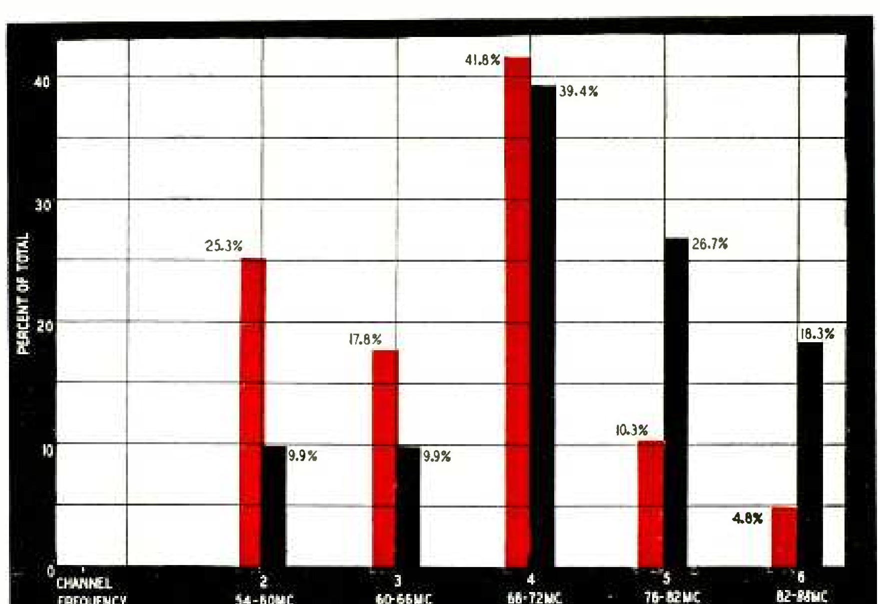



Fig. 1—This tabulation, compiled from 146 dx reports in RADIO-ELECTRONICS, illustrates the effect of increasing frequency on the occurrence of sporadic-E layer skip. The red columns show the percent of total reports, the black show the percentage of the total number of stations on each TV channel in the U.S.

partially successful. We do know quite a bit about it in a general way, however. We know that it can develop at any hour, in any season, but that it is most common in the mid-day and early-evening hours of the six-week period either side of the longest day of the year, or from early May to the middle of August. There is a minor period from early December to the middle of January.

Ionization sufficiently dense to reflect signals on frequencies up to 60 mc or more is very frequent in the May-to-August period, and the signal strengths encountered at times are nothing short of astounding. This explains the occasional dx reception reports from viewers having small receivers and indoor antennas. As an example, an observer in New England, in the fringe area of WCBS-TV, New York, may find his channel 2 reception taken over by WSB-TV, Atlanta, WJBK-TV, Detroit, WFMY-TV, Greensboro, North Carolina, or even KPRC-TV, Houston, Texas, instead of his customary New York program. Or the interference may be only strong enough to cause the uninformed viewer to call his repairman.

Examination of 146 low-band dx reports in recent issues of RADIO-ELECTRONICS shows them to be of sporadic-E origin. The times of reception, where given, agree closely with amateur 50-mc observations for the same period, and every date listed is one on which amateurs were making sporadic-E contacts over roughly the same paths.

From amateur experience on 28, 50, 56, 112, and 144 mc, and from observation of skip effects in the FM band, 88 to 108 mc, we know that sporadic-E drops off sharply with frequency, being relatively rare above about 100 mc. The top frequency is not precisely known, but it seems unlikely that high-band TV channels are ever affected.

This drop in sporadic-E with frequency is apparent in Fig. 1, even though the chart was compiled from a relatively small mass of data. From it we see that channel 2, with less than 10% of the country's stations, accounted for more than one-fourth of the reports. Channel 3, with the same number of stations, netted only 17.8% of the reports. Nearly 42% of the reports were for channel 4 stations. This slightly inconsistent figure (channel 4 having 39.4% of the stations) is easily explained. The presence of many more stations, with better distribution over the country, makes for more monitoring of that channel, and more antenna installations favoring it. Reports for channels 5 and 6 are greatly in the minority, though 45% of the country's stations are operating there.

## Other causes of v.h.f. dx

Though tropospheric bending and sporadic-E skip account for nearly all the TV dx thus far observed, other factors can enter the picture. There is a very slight possibility of reflection from the ionospheric F2 layer. The reception of BBC television by Henry Rieder, of Capetown, South Africa, in 1947 and 1948 was in this category. This is a daytime phenomenon exclusively, and it is possible only near the peak of the 11-year sunspot cycle. Even then (the peak was in February, 1948) it is doubtful whether the upper frequency limit of F2-layer propagation is high enough to affect American TV stations. Note that the BBC video is on 45 mc, the sound on 41.5 mc. The writer received both frequencies often in October and November, 1946-48, but the video has been heard infrequently since. The sound was heard well a few times in 1949, but not at all in 1950. There is practically no possibility of transatlantic TV reception again before 1957 or 1958, at the present state of the art.

V.h.f. waves can be bounced back by the aurora borealis. Swing your TV array around to the north the next time an aurora lights the skies. Because of the scattered nature of the reflected signals there may be severe multipath distortion of the reception, and signals so reflected are generally rather weak. Try all the channels, however—you may be in for some surprises!

## Anticipating favorable conditions

Armed with the above facts we can examine the TV dx reports so far published in this magazine and say, with some assurance, just how each of them happened. Better, we can look ahead and see when such things are likely to happen again.

Because tropospheric openings are closely related to weather conditions, we can spot them several days away if we study the weather across the country in detail. This can be done fairly well by watching the weather maps that are published in many newspapers. The type showing pressure distribution is best for our purposes. If a large high-pressure area is shown moving slowly across the country we can be almost certain that improved propagation will accompany its passing our locality. The best tropospheric bending is almost always closely associated with the middle or the trailing edge of a large high-pressure movement.

It is not the barometric pressure gradient that causes the bending, but rather the atmospheric stratification that accompanies it. The pressure lines on the weather map, called isobars (or lines of equal barometric pressure) are merely a convenient indicator as to when and where favorable conditions may exist.

We can do fairly well at short-term prediction of tropospheric openings if we do no more than watch the local weather. Temperature and barometric pressure changes, the wind direction, visibility, changing cloud forms—these are weather signs by which man has predicted the weather for generations, long before the advent of weather maps or television. They are still good for local forecasting, and for guessing when better TV reception is in prospect.

Some favorable signs: High barometer, after a slow rise. Thin high cloudiness, and little or no wind. Ground fog in the early morning, or late at night. Cumulus clouds forming around mid-day, but not mushrooming into thunderheads. A weather forecast for rain after a protracted fair spell in summer, or snow turning to rain in winter.

Prediction of sporadic-E skip is something else again, for the best minds in the business have not yet been able to do it with any reliability. We know when it is most likely to happen, and we can recognize it when it breaks, but it still pulls some surprises on us that don't fit in with previously observed patterns.

A classic example is the case of January 4, 1951. Beginning about 7:15 pm EST, sporadic-E skip began to break out over most of eastern United States and Canada. The area affected ranged from Nova Scotia to Florida, and from the Atlantic to well past the Mississippi. An amateur friend of the writer, in Yarmouth, N. S., taking time out from his rapid succession of dx contacts on 50 mc, found signals jamming his TV set on all channels from 2 to 6. The jumble was such that it was difficult to identify any one station. This was 300 miles from the nearest TV transmitter—and in midwinter!

Catching a major portion of the sporadic-E openings the year around takes frequent observation and not a little luck, but the ionosphere does drop a few clues. Begin checking in earnest in late April, particularly around 7 to 9 pm. If you have a receiver covering the amateur bands at 28 or 50 mc watch out for signs of "short skip" communication. If 28-mc stations are heard working distances of 300 to 1,200 miles there's a good chance that at least channel 2 may be open over the same paths. If 50-mc stations are heard similarly, several channels are probably open.

Make a note of any open dates. As sporadic-E is related to solar conditions in a general way, there is likely to be a recurrence of any pronounced opening in about 27 days, the time Old Sol takes to make one complete turn on his axis. There are usually two major openings each month, about two weeks apart, and once those periods are established there is a good chance that repeat performances can be caught the following months on similar days, four weeks later. The average solar disturbance will remain active for at least three solar rotations.

Probably the most important adjuncts to improved dx reception are a sensitive receiver and a high-gain antenna system. The best openings can be caught on any kind of gear, but a low-noise front end of adequate gain, and a properly designed antenna system equipped with a rotator will bring in dx signals many times when the average installation shows no sign of life whatever.


REFERENCES

1 Modern aerological techniques have been the subject of many popular texts in recent years. One recommended by the author is **Weather and the Ocean of Air**, Wenstrom, Houghton Mifflin Company.

2 *Radio-Electronics*, December, 1950, page 27.

3, 4 *Radio-Electronics*, January, 1951, page 69.


—end—

# TV Trouble Lexicon Lists Common Faults

**Beginning a series of technotes arranged for quick reference**

**By JOHN B. LEDBETTER***

OVER a period of time, different makes or models of television receivers are likely to develop traits or operating irregularities peculiar only to that particular model. In many cases, familiarity with these peculiarities or symptoms of trouble will save a great deal of time which otherwise might be spent in routine trouble-shooting. For example, a receiver brought in with the complaint "no high voltage, sound O.K." would warrant an immediate check of the high-voltage filter capacitor if this particular model were known for its tendency to blow out filters. Similarly, a model which invariably overloads or cross-modulates on strong local signals would suggest the proper procedure.

Although some of the troubles listed in the following paragraphs apply specifically to the receivers named, there are many cases in which similar troubles will appear in other makes and models. For this reason, diagrams of the affected stage or circuit are included so that comparisons can be made in similar complaints. *Code numbers on the diagrams are those of the manufacturer and may not agree with numbers on diagrams printed by other publishers of service information.*

It is recommended that all available service notes be entered in alphabetical order in a loose-leaf notebook or similar file system for easy reference. Very little time is required to keep this system up to date, and it is surprising how useful it can prove.

## Admiral

**T-10.** **Dark horizontal strip (4 inches wide) across top of picture; bottom of picture light.** If dark strip moves down slowly, check for cathode-heater short in one of the video amplifier or video i.f. stages. If dark strip is stationary, check filter capacitors.

**19A11.** **Picture off center to right, horizontal centering control has no effect.** Defective centering control. Defective 5V4-G. Open or shorted capacitor in horizontal deflection circuit.

**20A1, 20B1.** **Horizontal jitter on one channel only (usually channel 4).** Caused by overloading of 6AU6 sync separator. Remedy: Remove the 47,000-ohm resistor (screen grid to ground) in this stage. Disconnect one end of the 82,000-ohm screen grid resistor from B-plus and reconnect to arm of contrast control. (This change has been made in later models.)

**24D1.** **Arcing in vertical output stage.** In earlier models, the 6S4 vertical output plate terminal often arced to ground. Remedy: Replace tube socket with high-quality type. Also replace 2,200-ohm resistor R417 even though it checks good. (Later models use low-loss socket.)

**26X36N (chassis 24D1).** **Horizontal pulling toward left (top of picture only).** Improper adjustment of horizontal hold control. Defective horizontal output tube (earlier models use a 6BG6-G, later models a 6CD6-G.

**30A1.** **Microphonics.** Microphonic 6J6. Loose tube socket of shield base. (Spot-solder these to tuner chassis. This applies also to models using a 6C4 oscillator.) Loose or dirty fine tuning control. Improper lead dress in *sound* i.f. stages. Binding of control shafts or knobs to receiver cabinet. In stubborn cases, shock-mount the speaker and chassis.

**30A1.** **Pulling to right (top of picture only.** In earlier models, remove the two 470,000-ohm plate resistors R413 and R414 in the horizontal sync discriminator stage and replace with two 180,000-ohm resistors. Readjust horizontal oscillator if necessary.

## Capehart-Farnsworth

**CX-31.** **Horizontal sweep will not lock in.** Defective 6SN7-GT horizontal oscillator-a.f.c. tube.

**501P, 502P, 504P, 461P.** **No high voltage, no horizontal deflection.** Open h.v. winding on horizontal output transformer (terminals 2 and 3). Defective 1B3-GT (check by substitution; tube

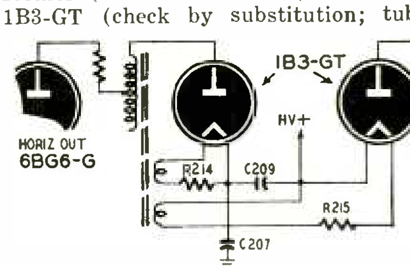



Fig. 1—Part of the high-voltage circuit used in Capehart-Farnsworth sets.

may check good, yet be gassy). Open 1B3-GT filament circuit. Shorted capacitors C209 or C207. Open resistors R214 or R215. (See Fig. 1.)

**Vertical jitter.** Excessive contrast setting. Noise in vertical sync circuit. Cold-soldered connections in vertical oscillator circuit.

**Picture smear.** Insufficient bias on video amplifiers, resulting in grid current on

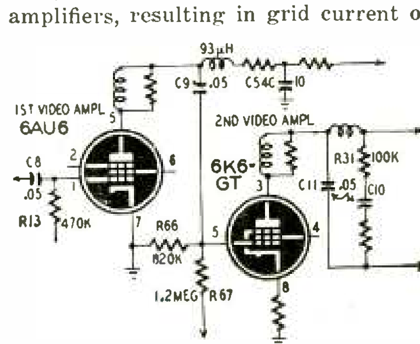



Fig. 2—Picture smear may be caused by incorrect bias on the video amplifier.

*Engineer, WKRC-TV

video signal. Defective coupling or grid-load resistor. Check R13, R67, R66, R31; C8, C9, C10, C11, C54C. (See Fig. 2.)

**Vertical nonlinearity.** Incorrect adjustment of vertical linearity control. Defective 6K6-GT vertical output. Defec-

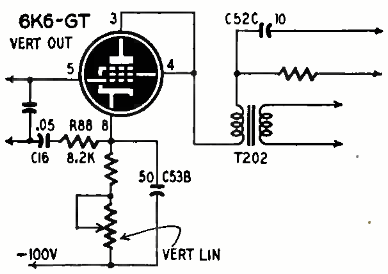



**Fig. 3—Vertical output stage has the linearity control in the cathode circuit.**

tive vertical output transformer. Defective resistor R88; capacitors C16, C53B, or C52C. (see Fig. 3.)

**Horizontal nonlinearity.** Incorrect adjustment of horizontal linearity control. Defective 6BG6-G horizontal output, 5V4-G damper, or 6AS7-G reaction scanner. Defective horizontal output transformer. Defective resistor R201, R219, R220, R223, or R224; capacitors C201, C211, or C212.

**Picture out of phase horizontally.** Incorrect adjustment of horizontal sync

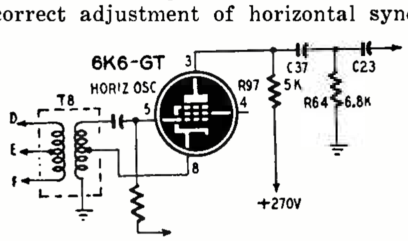



**Fig. 4—Horizontal oscillator circuit.**

discriminator phase control. Reversal of leads D and F on sync discriminator transformer. Defective resistor R97 or R64. (see Fig. 4.)

**Raster nonsymmetrical.** Improper adjustment of focus coil. Defective deflection coils.

**610P, 651P, 661P. Horizontal nonlinearity.** Change in resistance, capacitance, or inductance values in grid circuit of beam relaxer; check values against schematic. Shorted turns in horizontal deflection coils or transformer.

**Stretching at top of picture (wide spacing of several lines).** Open .05-μf coupling capacitor or open 5,600-ohm resistor in vertical oscillator. Open cathode bypass capacitor in vertical amplifier. Defective vertical output transformer.

**Black bars on left side of picture.** Defective 6L6 horizontal oscillator, causing spurious oscillation.

**Poor horizontal sync (lines similar to auto ignition interference).** High-voltage corona affecting sync. Check spacing of 1B3-G tube socket lugs. Re-dress wiring away from h.v. bleeder circuit.

**Horizontal sync drifts.** Defective 6SN7-GT or 6K6 on sync chassis. Defect in horizontal a.f.c. circuit.

**Picture size changes when vertical centering control is adjusted (jumpy movement of center of picture only).** Defective centering capacitor across vertical centering potentiometer.

**White bar at bottom of picture.** Overloading of vertical amplifier. Defective vertical amplifier tube.

**Portions of picture tear out.** Excessive contrast setting. Excessive signal at antenna. Strong outside interference. Defective 6L6 horizontal oscillator. Audio leaking through to picture-tube grid (check i.f. sound trap).

**No focus (picture size changes when focus control is adjusted).** Open focus coil. Poor solder joint or connection at coil or plug socket.

**No picture, focus and width controls run hot.** Breakdown of filter capacitor or other h.v. components (or wiring), causing B-plus short to ground. Arc-over in 6L6 socket. Use ceramic socket for replacement. Re-dress wiring around socket.

**No picture or sound, oscillation in system.** Poor or improper grounding in shields and r.f. subassembly, or in under-chassis i.f. shields. These shields must be well grounded with every nut screwed down tight *at only* the points provided. Touching the shield to another ground point can cause oscillation.

**651P. Microphonic howl.** Defective 6J6 mixer, 6J6 oscillator, 6J6 r.f., or one of the 6AC7 i.f. amplifiers. If a 6AC7 is causing trouble, try a lead damping weight on top of tube. This applies to receivers using tubes such as 12AT7, etc.

## Crosley

**9-408. No raster.** Defective 1B3-G or 6BG6-G. Shorted filter capacitor. Check .005-μf, 10.000-volt filter for open or high-leakage.

**307-TA. No raster.** Defective 6SN7-GT horizontal discharge. Check by substitution only.

## Du Mont

**RA-101. Sync instability (horizontal breakup after hour or so operation).** Defective 6H6 or 6AC7 in a.f.c. circuit. Defective .01-μf capacitor C10, .05-μf C9, or .01-μf C3. *Note:* Lock-in range of secondary tuning slug should be at least 1 full turn. Stabilization can be improved by mounting sync chassis on spacers or otherwise increasing ventilation.

**RA-102. AM tuner birdies (heterodyne), evenly spaced carriers every 17 kc across broadcast band. (H.v. r.f.** oscillator or horizontal sweep generator is in free-running condition). Defective cathode resistor, grid resistor in h.v. oscillator. Dirty contacts of beam cut-off relay. Improper adjustment of armature return spring tension.

**No high voltage.** Defective 1B3-G or 807 in power supply. Defective h.v. transformer.

**Horizontal "wobble" in picture.** Defective 6AC7 video amplifier. Defective 807 horizontal output. Defective 6SN7-GT first sync amplifier.

**Arc between 807 plate cap and power cable wiring.** (This cable tends to work its way close to the plate of the 807 sweep amplifier.) See that cable runs directly to chassis plug and is clear of all tubes on receiver chassis.

**Abnormal noise flashes on screen (in high-humidity and salt-water areas).** Corona discharge in h.v. r.f. power supply. Remedy: dress leads to lengthen discharge path, paint exposed h.v. points with insulating compound, install insulating sleeving on leads.

**Low picture i.f. sensitivity (picture level drops when sound carrier is properly tuned in).** Weak i.f. tubes. Defective 1N34 video rectifier. Defective tube in Inputuner.

**Notches in picture or raster (moving up and down).** Defective 6AS7.

**Poor definition.** Defective 1N34 crystal video detector.

**Excessive variation in picture size (during evening's operation).** Improperly adjusted high voltage.

**RA-102, -103D, -104D, -110A. Vertical jitter (bounce) in strong signal areas.** Modification of vertical oscillator circuit helpful; contact nearest Du Mont distributor or service organization for details.

**RA-103. Flicker in picture.** Faulty installation. Defective 6AG5 in video i.f. strip. Fluctuating line voltage. *Note:* In latter case, connect a 0.5-μf capacitor from the picture-tube cathode (arm of potentiometer R227) to junction of resistors R222 and R223 and capacitor C216B.

**RA-103, -105. No picture or sound, or very weak picture and sound** (early models only). Breakdown of 125-μμf capacitor C113 in Inductuner. (Breakdown due to defect in particular manufacturer's item, replaced by different manufacturer's capacitor in later sets.

**Flicker (jumping or pumping); lack of sharpness or definition.** Fluctuating or low line voltage. Install Sola constant-voltage transformer. (RA-108A models have self-regulating power transformers and are not affected by line-voltage fluctuations.

—end—

# Television Service Clinic

## Conducted by WALTER BUCHSBAUM*

MANY of our readers have submitted problems involving foldover either on new TV sets or on those which have been converted to a larger picture tube. This foldover appears on the left side of the picture and can be shifted slightly by adjusting the horizontal hold control or the phasing slug on some types of horizontal oscillator transformers. The origin of this defect lies usually in the inherent time constant of either the flyback transformer, the deflection yoke, or both. For the present TV scanning rate the horizontal retrace time is approximately 9 microseconds and most of the high-efficiency transformers have a time constant of 11 to 18 microseconds. Thus the entire picture information is not contained in a single line, but continues for a short portion of the otherwise invisible retrace, giving the appearance of a transparent folding-over of the picture on the left edge.

In some instances this foldover can be reduced or eliminated by proper alignment of the horizontal oscillator transformer, or by using a properly matched flyback and yoke combination. Since very few high-efficiency flyback transformers have the required short time constant, the next best approach is to eliminate not the foldover, but its annoying appearance.

The flyback pulse voltage present at the "hot" side of the horizontal yoke is a strong positive pulse which occurs at exactly the same time and for the same duration as the horizontal retrace. This pulse can be used to eliminate the foldover effect. One simple scheme is to connect a portion of this pulse to the first anode of the picture tube, an element which is usually connected to a 350- to 400-volt B-plus point. A voltage divider is made as shown in Fig. 1 and the values of R1 and R2 are adjusted

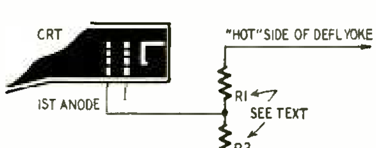



Fig. 1—A circuit to reduce foldover.

to blank out the foldover without affecting the rest of the picture. If too strong a pulse is used the left side of the picture will appear darkened. If the pulse is too weak, the foldover will remain visible. A good starting value for R1 is 100,000 ohms and for R2 between 330,000 and 470,000 ohms. Both resistors should be 1-watt types to avoid deterioration under the high pulse voltages. If too much pulse results, increase the value of R1; if too little is present, reduce R1. The lead to the first anode of the picture tube is usually a bright red lead going directly from the socket to a B-plus point.

It can be argued that by the above method a portion of the picture is lost. This is true, but the portion is only a very thin strip, normally at the extreme right of the picture, and we doubt that any viewer would ever miss this tiny edge. In any event, the elimination of the foldover is usually such a great improvement that it far outweighs the loss of a small edge which is often blanked out by the mask anyway.

### Remote picture tube

*I want to add a remote 17-inch tube to an RCA T-100 to be located 10 feet from the receiver. What kind of cables should I use and how should I obtain the picture signal from the present set? How can I connect a cathode follower? What circuit should I use for an additional picture amplifier?—F. R. Carr, San Mateo, Cal.*

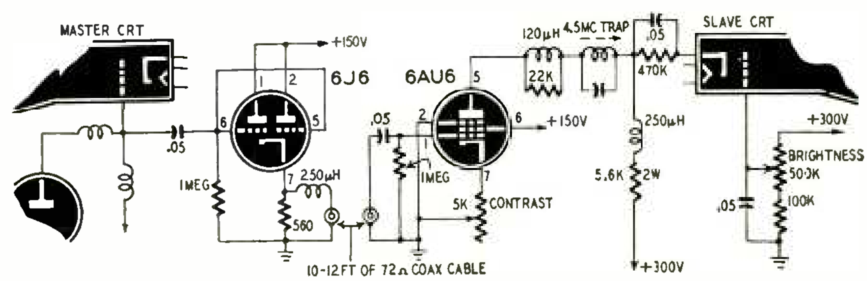



Fig. 2—Cathode follower and picture amplifier hookup for remote picture tube.

Fig. 2 shows suitable connections for a cathode follower and the extra pic ure amplifier. Different values may be required for the video peaking coils, depending on the wiring and layout, but with the coils shown you should get a fairly good frequency response from the circuit.

The 6J6 cathode follower is connected to use both sections in parallel and this tube should be mounted near the video amplifier of the original receiver. The 6AU6 auxiliary amplifier should be located at the remote viewing unit. It may be possible to bring the filament and B-plus leads over from the main chassis, but if the sweep sections for both picture tubes are in use, a separate power supply and sweep circuits will be required for the slave unit.

### No gain from booster

*We have an Astatic AT-1 TV booster that gives no gain at all. The set works better without it, although we have followed manufacturer's specifications to the letter.—H. Masterson Radio, Grand Rapids, Mich.*

Apparently one of the tubes is not working properly or else a coil or other defective part may be the reason for this failure. I would suggest that you replace all tubes in the booster, measure the plate, screen, and B-plus voltages, and check all coils and connections with an ohmmeter. As a last resort, replace each coupling capacitor in turn and try tuning each circuit slightly.

### Distorted scanning lines

*The scanning lines in a Zenith model 23H52R are distorted on the left side for about 4 inches horizontally and extending from top to bottom. How can this be cured?—S. Barton, Pittsburgh, Pa.*

This condition is known as "damping bars" or "ringing." To remove it, replace the 56-µµf capacitor in the deflection yoke by one of at least 68 µµf. Replace the damping tube and the 6BG6-G and readjust the horizontal drive control. As a last resort, shunt the grid resistor of the 6BG6-G with a 1-megohm resistor.

### 6CB6 in weak-signal area

*Is it possible to use 6CB6's in place of 6AG5's in a 630 TS type set for better weak-signal area reception?—L. H. Paefke, Arp, Tex.*

The new 6CB6 can be used in place of either a 6AG5 or a 6BC5. However, the 6CB6 has no internal connection from suppressor (pin 7) to cathode (pin 2) so that some rewiring is necessary. In the tuner, connect pin 7 to pin 2; in the i.f. circuit connect pin 7 to ground and connect the cathode resistor (39 ohms) from pin 2 to ground. Realignment of tuner and the i.f.'s is necessary.

Should oscillation occur with the new tubes, dress all leads carefully to prevent grid-to-plate coupling. Change the cathode resistors to 56 ohms in those stages showing the greatest tendency to oscillate.

—end—

*Author of *Television Servicing*, Prentice-Hall, 1950.

# Useful 2-in-1 Meter

***A grid dipper plus an absorption meter, both in one case, give versatility to this unit***

By H. L. BUMBAUGH

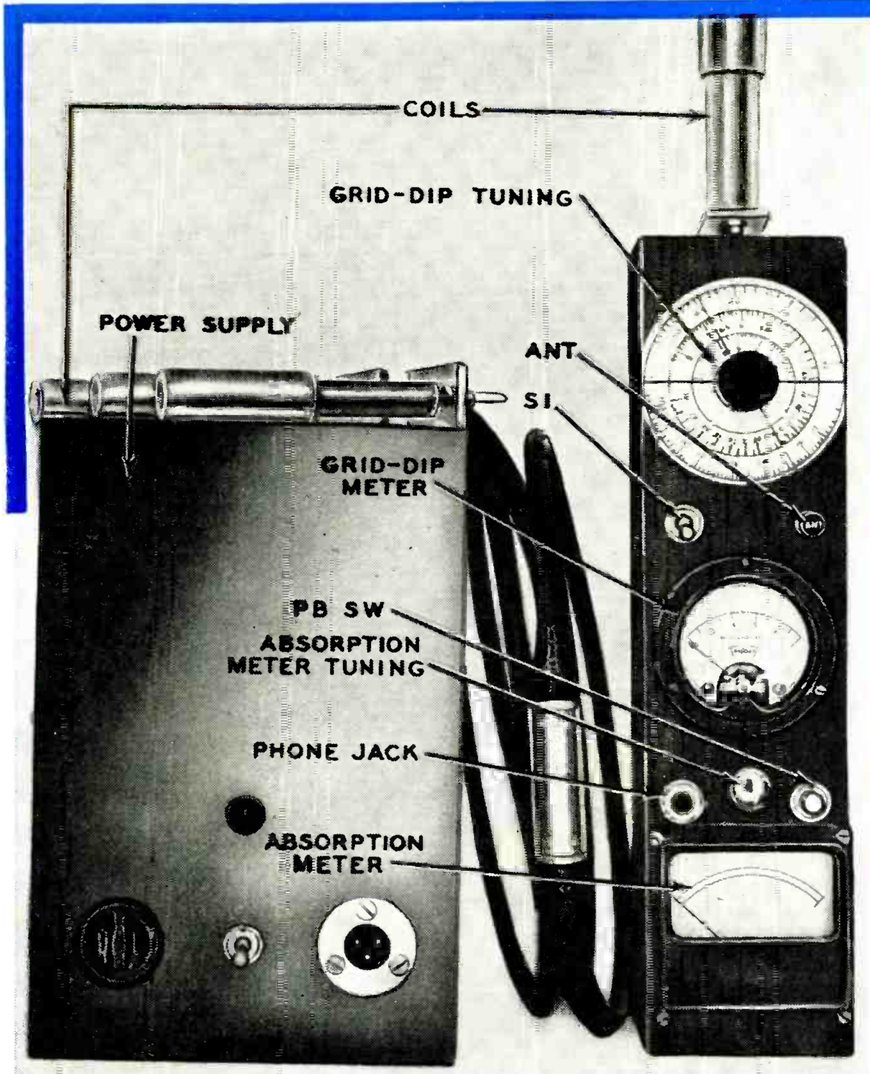
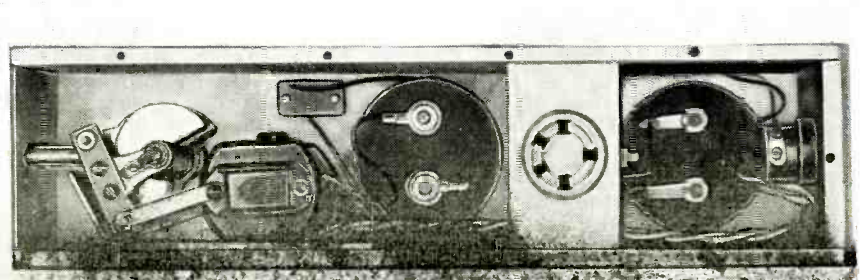



Photo of the grid dip and absorption meter together with the power supply. The absorption meter uses no power, is entirely independent of the dip meter.



Rear view of the meter. The 5-pin coil socket is mounted between the meters on a metal strip fitted across the back. The left end of the case is of lucite.

MANY radio technicians and amateurs do not have access to such laboratory instruments as inductance and capacitance bridges and must first energize circuits to check their operating frequency and characteristics, instead of being able to assemble combinations of capacitors and inductors and predetermine their behavior when they are placed in circuit. Amateurs also frequently cannot determine the actual power output of their transmitters by the only reliable measurement—that of field strength at a distance.

This meter is an r.f. oscillator with a milliammeter in the grid circuit. Plug-in coils are used to vary the inductance, and a calibrated variable capacitor extends the frequency range for any one coil. The milliammeter reads rectified grid current, and this current is a measure of the energy in the oscillatory circuit—the greater the energy the greater the current.

This type of meter is called a grid dip meter and its operation is based on the interaction of coupled circuits. An example will best explain its operation.

Assume we have a coil and fixed capacitor hooked up in parallel and we wish to find the resonant frequency and Q of this circuit. The L-C combination will absorb energy from an external or exciting source when its resonant frequency is the same as that of the source. Since our L-C combination is fixed, we must vary the frequency of the source to the correct resonant frequency. In this case the source will be a grid dip oscillator, or, as we prefer to call it, a grid dip meter.

We first select a coil for the meter whose range is likely to include the resonant frequency of our L-C combination. Then we place the meter coil alongside the coil of the L-C circuit and tune the meter through its range and watch the milliammeter for any change in reading. Initially the meter will read well up on the scale, but as we turn the capacitor dial it will make a sudden dip and then return to its high reading. We tune the meter for its greatest dip and refer to the tuning capacitor dial which is calibrated in frequency for each inductance coil. This frequency is the resonant frequency of our L-C combination, and the sharpness of tuning and depth of the dip give us a good idea of its Q.

When the energized circuit of the grid dip meter has the same frequency as the resonant frequency of our L-C combination, a transfer of energy takes place between the energized and the unenergized circuits. The energy lost from the meter circuit causes the feedback in the oscillator circuit to decrease, and there is less rectified grid current. The milliammeter which measures this grid current dips to its lowest value at the frequency where the energy absorption is greatest, and this is the resonant frequency of the circuit under test.

Fig. 1 shows the circuit of the meter. It is one long used for grid dip meters and is easy to construct. The coil design and certain mechanical details follow the design of W2AEF, W. M. Scherer, whose coil design* in particular was such an improvement over previous models that we scrapped some previously purchased equipment to incorporate it in a meter which could be used as either a "powered" meter or a field strength meter requiring no batteries. This is an advantage where a battery-powered meter would be unnecessary or cumbersome, and to take advantage of this feature, the power supply is built in a separate chassis.

Fig. 2 is the additional circuit which is built into the meter case. It is an absorption meter for making field strength measurements in locations where it is inconvenient to use line or batteries. When using the circuit a short antenna may be attached to the antenna binding post.

### Construction details

The instrument is built into a 3 x 3 x 12-inch case made of Dural with the two sides and one end piece made of ¼-inch thick pieces and the top and bottom of ⅛-inch pieces. The side pieces are drilled and tapped to hold the top and bottom in place with 6-32 screws.

One end of the case is made of lucite which is drilled to accommodate the two jack bars in which the coils are plugged. Details of the jack bars are shown in Fig. 3.

Two brackets, also shown in Fig. 3, must be made to hold the jack bars which are peened to these brackets in hole A which is drilled and countersunk to provide anchorage. To mount the brackets on the tuning capacitor, in this case a National STD 50, first take the capacitor apart and reassemble it with the brackets bolted to the stator assembly. When this is done, the jack bars will stick out from the stator plates with their center-to-center distance about 1½ inches. Now the lucite end piece can be drilled to take the jack bars. One of the photos shows the capacitor assembly complete with tube and other components.

The jack bars should extend through the lucite end piece about ⅛ inch. A little Vinylite cement around the jack bars on both sides of the window will help keep them in place. The only other fastening is a sleeve of copper tubing around the jack bars between the lucite and the bracket on the capacitor. This sleeve takes up the thrust when the coils are inserted.

Another bracket, made of aluminum, is mounted on the back to take the 5-pin coil socket for the absorption meter coils. Use ceramic sockets for the coil and the 955 tube. This socket is mounted about 4 inches from the Dural end of the case, and a hole must be cut in the Dural bottom piece to fit over this socket. The rear view photo shows this bracket in place. The 140-μμf capacitor of the absorption meter is mounted directly below this bracket with its shaft extending through the top piece between the two meters.

The rest of the circuit can be assembled in any way. The only requirement is that the mechanical construction be very rigid, because this is a frequency measuring circuit.

### Coil data

Two sets of coils are needed for the instrument. One set is for the absorption meter and the other for the grid dip meter.

The absorption meter coils are wound on standard 5-pin, 1½-inch diameter coil forms. Fig. 2 shows how the coils are connected to the base, and Table I gives the winding data.

The grid dip meter coils are wound on special forms which must be made up. These forms are mounted on a polystyrene or lucite base which is fitted with banana plugs that plug into the jacks on the lucite end piece of the meter case. Dimensions for the coil form and base are shown in Fig. 4. Dimensions A and B depend on the number of turns on the coil and are given in the winding data of Table II.

Two 1/16 x 1/16-inch slots are milled in the coil form. One extends from hole X to the base, and the other from hole Y to the base. Start the coil winding by passing the wire through hole Y, run it through the longest slot and solder it to the lug on the banana plug on the base. Now start the winding from the top of the winding space. When the correct number of turns are wound, pass the wire through hole X from the side opposite the shorter slot, run it through this slot to the base, and solder it to the banana plug on that side. When the coils are finished, they are fitted with a protective sleeve of polystyrene or lucite which is ¾ inch longer than dimension B. These caps appear in some of the photos.

### Calibration

The meter may be calibrated for frequency coverage with a good communications receiver, or better yet, compared with a good frequency meter.

When using a receiver, allow it to warm up thoroughly, then beat the meter oscillator frequency against the b.f.o. of the receiver. The frequencies for various zero-beat points can then be marked on the meter tuning dial. Each coil has a separate scale on the meter dial.

A good check of the calibration is to make a zero-beat setting between meter and receiver at some frequency. Then move the meter setting to what should be the second harmonic of the frequency. Leave the meter set and retune the receiver to the second harmonic on its own scale. If the meter calibration is good, the new setting should also be close to zero-beat.

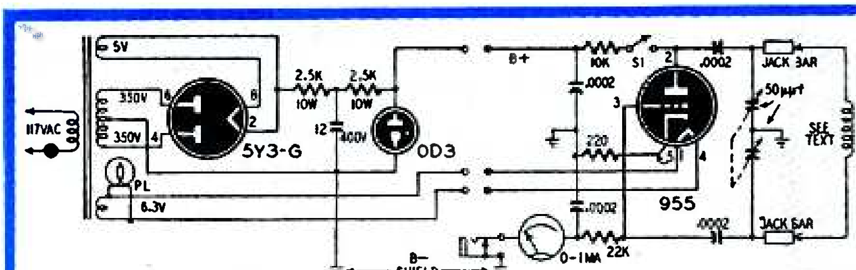


Fig. 1—The grid dip meter and supply circuit. A 3-wire cable connects them.

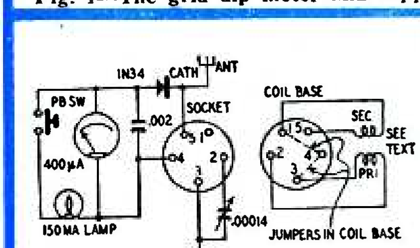


Fig. 2—The absorption meter circuit.

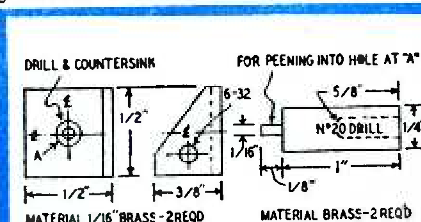


Fig. 3—Construction details of the capacitor brackets and the jack bars.

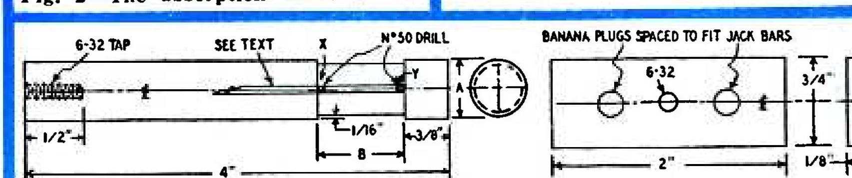


Fig. 4—The details and dimensions of the coil forms for the grid dip meter.

* CQ, May, 1947.

## Uses for the meter

The grid dip meter can be used as an absorption type frequency meter by removing the plate voltage from the 955 tube with switch S1. In this case, resonance is indicated by upward readings on the milliammeter.

**Table I—Absorption Meter Coil Data**

| Range (mc) | Secondary | | Tuned primary | | |
|---|---|---|---|---|---|
| | Turns | Wire Size | Turns | Wire Size | Winding Length (in) |
| 1.75-6 | 11 | 30 | 38 | 24 | 1⅝ |
| 4.5 -16.3 | 6 | 30 | 18 | 20 | 1½ |
| 10.4-28 | 4 | 30 | 9 | 16 | 1¼ |
| 25.3-80 | 2 | 30 | 3 | 16 | 1 |

Secondary turns all close-wound, 1½-inch diameter, spaced ¼-inch from primary. Use enameled wire for all windings.

Inductance can be measured with the meter by hooking it up in parallel with a known value of capacitance and finding the resonant frequency of this combination. The value of the inductance is then given by:

$$L = \frac{1,000,000}{4\pi^2 f^2 C}$$

where L is in henrys, f in cycles, and C in microfarads.

In the same way a capacitor can be measured with a known value of inductance. In this case the value is given by:

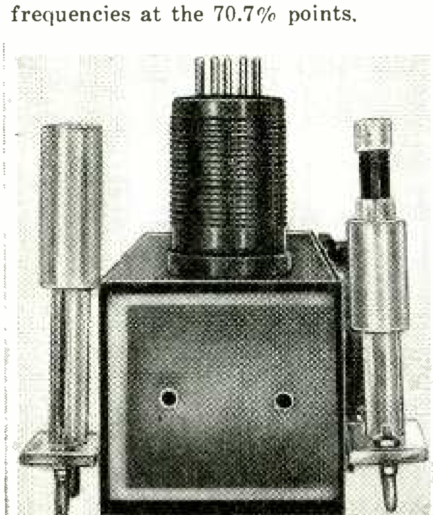
$$C = \frac{1,000,000}{4\pi^2 f^2 L}$$

and the answer comes out in microfarads.

Being an r.f. oscillator, the grid dip meter naturally will serve as a signal generator. It can be used for receiver alignment, as well as to measure the Q of a tuned circuit. To find Q, connect a v.t.v.m. across the tuned circuit and measure the voltage as the grid dip oscillator is tuned to the resonant frequency of the tuned circuit. Then back the meter off resonance (both above and below) to the point where the v.t.v.m. reads 70.7% of the voltage at resonance. The Q is then found by applying the formula:

$$Q = \frac{f}{f1 - f2}$$

In this case f is the resonant frequency, and f1 and f2 are the off-resonance frequencies at the 70.7% points.



An end view of the meter showing the lucite end piece and some of the coils.

**Table II—Grid Dip Meter Coil Data**

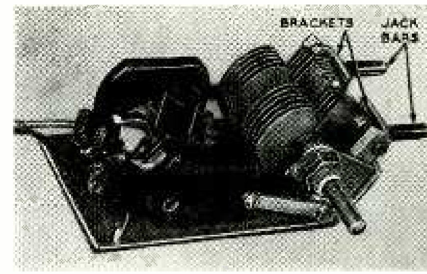
| Coil No. | Range (mc) | A (in) | B (in) | Wire Size | Turns |
|---|---|---|---|---|---|
| 1 | 2.9.-5.4 | ¾ | 1⅛ | 30 | 100 |
| 2 | 4.5.-8.3 | ½ | 1¼ | 30 | 108 |
| 3 | 6.5.-11.9 | ½ | ¾ | 30 | 57 |
| 4 | 10.2-18 | ½ | 1-3/16 | 24 | 45 |
| 5 | 17.5-31 | ½ | 1⅛ | 20 | 24 |

Coil No. 5 spaced over 1 inch, all others close-wound. Use enameled wire for all windings.

Antennas also can be checked with the meter. In this case it is necessary to get near a point of high current in the antenna because coupling to the meter coil is inductive. If such a point cannot be reached, turn the meter pickup coil so its axis is parallel with the antenna wire to get capacitive pickup. Normally this pickup is rather weak. Another way to get pickup is to wrap a turn or so of the antenna or several turns of the lead in around the pickup coil.

Standing waves on a transmission line can be detected by energizing the line and sliding the meter pickup coil along the line while watching for a reading. For this check, use the meter as an absorption meter and watch the milliammeter for a reading. Neutralization can be checked in the same way.

Parasitics are located by plugging headphones into the jack provided for them on the front panel and using the instrument as a grid dip meter. Be careful not to come in contact with the power circuits of the transmitter. Using the meter as a grid dip meter, tune it through its range until you find the




**The oscillator circuit is built on a separate subassembly. This view shows the two jack bars mounted on the capacitor.**

parasitic beat note. Leave the meter setting unchanged and explore the transmitter until the dip of the milliammeter indicates that the offending resonant circuit is nearby.

### Materials for Grid Dip Meter

**Resistors:** 1—220, 1—10,000, 1—22,000-ohm, ½-watt.
**Capacitors:** 4—200-μμf, mica; 1—50-μμf, 2-gang, variable.
**Miscellaneous:** 1—type 955 tube and ceramic socket; 1—0-1-ma meter; 1—closed circuit phone jack; jack bars, coil forms and coils (see text); 1—s.p.s.t. switch; hookup wire and assorted hardware.

### Materials for Absorption Meter

**Capacitors:** 1—.002-μf, mica, 1—140-μμf variable.
**Miscellaneous:** 1—0-400-μa meter; 1—150-ma lamp; 1—push-button switch; 1—1N34 crystal; 5-pin, 1½-inch diameter coil forms and sockets; hookup wire, and assorted hardware.

### Materials for Power Supply

**Resistors:** 2—2,500-ohm, 10-watt.
**Capacitors:** 1—12-μf, 450-volt, electrolytic.
**Miscellaneous:** 1—350-0-350-volt a.c. power transformer with 6.3 and 5-volt windings; 1—5Y3-GT, 1—0D3, tubes and sockets; 1—pilot lamp; 3-wire shielded cable; hookup wire and assorted hardware.

—end—

# A Voltage-Regulated Power Pack

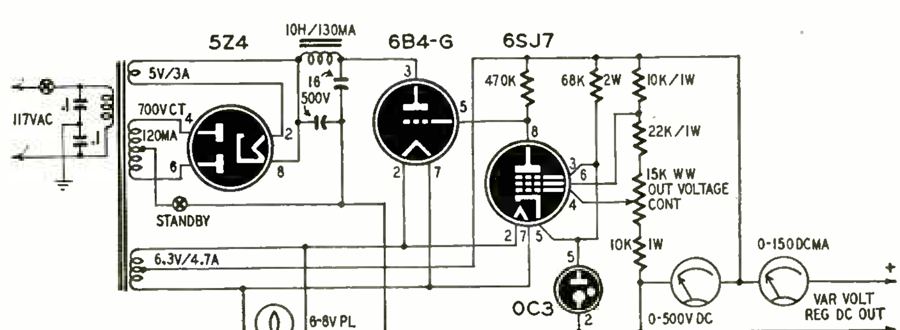
Voltage-regulated and variable-voltage power supplies are described from time to time but supplies having variable output which is stable over a range of load conditions are hard to find. Capable of delivering 110 ma at 175 volts d.c. and 60 ma at 300 volts, this electronically regulated variable-voltage supply is recommended by Cornell-Dubilier Electric Corp. for experimental and laboratory service.

The power transformer is rated at 120 ma. If more current is required, the power transformer and rectifier can be replaced with units having higher current ratings.

The 6B4 serves as a variable resistor in series with the load. The internal resistance of the tube is controlled by the bias applied to its grid by the 6SJ7 d.c. amplifier. A drop in output voltage lowers the bias on the 6B4 so its internal resistance drops and restores the output voltage to its preset level. The 15,000-ohm potentiometer controls the output voltage by varying the grid bias on the 6SJ7. This tube is stabilized by passing its cathode current through the 0C3 voltage-regulator tube.

A 150-ma meter measures the current drawn by the load and a 500-volt d.c. meter measures the output voltage. A standard 1-ma d.c. meter having a resistance of 105 ohms can be converted to a 150-ma meter by shunting it with a 0.7-ohm resistor. Likewise, a 1-ma meter can be converted to read 500 volts by connecting a 500,000-ohm resistor in series with it.

—end—



# TV Tube Substitutions

By I. QUEEN

THE present tube shortage affects many types. In many areas, however, the demand is especially frantic for types widely used in TV service. The replacement problem is more serious for TV owners because their sets require about three times as many tubes as radios do. Besides, there are factors which increase the mortality rate of TV tubes.

For one thing, the eye is more critical than the ear. Distortion or low gain in picture circuits become apparent when tubes become weak. Many listeners remain unaware of audio defects long after their tubes are definitely bad. Another factor is the TV service which is commonly sold on a contract basis. A radio owner may be reluctant to call his service technician until his set suffers a major breakdown. On the other hand, with service guaranteed, the TV owner may expect almost perfect reception. The service technician may want to replace doubtful tubes himself to avoid unnecessary calls. All this helps to increase the replacement rate of TV tubes.

Technically, TV tube replacements are far more critical than substitutions in AM radios, where tolerances are often very broad. During the last war, more than one large service department worked on the basis that if a substituted tube did not burn out immediately, and if the set continued to play, the substitution was satisfactory!

Television is not as simple as that. In the v.h.f. front ends, a tube whose characteristics are almost exactly similar to those of the one replaced may refuse to work at all. According to several recent Technotes, tubes *of the same type number* but made by different companies may vary enough to prevent full interchangeability in certain circuits (RADIO-ELECTRONICS, April, 1951, page 98). This may be the case in video i.f. and detector circuits—and possibly others—as well as in the front ends.

Differences in sets and circuits are also important. The technician will find that a tube substitution which is satisfactory on one model may not work at all on another by the same maker.

As compared to anything we have experienced before, television tube substitution is going to be a matter of cut-and-try, and will depend far more on the technician's individual ingenuity and intelligence than on any help he may get from substitution charts.

The accompanying chart is therefore intended to serve merely as a rough guide and possible time-saver. It lists five categories of tubes used in many TV sets. Each group includes tubes closely related. In some cases only slight changes are required to substitute one type for another. In others the difference in characteristics is rather wide. This is because of the wider variation in TV circuit characteristics than in AM radios. In almost any a.c. receiver, the voltage applied to a given element of a given tube may be predicted within 10%. The range is much wider in television. As a result it may be found that a replacement tube which varies from the original may still be suited to the conditions of a given circuit. When substituting one h.f. type for another, realignment is nearly always necessary. In the rectifier and power tube columns, peak voltage and maximum current ratings should be noted. Remember that a tube with a *higher* voltage rating than the one replaced often may be used.

Any of the tubes listed as damper-rectifiers will operate as straight rectifiers. The inverse peak plate voltage is considerably lower for rectifier than for damper use. The 5V4-GT operates as rectifier with a 1400 IPV rating, and the 6W4-GT with 1250. Ratings for the tubes marked (R) are rectifier ratings. Their high voltage drop makes them unlikely damper substitutes, as the internal resistance of a damper should be as low as possible.

Sometimes a substitution is advantageous as well as necessary. This is true because many of the newer type tubes are more efficient than those formerly used. For example, the original 630 TS RCA chassis used several 6AG5 tubes in the i.f. channel. The latest models use 6AU6 and 6CB6 tubes. Not only do these perform better but they are cheaper as well.

—end—

| RF-IF VOLTAGE AMPL. | DUO-TRIODE MEDIUM MU | HIGH VOLTAGE RECTIFIER | DAMPER-RECTIFIER | BEAM POWER HORIZ. DEFLECTION |
|---|---|---|---|---|
| ● 6AG5, 6AK5, 6BC5<br>RATINGS AT Ep 180V<br>6AG5: Ip 7.0, Rk 350, gm 5700, P-G .025<br>6AK5: Ip 7.7, Rk 200, gm 5100, P-G .02, FIL 6.3V/.175A<br>6BC5: Ip 8, −Eg 4.9, gm 6000, P-G .03 | 6SN7-GT<br>FIL 6.3V/.6A<br>Ep 250V Ip 9 −Eg 8.0V | 1B3-GT<br>FIL-1.25V/.2A<br>Ip 2 IPV 40KV | 5V4-GT<br>FIL-5V/2A<br>Ip 175 IPV 2KV | 6BG6-G<br>FIL-6.3V/.9A<br>PL. SURGE 6KV DISS 20W |
| ● 6CB6, 12AW6<br>12AW6 FIL 12.6V/.15A<br>6CB6: Ep 200V/9.5MA, gm 6200, P-G .02<br>12AW6 SAME AS 6AG5 | 7N7 LOCTAL<br>SAME RATINGS AS ABOVE | ● 1X2<br>FIL-1.25V/.2A<br>Ip 1 IPV 15KV | 5U4-GT<br>FIL-5V/3A<br>Ip 225 IPV 1.55KV (R) | 807 5 PIN SOCKET<br>RATINGS SAME AS ABOVE |
| ● 6AU6, 12AU6<br>12AU6 FIL 12.6V/.15A<br>Ep 250V/10.8MA, −Eg 1.0, gm 5200, P-G .0035<br>12AU6 SAME EXCEPT 12.6V/.15A FIL | 6F8-G<br>SAME RATINGS AS ABOVE | ● 1V2<br>FIL-.625V/.3A<br>Ip .5 IPV 7.5KV | 5Y3-GT<br>FIL-5V/2A<br>Ip 125 IPV 1.4KV (R) | 6BQ6-GT<br>FIL-6.3V/1.2A<br>PL. SURGE 5KV DISS 10W |
| ● = MINIATURE BASE | ● 12AU7, 12BH7<br>12AU7 FIL 12.6V/.15A; 6.3V/.3A<br>12BH7 FIL 12.6V/.3A; 6.3V/.6A<br>12AU7 − Eg 8.5V Ep 250V Ip 10.5<br>12BH7 − Eg 10.5V Ep 250V Ip 11.5 | FILS 6.3V/.3A UNLESS NOTED<br>P-G = UNSHIELDED PLATE TO GRID CAPACITANCE IN μμf<br>DISS = MAXIMUM PLATE DISSIPATION<br>Ip = RATINGS IN MA UNLESS NOTED OTHERWISE<br>ALL TUBES FIT OCTAL SOCKETS UNLESS NOTED OTHERWISE<br>IPV = PEAK INVERSE PLATE VOLTAGE | 6W4-GT<br>FIL-6.3V/1.2A<br>Ip 125 IPV 3.5KV | 6BD5-GT 6.3V/.9A<br>6AU5-GT 6.3V/1.25A<br>6AV5-GT 6.3V/1.2A<br>SURGE / DISS:<br>6BD5-GT 4KV 10W<br>6AU5-GT 4.5KV 10W<br>6AV5-GT 5.5KV 11W |

# Picture-Tube Replacements

THE current tube shortage and the gradual change to larger screens are making some types of picture tubes difficult to replace. A replacement guide for picture tubes can become an almost endless cross-index of tube types unless we assume that physical and electrical alterations are to be held to a bare minimum which requires hardly more work than replacing a tube with another of the same type. *Interchanging metal and glass, round and rectangular, or electrostatic and magnetically-focused tubes are conversion jobs rather than simple tube replacement.*

The over-all dimensions of tubes become the most important factor in substituting tubes of the same general size and type, so this replacement guide lists tubes in *descending order of size*. Thus, if tube lengths vary from 18¾ to 17½ inches (as they do in 12½-inch round types) you can feel sure that you are not likely to have as much trouble replacing with one listed above it as you would when using the top tube in the list to replace the one on the bottom. Tubes with the same dimensions and electrical characteristics and differing only in the type of face plate are considered as being completely interchangeable without modifying the circuit or cabinet in any manner. For example: the 16GP4, 16GP4-A, -B, and -C are identical except for the face plate. There are no types which approximate the 8AP4 (metal round) and 17CP4 (metal rectangular) tubes.

Deflection angles can be divided roughly into two classes. The first covers from 50 to 60 degrees and the second covers wide-angle tubes of the 70-degree variety. A new deflection yoke is necessary when a 50-60-degree tube is replaced by a wide-angle type. When replacing a 16AP4 (53 degrees) with a 16EP4 (60 degrees), the necessity for replacing the deflection yoke will depend on the particular set. Some may use a yoke like the RCA 20D1 or 20D12 which provides for deflections up to 53 degrees, while other sets may use a type 205D1 or equivalent which can be used with tubes up to 60 degrees. The need for replacing the yoke is best determined by experiment.

Face-plate curvature may be a factor in selecting a substitute tube. If you substitute a tube having a smaller radius of curvature, the center of the face is likely to strike the safety-glass when the tube is properly seated in its cradle. Likewise, if a tube having a larger radius of curvature (flatter face) is used as a replacement for one having a smaller radius, the mask may not fit.

Anode connectors for glass tubes are of two general types. Some are recessed balls and the others are cavities. The location of the connectors with respect to the base pins and the position on the cone varies from one type of tube to another. This may make it necessary to use a longer high-voltage lead. It is better to replace the entire lead rather than to splice it. A faulty splice is likely to cause arcing and the wrapping over the splice is likely to be a point for voltage breakdown and corona.

| Tube type | Bulb diameter or diagonal (inches) | Overall length (inches) | Ion trap type | Base diagram Fig. No. | Anode connector | Misc. notes |
|---|---|---|---|---|---|---|
| **10-inch glass round, 50 degrees** | | | | | | |
| 10BP4 | 10 1/2 | 17 5/8 | Double | 1 | Cavity | |
| 10EP4 | 10 1/2 | 17 5/8 | Double | 1 | Ball | |
| 10FP4 | 10 1/2 | 17 5/8 | None | 1 | Cavity | |
| 10MP4 | 10 1/2 | 17 | Single | 2 | Cavity | |
| 10CP4 | 10 1/2 | 16 5/8 | None | 1 | Ball | |
| **12½-inch glass round, 50 degrees** | | | | | | |
| 12LP4 | 12 7/16 | 18 3/4 | Double | 1 | Cavity | a, b, c |
| 12TP4 | 12 7/16 | 18 3/4 | Double | 1 | Cavity | |
| 12CP4 | 12 1/16 | 18 5/8 | None | 3 | Cavity | a |
| 12VP4 | 12 7/16 | 18 | Single | 2 | Cavity | b |
| 12XP4 | 12 7/16 | 17 5/8 | None | 1 | Cavity | |
| 12QP4 | 12 7/16 | 17 1/2 | Single | 1 | Ball | a |
| 12JP4 | 12 | 17 1/2 | None | 1 | Ball | a, d |
| 12RP4 | 12 | 17 1/2 | Single | 1 | Ball | a, d |
| **14-inch glass rectangular, 70 degrees** | | | | | | |
| 14EP4 | 13 11/16 | 16 13/16 | Double | 1 | Cavity | |
| 14CP4 | 13 11/16 | 16 3/4 | Single | 1 | Cavity | e |
| 14DP4 | 13 11/16 | 16 3/4 | Double | 1 | Cavity | a |
| **16-inch glass rectangular, 70 degrees** | | | | | | |
| 16QP4 | 16 1/8 | 19 1/8 | Double | 1 | Cavity | a |
| 16KP4 | 16 1/8 | 18 3/4 | Single | 1 | Cavity | e |
| 16RP4 | 16 1/8 | 18 3/4 | Single | 1 | Cavity | e |
| 16XP4 | 16 1/8 | 18 3/4 | Double | 1 | Cavity | a, e |
| 16TP4 | 16 1/8 | 18 1/8 | Single | 1 | Cavity | e |
| 16UP4 | 17 1/8 | 18 1/8 | Single | 1 | Cavity | e |
| **16-inch glass round, 50—60 degrees** | | | | | | |
| 16LP4 | 15 7/8 | 22 1/4 | Double | 1 | Cavity | f, g |
| 16MP4 | 16 1/8 | 21 3/4 | Double | 1 | Cavity | |
| 16FP4 | 16 1/8 | 21 1/4 | Single | 1 | Ball | a |
| 16CP4 | 15 7/8 | 21 1/2 | Double | 1 | Cavity | a, f, g |
| 16HP4 | 15 7/8 | 21 1/4 | Double | 1 | Cavity | f |
| 16JP4 | 16 1/8 | 20 3/4 | Double | 1 | Cavity | |
| 16DP4 | 15 7/8 | 20 3/4 | Double | 1 | Cavity | a |
| **16-inch glass round, 70 degrees** | | | | | | |
| 16ZP4 | 15 7/8 | 22 1/4 | Double | 1 | Cavity | |
| 16WP4 | 15 7/8 | 17 3/4 | Double | 1 | Cavity | a |
| 16SP4 | 15 7/8 | 17 5/16 | Single | 1 | Cavity | |
| 16YP4 | 15 7/8 | 17 5/16 | Single | 1 | Cavity | |
| 16VP4 | 15 7/8 | 17 3/16 | Single | 1 | Cavity | a |
| **16-inch metal round** | | | | | | |
| 16AP4 | 15 7/8 | 22 5/16 | Double | 1 | Cone | h |
| 16EP4 | 15 7/8 | 19 5/8 | Double | 1 | Cone | i |
| 16GP4 | 15 7/8 | 17 11/17 | Single | 1 | Cone | i, k |
| **17-inch glass rectangular** | | | | | | |
| 17BP4 | 16 5/8 | 19 5/8 | Single | 1 | Cavity | |
| 17AP4 | 16 5/8 | 18 5/8 | Single | 1 | Cavity | |
| **19-inch glass round** | | | | | | |
| 19FP4 | 18 7/8 | 22 | Double | 1 | Cavity | a, e |
| 19DP4 | 18 7/8 | 21 1/2 | Double | 1 | Cavity | |
| 19GP4 | 18 7/8 | 21 1/4 | Single | 1 | Cavity | a, e |
| **20-inch glass rectangular, 70 degrees** | | | | | | |
| 20DP4 | 20 3/32 | 21 7/8 | Single | 1 | Cavity | l |
| 20CP4 | 20 3/32 | 21 7/16 | Single | 1 | Cavity | |

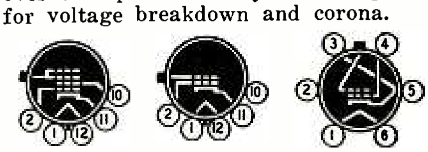



Fig. 1 Fig. 2 Fig. 3

Socket wiring diagrams are the same for most type of tubes, but the size and type of base may make it necessary to change the socket. In most instances, this is a small job which can be done in a few minutes.

*This chart is not foolproof* and we don't believe that you will ever find one that is foolproof as long as each manufacturer continues to produce sets in many different types and models. If you give some thought to the possible substitutions before installing a new tube you will find that a large number of common tubes can be replaced with a minimum of time and effort.

Special notes:

a—This tube has no exterior conductive (Continued at bottom of facing page)

# Speed Means More Money

By W. G. ESLICK

TIME is the all-important factor if one is to make a living out of radio. Watch your time and your reputation, and make an honest charge large enough to pay for your time and investment, and you *can* eat.

In any radio with distorted tone, look immediately for leaky coupling capacitors. A 1,000-ohm-per-volt meter is almost useless for this quick test, but a 20,000-ohms-per-volt or a v.t. voltmeter will do. Measure between grid and ground, usually on the lowest range. There will be a slight upward movement of the meter (if a leaky coupler is very bad, sometimes full-scale deflection). With the meter on a higher range (depending on ohms-per-volt of the meter and voltage of the particular circuit) shunt the grid resistor, the plate resistor, and the screen grid with meter probes. This will tell about the resistors (if tone clears up or volume comes up to natural strength).

Gassy tubes will sometimes cause a *plus* potential on the grid. In a Grunow 11G, the two coupling capacitors that feed the 6F6's were replaced and new metal tubes were installed. About 10 volts plus appeared on one grid and 2 on the other. First thought was that the new capacitors were at fault but it chanced that the 6F6's didn't have the No. 6 pin and by looking through one could see a purple glow in the one that had a 10-volt reading. It was due to gassiness of the tube, fresh off the shelf.

## Revealing voltage checks

On portable radios be sure to check the filament voltage. Comebacks are frequent otherwise, for the oscillator won't "fire" if either weak filters, weak rectifiers, or a changed filament-dropping resistor be at fault. If replacements are not handy, a resistor bridged across the filament resistor will raise the voltage (start at 10,000 ohms and work down till filament voltage is correct). This is a temporary repair, so a tag ought to be put on the set.

On any set, after checking the tubes measure the B-plus at the rectifier and screen, plate, and cathode of the power tube (if self bias is used). That will indicate if the power circuit is O.K.

## "Circuit-disturbance" is quick

Assuming the set is dead, a "noise check" is the fastest way to locate trouble. Start at the grid of the power tube, then to the plate of the first audio for hum or a loud click, and then to the grid of the a.f. tube, to diode plates of the second det. and back through the i.f. system grid by grid and plate by plate to the mixer and r.f. (if any). If a hum or click is heard back to the diode plates and a click is heard on the i.f. plate but not on the grid, for example, the trouble is in that stage.

By using the meter as a test resistor as practiced by older radiomen for years trouble-shooting can be narrowed down in seconds to one certain point. Use a little common sense on what range to use. With a 20,000-ohms-per-volt meter, 200 volts would be the equal of a 2-meg resistor (with some capacitance and inductance of course). Then use the voltage check and hum-click test.

Many of the midget portables of several different brands—even some in dealer warranty—are low in volume and mushy. Either making a voltage check or using the meter as a resistor will find a bad screen resistor in the first audio in 90% of the cases.

Using a low-range voltage scale to check for positive voltages on grids will also work in the r.f. section, as a lot of r.f.'s are resistance-coupled to the mixer (and a few sets use the same in the i.f.'s also).

If noise can be obtained through the set at the grid of the mixer and r.f. when the grid is touched, it's a good bet that the oscillator is the guilty stage.

Many noisy volume controls (if not worn out, of course) can be cleaned with carbon tet. Using an eye dropper and squirting some in at the solder lugs and where the shaft enters the control will clear up noise. Also use carbon tet for tuning noise at capacitor end and at bearings, at all pulleys, and at shaft.

## Know your tubes!

Memorize the popular tube base connections so you know which point is which and what normal voltage to expect at each plate and screen, of course depending on their use in the set and whether it is a.c., a.c.-d.c., or battery. Voltages vary a lot, it's true, but one can know if the voltage is low or high by knowing tubes and circuits. If an r.f.-i.f. or mixer plate voltage is around 250, the screen should be around 80 to 125 volts (with exceptions, of course). In a.c.-d.c. sets the screens are usually the same as the plates but never below 60 volts if the set is to have any power. Audio screens may run as low as 15 to 20 volts, depending on other circuit values. Example: on a 6V6 power tube one would find around 250 volts on pin 3 (plate) and on pin 4 (screen) and either zero or 12–18 volts on the cathode (self bias or fixed bias). If zero, check to see for sure if there is fixed bias and measure it between ground and the cold side of the grid resistor (if a divider network isn't used).

## Automobile radios

Some auto radios using 6V6's (7C5's) have around 160 and upward of plate voltage and some have as much as straight a.c. sets. This will have to be learned by testing, then remembering it on the next one of the same type.

If an auto radio has a high current drain and buzzing vibrator, check the buffer first, and then after a new one is installed, see if the vibrator is O.K.

Outside of the power pack and hash filter system, the auto radio is the same as any other radio, except antenna input circuit to match the small auto antenna.

A handy tool for catching those intermittent filaments that come and go in an a.c.-d.c. set is a little neon lamp to bridge across each filament and find the intermittent. A v.t.v.m. or at least a meter of 20,000 ohms per volt sensitivity is almost a must in radio.

Another speedy tool is a signal tracer, a simple audio amplifier with one tube preferably in a probe with an .01 and an .0001 capacitor between probe and grid, one for a.f. and one for r.f. One can find *where* volume is lost, *where* the tone mushes up and a score of other things. It is worth its weight in gold.

—end—

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(*Continued from facing page*)

coating. It may be necessary to add approximately 500 μμf to the high-voltage filter when it replaces one with an exterior coating. In the reverse case, be sure to ground the exterior coating of the replacement tube.

b—A triode-type tube. It has no No. 2 grid. For circuit modifications, compare circuits of sets having triode- and tetrode-type tubes.

c—This tube has a 2.5-volt, 2.1-amp heater. All others have 6.3-volt, 600-ma heaters.

d—Face plate has 20-inch radius of curvature. All others in this size group have 40-inch radius.

e—Requires RMA 109 focus coil. Others in this group require RMA type 106.

f—Face-plate curvature has 56-inch radius. Others in this group have 27-inch radius.

g—Deflection angle is 50 degrees. Others in this group have 60-degree angles.

h—50-degree deflection angle.

i—60-degree deflection angle.

j—70-degree deflection angle.

k—Face plate curvature has 40-inch radius. Others in this group have 27-inch radius.

l—Some have outside conductive coatings, others have not. (See note a.)

—end—

# Video Bar Generator Speeds Set Alignment

**This compact instrument provides a pattern for precise adjustment of television sweep circuits**

**By RICHARD HENRY**

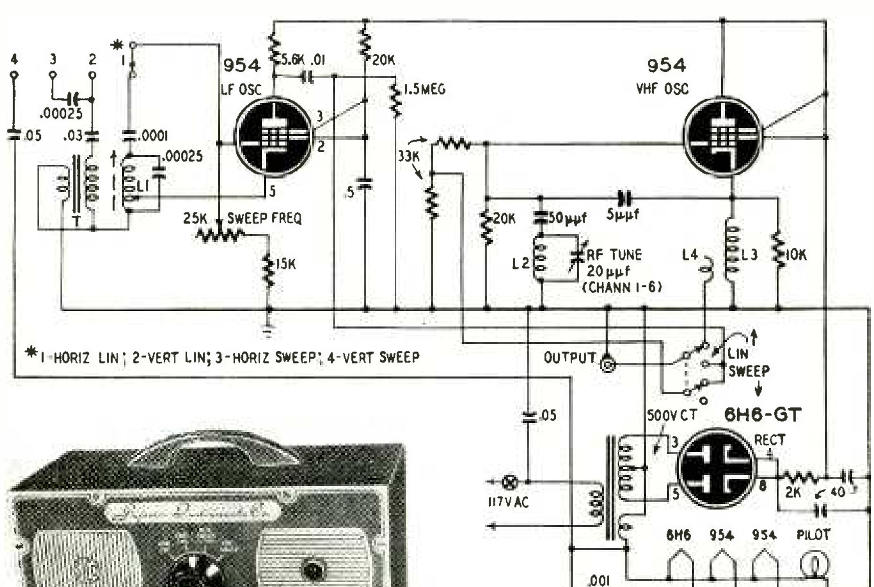
SERVICE technicians have come a long way indeed from the days when a voltohmmeter, tube tester, and signal generator could do just about any testing job that came up in ordinary service work. The outstanding cause of the additional headaches is television.

Most technicians have found that existing test instruments satisfy their needs except in one department: there is still no cheap and easy way to put an actual picture on the receiver screen to simulate exact operating conditions. Perhaps some day someone will make a monoscope camera chain cheaply enough so that every service shop can put the RMA test pattern on every receiver before it leaves the bench. Meantime, some cheaper and handier way to check linearity and operation of the sync circuits and the signal channels is very useful.

One good answer is a bar generator such as the one pictured and described on these pages. As the diagram shows at a glance, the circuit is easily constructed by an experienced experimenter with the time to spend, or the instrument may be purchased ready made.[1] As photo A indicates, it is small enough to be carried around for use in adjusting receivers after they are installed, and it takes up little space on the service bench when it is used for checking the sweeps and as a handy signal generator.

The bar generator is most often used to adjust horizontal and vertical linearity of receivers. It contains a v.h.f. oscillator, tunable continuously over channels 2 through 6. The v.h.f. oscillator is grid-modulated by a second tube which may be either an oscillator or an amplifier.

[1] Superior Instruments Company, New York, N. Y.




Complete schematic diagram of the Superior bar generator. Data on the coils is given in the text. Other v.h.f. tubes may be substituted for the 954's shown.


Photo A—The Superior bar generator is housed in this 5 x 10 x 7-inch case.

## Vertical linearity

When vertical linearity is to be adjusted, the v.h.f. oscillator is tuned to some channel between 2 and 6 and the receiver tunes in the signal. (Since all the tests can be made on these lower-frequency channels where the receiver is most stable, it is not necessary to use channels 7-13. However, if there is some necessity for testing on the upper channels, the v.h.f. oscillator generates plenty of harmonics which can be used.) The oscillator which furnishes the modulation is tuned to a frequency which is an integral multiple of the receiver's vertical-sweep frequency. Assuming that the vertical hold control is set correctly with a tuned-in station to begin with, the vertical-sweep frequency is 60 cycles.

If the frequency reaching the C-R tube grid from the bar generator (the demodulated signal) is 120 cycles, and the waveform is sine, two light and two dark bars, all equal in height, will appear horizontally across the screen. The reasoning is quite simple. It takes the cathode-ray spot 1/60 second to go from top to bottom of the raster. It takes the modulation signal only 1/120 second to go through a cycle from zero to maximum positive, to maximum negative, and back to zero. Therefore there are two modulation cycles for every field scanned by the spot. Each time the modulation goes positive the screen darkens; each time it goes negative the screen is brighter. The brightening and darkening takes place twice per field and the result is two horizontal light bars which appear against a dark background.

The same kind of reasoning applies when we modulate the generator's v.h.f. oscillator with, say, a 600-cycle signal, which is easier to work with, for it produces 10 light bars. And if we use a highly pulsed waveform (with pulses negative), like the oscillogram of Photo B, the light areas of the picture are very narrow and the pattern looks like that in Photo C.

Now we have a very useful pattern on the screen. If the receiver's vertical-sweep oscillator's waveform is a perfect sawtooth with linear rise, the bars are equally spaced. If it is nonlinear, the bars will be unequally spaced as in Photo D. The bar pattern is even more useful than the usual station test pattern (which is now almost unobtainable on the air), for it shows exactly where the nonlinearity is on the screen (at the top in the case in Photo D). It is a simple matter to readjust the vertical linearity and height controls on the receiver to eliminate the nonlinearity. Though the results are easy to judge by eye, finicky purists can even take a ruler and measure the distances between adjacent lines until linearity is correct to the narrow side of a gnat's whisker.

### Horizontal linearity

The same idea is used to create vertical bars for judging horizontal linearity. The modulation oscillator this time must operate at a multiple of the 15,750-cycle line-scan frequency. To produce 23 bars, for instance, it operates at 362.25 kc, which is 23 times 15,750 cycles. Each time the light spot travels from left to right once, it is darkened and brightened 23 times. When the 23-times ratio is exactly right the bright spots are lined up vertically and we have vertical bars. If the ratio is slightly off, the bars become diagonal. However, as with the horizontal bars, the vertical-bar signal itself tends to lock the horizontal oscillator in sync with itself, so the bars can be made to stay put.

Judging horizontal linearity is simply a matter of observing the spacing between the bars. In Photo E, for instance, the bars are fairly equally spaced except at the very edges, where better linearity probably would not be possible anyway.

The bar method of checking horizontal linearity proved particularly useful in the writer's Admiral 30A1 which has three controls for adjusting horizontal scanning. The two most often used are the horizontal drive potentiometer and the width slug. There is, however, an additional slug adjustment (on the chassis deck) whose principal effect is only in the center of the screen. Using a station test pattern, an egg-shaped circle would normally be corrected with the first two controls. However, if, the inner slug needs adjustment, there is no way of knowing it; rounding the pattern circle with the outer controls would cause nonlinearity at the edges and that would not be easy to put a finger on. Using the bars, the conditions at each area on the screen show up independently of other areas and the technician can see exactly what is needed.

### Checking sweep circuits

There are two more uses for the bar generator which are possible with only a very slight addition to the equipment necessary for linearity checking. These are checking the horizontal and vertical sweep oscillators.

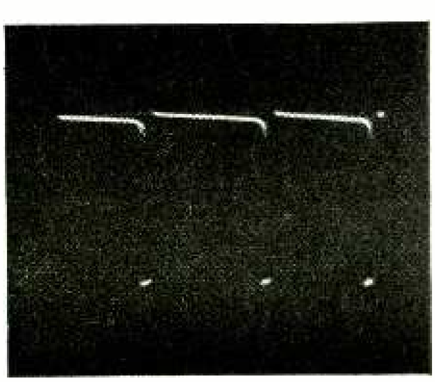


**Photo B—Pulsed waveform for vertical linearity testing gives narrow light bars.**

If the modulation oscillator is used by itself as a 15,750-cycle pulse generator, it is an excellent tool for checking sets in which the high voltage is dead. A common cause of this is failure of the horizontal sweep oscillator, whose pulses are used to create the high voltage necessary for the second anode of the cathode-ray tube. There are other causes, however.

The 15,750-cycle pulse generator is simply connected to the point where the sweep pulses should normally appear. If high voltage returns, the sweep oscillator itself was the cause of the trouble. If not, the sweep oscillator is probably working and the following circuit should be checked for bad components or open connections. In contrast to the usual way of diagnosing high-voltage failure—laboriously checking all the components—this system of simply replacing the sweep oscillator is a big time-saver.

The vertical sweep also can be checked. In this case it is only necessary to use the modulator tube as an amplifier. A 60-cycle signal from the bar generator's filament supply is fed to the grid, and the plate output is connected to the receiver in place of the vertical-sweep oscillator. The amplifier distorts the waveshape so as to approximate a sawtooth, as illustrated by the oscillogram of Photo F.

In both cases the amplitude of the signals is not usually as great as would be obtained from the set's own oscillators. The result is that the sweep is not as great as normal and the width and height of the raster are smaller than usual. For testing purposes those deficiencies are of no importance as their mere presence indicates that oscillator was faulty.

### The circuit

The schematic diagram shows how simple the bar generator is. The 954 tubes are still plentiful on the surplus market at low prices and they perform excellently at all television frequencies. Their only drawback is that they require the special acorn sockets. Other high-frequency miniatures would undoubtedly be adequate and a little experimenting might be worthwhile.

The v.h.f. oscillator is an adaptation of the grounded-plate Colpitts. L3 is an r.f. choke consisting of 80 turns of No. 34 enameled wire close-wound on a 5/16-inch form. L2 is 2 turns of No. 20 enameled wire on a 3/16-inch form. The circuit is unconventional but it oscillates at the drop of a hat without the touchiness of some v.h.f. oscillator circuits.

The low-frequency modulating oscillator has a 4-position switch. In position 1 it is a grounded-plate Hartley, oscillating in the 300-kc region. The tuning slug can be set for about 362.25 kc. to obtain 23 vertical bars. Fewer bars can be had if additional capacitance is added to the .00025 μf across the coil. A lower harmonic of the line frequency syncs more easily, though the higher frequency places more bars on the screen for easier visual interpretation of linearity. The coil L1 can be wound by experiment, or a standard 12SA7 oscillator coil for the broadcast band can be used with about .001 μf connected across it.

In positions 2 and 3 the oscillator

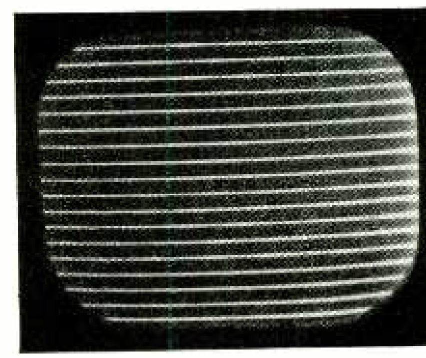


**Photo C—Horizontal bars on receiver screen for testing of vertical linearity.**

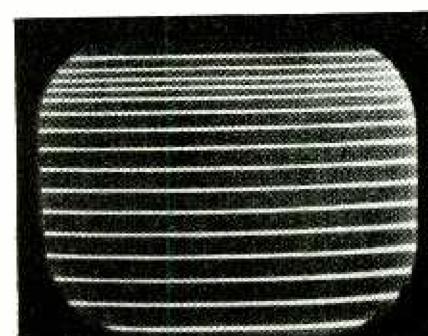


**Photo D—Set with nonlinear vertical sweep shows bunching of bars at top.**

**Photo E—Pattern of 23 vertical bars on the receiver screen for horizontal check.**

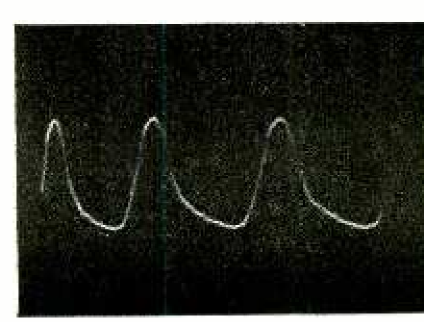


**Photo F—The modulator distorts the 60-cycle vertical sweep signal from the line.**

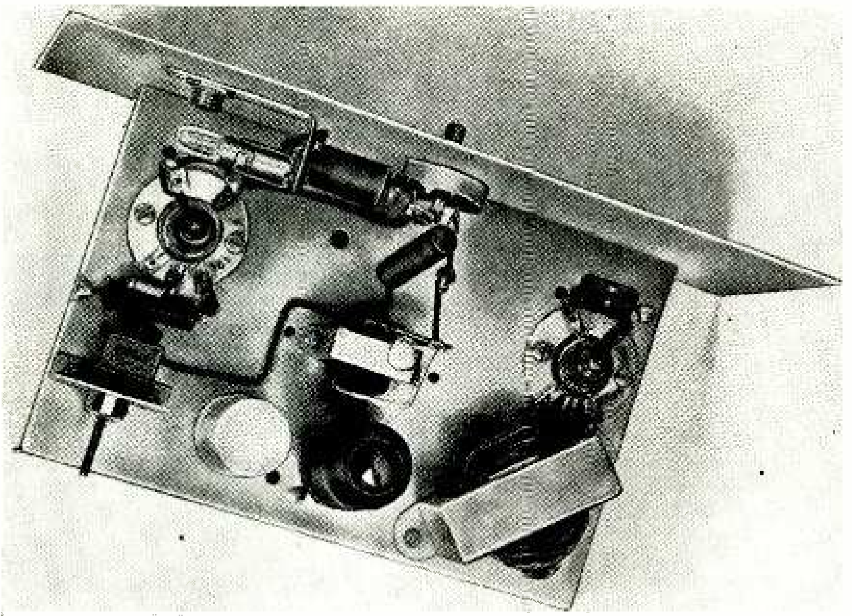


Photo G—Chassis top of the unit. V.h.f. oscillator is at right, l.f. at left.

grid is connected to a blocking-oscillator transformer T. In the commercial instrument these are special units, but a transformer designed to couple a single low-mu triode to a 500-ohm line will work practically as well. The 500-ohm winding should be the one that is grounded.

In position 4, the grid is connected to a 60-cycle signal from the filament supply, and the tube is used as a distorting amplifier and modulator.

The grid leak is variable, the simplest method of fine-tuning the oscillator. It provides a rather wide range for vertical linearity checking—anything from 3 to 12 or more horizontal bars. Its effect is not great for producing vertical bars because of the much higher oscillator frequency, but it is useful for getting the frequency exact once the slug of L1 has been adjusted approximately.

The output of the generator is available through a standard phono jack connected to a switch. In the LINEARITY position, the jack is connected to a small coupling coil L4 consisting of 10 turns of No. 26 enameled wire wound around the ground end of L3. The coupling is capacitive, not inductive. At the same time the switch connects the output of the modulator tube to the grid of the v.h.f. oscillator to provide grid modulation.

In the SWEEP position the output switch connects the jack directly to the modulator. Though, as we have described, positions 3 and 4 of the selector switch are used for sweep-circuit substitution, the bar generator is also useful as a source of audio voltage for rough checking of sound circuits. With the selector in position 2 and the output switch on the sweep position, an audio signal of 180 to 600 cycles or more is available. It is pulsed, of course (see Photo B), and cannot be used for any exact measurement, but it is a handy source of audio for signal tracing the a.f. circuits.

## Construction and operation

Simple as the bar generator is in principle, it still includes a v.h.f. oscillator which must be reasonably stable, and a modulation oscillator which must remain on frequency for reasonable periods. The commercial instrument is built on a copper-clad chassis (see Photos G and H) to avoid ground loops as far as possible, and is entirely cased in a metal box to avoid interference to other receivers on the bench or nearby. Use short leads and take care to avoid cold solder joints. The slug of L1 is reachable through a small hole in the rear of the case so that the operator can set up the number of vertical bars he wishes on a particular set. Larger screens require more bars for the average person because when there are few and they are widely separated they are harder to judge quickly by eye with any accuracy.

Operation for linearity checking is very easy. The shielded connector cable is plugged into the jack on the front panel and the alligator clips on the other end are fastened to the receiver's antenna terminals. The receiver's station selector is set at some channel between 2 and 6 and the bar generator's r.f. tuning knob is rotated until the screen brightens. It is satisfactory to have the brightness and contrast controls of the receiver set as for an average picture. The selector-switch knob is set to vertical or horizontal linearity and the SWEEP FREQ control is adjusted until the bars appear and stand still on the screen.

When the unit is used as a substitute sweep source, the receiver chassis of course must be pulled out of the cabinet. Reference to the receiver diagram will quickly indicate where to connect the generator output to substitute for the suspected sawtooth generators of the faulty set.

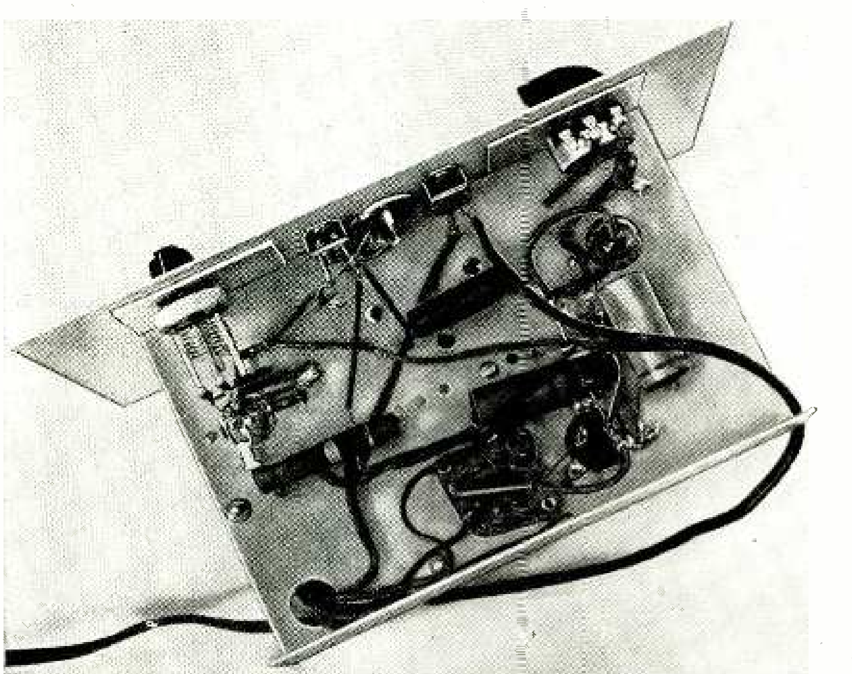


Photo H—Underchassis view. The r.f. tuning coil is at the end of the tuning capacitor at photo left. Below it is the cathode coil combination L3-L4 in the diagram.

### Materials for Generator

**Resistors:** 1—2,000, 1—5,600, 1—10,000, 1—15,000, 2—20,000, 2—33,000 ohms; 1—1.5 megohms; 1—25,000 ohms, potentiometer.
**Capacitors:** 1—5, 1—50, 2—250 μμf, ceramic; 2—.001, 1—.01, 1—.03, 2—.05, 1—0.5 μμf, 400 volts, paper; 2—40 μf, 450 volts, electrolytic; 1— 30 μμf, variable.
**Miscellaneous:** 2—954, 1—6H6-GT, tubes and sockets; 1—500-volt c.t. transformer with 6.3-volt winding; 1—s.p.s.t., 1—d.p.d.t., 1—single pole, 4-position, switches; 1—pilot lamp and assembly; coil forms, chassis, hookup wire, assorted hardware.

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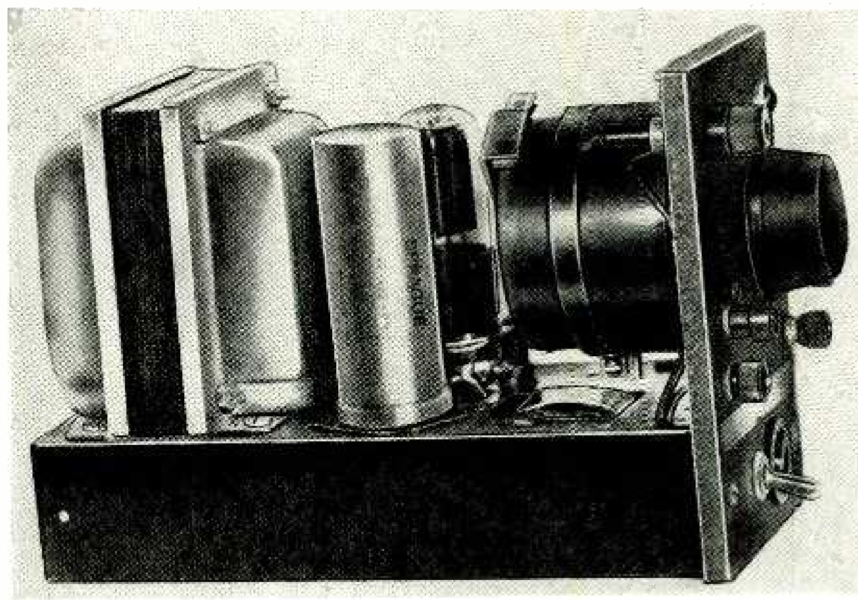

Side view of the power supply. Receptacle on front panel supplies variable a.c.

# Variable Power Supply For Shop or Laboratory

By ALLEN W. SMITH

A USEFUL addition to any laboratory or shop, this power supply furnishes a continuously variable a.c. voltage with perfect smoothness from 0 to 17% above the line voltage and a d.c. voltage with equal smoothness from 0 to 350 volts at 150 milliamperes.

While it is not a regulated supply, it does have the advantage that any a.c. or d.c. voltage between zero and the limit of the supply is available, without steps. The circuit appears in Fig. 1.

The a.c. section can be used to regulate the line voltage, furnish filament voltage, increase or decrease the secondary voltage in plate and modulation power supplies, to regulate the speed of motor-driven devices, to control lighting for photographic work, and for any experimental work requiring a varying a.c. voltage. It is exceptionally useful in tracing unknown transformer windings.

The d.c. section can be used to furnish d.c. power for experimental work, receivers and amplifiers, for test voltage to determine proper coefficients in unknown circuits, to obtain proper voltage for relay operation, for emergency power supply for bias, screen, or plates, for calibrating instruments, running characteristic curves, etc.

The a.c. section uses a General Radio Company Variac, type 200-C. I was lucky enough to pick up one on the surplus market. The Variac is a continuously adjustable autotransformer; it consists of a single copper winding on an iron toroid core. Contact between the winding and the load circuit is made through a special carbon brush which contacts at least one turn of wire at all times. This autotransformer is rated at 1 ampere, or around 120 watts, and should be provided with a fuse.

For the d.c. section the output of the autotransformer is connected to the primary of the power transformer. Thus a varying high-voltage secondary is obtained by varying the a.c. input. As the filament windings will also vary with input, a separate rectifier filament transformer is required. This is, of course, connected to the primary of the autotransformer. The filter section is conventional and is provided with a bleeder to improve regulation and to provide a measure of safety by discharging the filter capacitors when the supply is turned off.

A power supply furnishing 350 volts at 150 milliamperes dissipates around 43 watts ($W = EI = 350 \times 0.150 = 42.4$ watts). The autotransformer will handle over 120 watts ($W = EI = 120 \times 1 = 120$ watts), and a momentary overload of over 50%. Thus the power supply operates well within its rating. Consideration was given to including a voltmeter in the unit, or calibrating the control dial in a.c. and d.c. volts. This idea was abandoned because it was felt that fluctuations of the line voltage would render the calibrations inaccurate. And the addition of a voltmeter would require a larger cabinet.

A double-pole a.c. switch is used in the primary of the Variac to disconnect both sides of the line—thus minimizing the danger of shock when working on equipment where a.c. is also present. The unit was built on a 9 x 4 x 1¾-inch chassis with a 6 x 4-inch front panel, and housed in a well-ventilated metal cabinet measuring 9 x 6 x 4 inches.

The a.c. is connected to terminal posts and a conventional a.c. outlet fitting. The d.c. is connected to terminal posts. The a.c. line switch, pilot-light jewel, line fuse, control knob, and all terminals are mounted on the front panel. The rectifier tube socket is mounted above the chassis with a circle of ventilating holes around its base. The filter choke and filament transformer are mounted under the chassis by cutting square holes in the chassis to make room for the transformer's winding bulge. The a.c. cord is brought through the rear of the cabinet. Large rubber grommets are used on the cabinet for feet to prevent scratching of tables. The unused winding leads of the power transformer are folded and taped. The 5-volt filament transformer must be wired ahead of the 1-ampere fuse, otherwise a 3-ampere fuse is required and the autotransformer will not have proper protection.

Take care when using any type power supply. Remember that the autotransformer, unlike the two-winding transformer, does not isolate the output from the a.c. power line. One side of the variable a.c. output of this unit is therefore at ground potential.

In most cases a power supply of this type is used in one location and a polarized outlet can be arranged. The ground side of the a.c. line can be found with a test lamp. Connect one of the test leads to a good cold water pipe ground and insert the other lead in the a.c. outlet. In one side of the outlet the test lamp will light. The other side is the ground

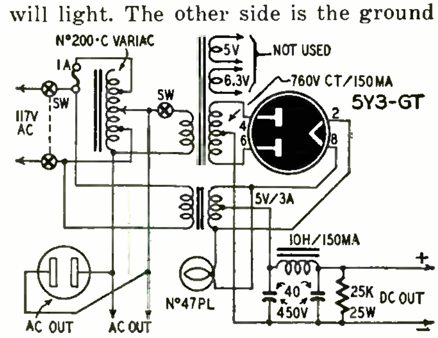


Fig. 1—Schematic of the power supply.

side. The ground side of the output of the autotransformer should be connected to the a.c. outlet terminal marked GROUND. However, neither of the a.c. output terminals are grounded to the metal chassis of the supply.

**Materials for Power Supply**

**Transformers:** 1—autotransformer (General Radio No. 200-C Variac or equivalent); 1—380-0-380-volt, 150-ma power transformer; 1—5-volt, 3-amp filament transformer; 1—10-h, 150-ma filter choke.
**Miscellaneous:** 1—25,000-ohm, 25-watt resistor; 2—40-μf, 250-volt, electrolytic capacitors; 1—5Y3-GT tube and socket; 1—1-amp fuse and fuse holder; 1—6.3-volt pilot lamp and assembly; 1—d.p.d.t. toggle switch; 1—s.p.s.t. toggle switch; chassis, hookup wire, assorted hardware.

—end—

# Speaker Impedance?

By JOHN W. STRAEDE*


THE radio service technician often comes across speakers with unknown voice-coil impedances. Furthermore, in designing a good sound system it is necessary to know the *true* voice-coil impedance with the actual load. The nominal impedance (usually that at 400 or 1,000 cycles) is insufficient. The true impedance at some resonant frequency may be as much as ten times the nominal value stated by the manufacturer. If both the impedance of the voice coil and the input to the speaker transformer can be measured over the entire frequency range, the latter can be checked for spurious resonances.

The method described in this article can also be adapted to measure other impedances, as those of recording cutters and magnetic recorders.

Variation of voice-coil impedance with frequency, together with the d.c. resistance, gives a good indication of the efficiency of the speaker. A good speaker (including its baffle or flare) has an almost constant impedance. A cheap speaker has pronounced peaks—the impedance at the bass peak may be many times that at mid-frequencies.

Knowing the correct impedance of a speaker is especially important if the speaker is used in combination with one or more other speakers. Several speakers in parallel might be used to supply sound to various locations; or several might be used at one location, each covering a different frequency range. In either case correct impedance matching is essential for best results.

What does impedance mean? It is defined as the ratio of the voltage across the speaker to the current flowing through it (both measured in r.m.s. or both in peak values):

$$Z = \frac{E}{I}.$$

## What makes up impedance?

As shown in Fig. 1, the voice-coil impedance is made up of the ohmic or d.c. resistance of the wire, radiation

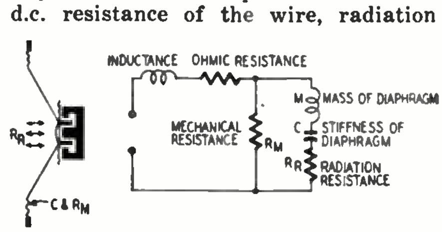


**Fig. 1—Equivalent circuit of a loudspeaker showing the various components that make up the voice-coil impedance.**

resistance due to the dissipation of energy in the form of sound, mechanical resistance because the spider and cone rim are not perfectly flexible, and a number of reactances (which change with frequency). The inductive reactances—those which increase with frequency—include that due to the number of turns in the coil and the mass of the diaphragm. The capacitive reactances (inversely proportional to frequency) include those due to the stiffnesses of spider and cone rim.

There is also a reactance due to the elasticity of the air directly in front of the diaphragm.

## Methods of measuring

Just as there are two main methods for measuring resistance—the Ohm's law method and the Wheatstone bridge

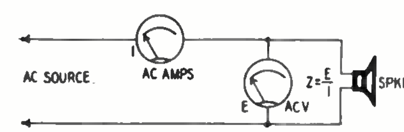


**Fig. 2—Hookup for the voltmeter-ammeter method of impedance checking.**

—so there are two main methods for measuring impedance! Using the formula Z = E/I, where

Z = impedance in ohms,
E = potential difference in volts,
and I = current flowing in amperes,

all we need to do is pass an alternating current of suitable frequency through the voice coil and make two measurements (see Fig. 2). In fact if we have an a.c. supply of constant voltage, we could calibrate an a.c. ammeter to read impedance directly in ohms, just as the simple d.c. multimeters use a 1½-volt battery and are calibrated to read directly.

It is the Ohm's law method we use here, but with certain modifications.

For very precise impedance measurement there is nothing to beat an a.c. bridge—balance being necessary for both the resistive and reactive components (Fig. 3). While the bridge methods will yield accurate results they are rather tedious, and a faster method is better for the service technician and amplifier designer.

If the same current flows through two components in series, the voltage across those components will be proportional to their impedances. If Z = E/I, then Z is proportional to E if I is constant.

This method, derived from Ohm's law, consists of connecting a resistance of known value in series with the voice coil and connecting the pair across the output of an audio-frequency oscillator. An a.c. voltmeter (preferably of

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high impedance) is used to measure the voltage $E_z$ across the voice coil and $E_r$ across the resistor (of resistance R ohms). Then

$$Z = R \times E_z/E_r.$$

The circuit is shown in Fig. 4 and is quite practical. The value of R should be of the same order as that of Z, say 5 ohms for voice-coil measurement and

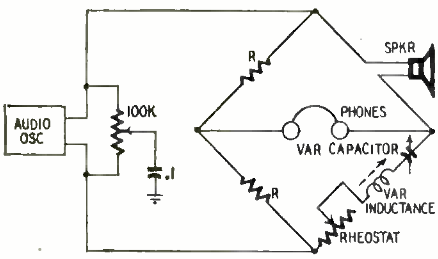



**Fig. 3—Circuit of an a. c. bridge for measuring speakers of high impedance.**

5,000 ohms for the reflected impedance at the primary of a speaker transformer. For accuracy a fairly high current is necessary.

### Using an oscilloscope

A more interesting method uses an oscilloscope as a voltmeter and has the advantage that both voltages are indicated simultaneously on the screen. As

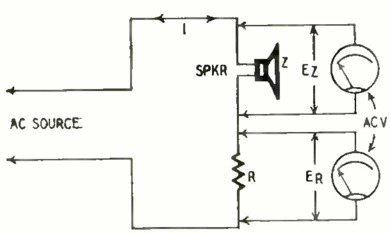



Fig. 4—**A simple but effective hookup for measuring speaker impedance with a voltmeter, resistor, and oscillator.**

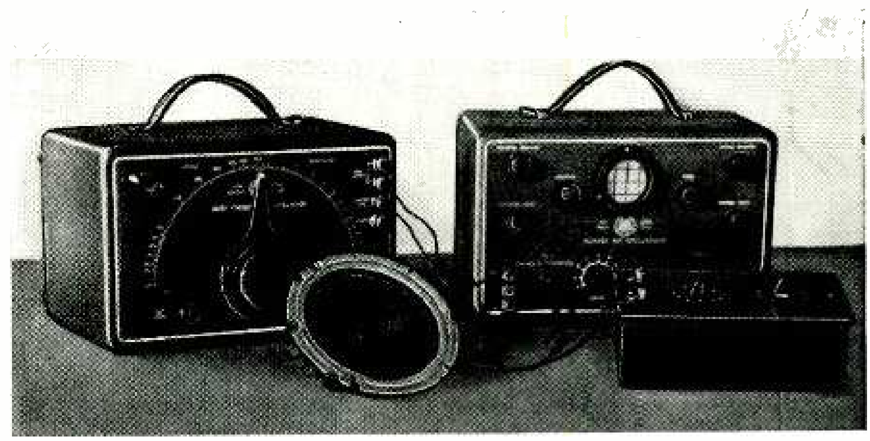
shown in Fig. 5, both the voice coil and a calibrated variable resistor are connected in series and the voltages are applied (via the amplifiers of the scope) to the vertical and horizontal plates.

Here is the procedure: First replace the voice coil by a known resistance (say 5 ohms), and adjust the variable resistor to the same value. Now adjust the sensitivity controls of the amplifiers to give a trace consisting of a line at a 45° slope on the screen. This adjustment is important. The horizontal width of the trace must be exactly equal to the vertical height. After this adjustment, which equalizes the amplifier sensitivities, the controls must not be moved. The 5-ohm fixed resistor is replaced by the voice coil; and from here on there are two ways to proceed.

*Method A*: Without touching any oscilloscope control and leaving the variable resistance set at 5 ohms, measure carefully the horizontal width w and the vertical height h of the trace. Both measurements should be in the same units.

Now the impedance is calculated from the formula

$$Z = 5h/w \text{ ohms.}$$



**This photo shows the setup for using a scope to measure the speaker impedance.**

This method is handy if a large number of measurements are to be made, and should be used if the trace is *very* different from a straight line. (It will probably be a narrow ellipse.)

*Method B*: Leave the oscilloscope controls alone and readjust the variable resistor until the trace is symmetrical about a 45° line (so that the width and height of trace are equal). The voice-coil impedance is then equal to the value of the variable resistor. This method is useful if the trace is very nearly a straight line—the trace *will* be a straight line at one or more frequencies when the voice coil acts as a pure resistance. One of those frequencies is very close to the bass resonant frequency. This method is also better for small oscilloscopes using tubes 2 inches or less in diameter.

Whichever method is used, it is interesting to study the variation in impedance with type of baffle. Even if a hand is placed in front of the speaker, a distinct change will occur in the oscilloscope trace as impedance varies.

In all this work a source of audio-frequency voltage is required. Such an oscillator should have an output of at least 5 volts across a load of 10 ohms for low-impedance work. For high-impedance measurements an output of 20 volts across 10,000 ohms is required. These outputs are low and easily satisfied by commercial oscillators.

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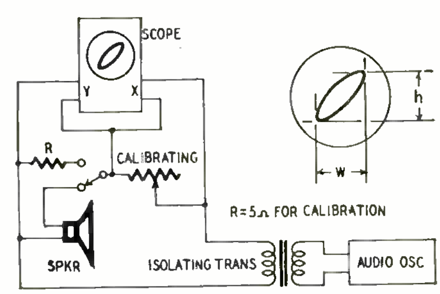



**Fig. 5—How to use an oscilloscope to compare voltages and impedances.**

# 3-Way Speaker Net Uses Low Cost Parts

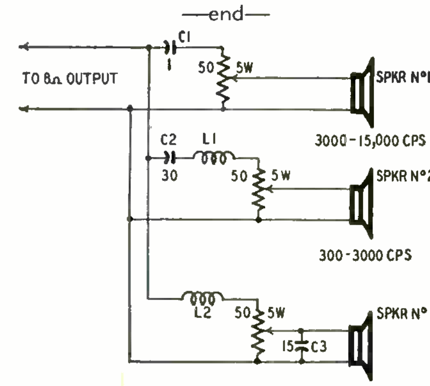
This high-fidelity, 3-way loudspeaker system, demonstrated at the 1950 Audio Fair in New York City, can be constructed from relatively inexpensive components. It handles 30 watts of power and its frequency response is from 30 to 15,000 cycles. Variable attenuators are used to adjust the output level of each speaker.

Speaker No. 1 is a University tweeter model 4408, No. 2 is a Cobra 12, and No. 3 is a 12-inch speaker model 6200. L1 is a 0.5-mh coil which may be made by winding 175 turns of No. 16 d.c.c. wire on a bobbin 1 inch in diameter and 1 inch long fitted with flanges 2¼ inches in diameter. L2 is approximately 5 mh and may consist of 550 turns of No. 16 d.c.c. on a 1-inch bobbin 2 inches long with flanges 4 inches in diameter.

The variable attenuators are 50-ohm, wire-wound potentiometers rated at 5 watts or more. C1, C2, and C3 are paper capacitors. Their working voltages need not be more than 100 volts. If low-voltage papers are not available. you can use low-voltage electrolytics connected back-to-back (with the negative or positive terminals tied together). Remember that the electrolytics are in series, so it takes two 30-µf units to replace the 30-µf paper unit. The same applies to the 15-µf capacitor.

The cabinet, 30 x 40 x 16 inches, was constructed of ¾-inch plywood with a 4 x 20-inch port cut in the top of the rear cover.

—end—



# Audio Feedback Design

## *Part VII—How to use positive feedback to cut down distortion*

By GEORGE FLETCHER COOPER

THE earlier articles of this series have discussed the method of designing a conventional negative feedback amplifier for audio frequency use. The control of output impedance has not yet been discussed, but this will be considered in a later article. In this article we shall discuss one of the refinements of design which can give a considerable improvement in performance at very low material cost. Low material cost we consider a factor because the use of positive feedback can involve quite a lot of time and trouble.

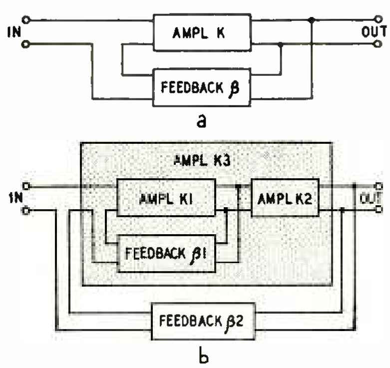



**Fig. 1—The basic feedback circuit is at *a*, while *b* shows a second feedback loop within the over all feedback loop.**

By using negative feedback we can flatten the frequency response, and we can reduce the harmonic and intermodulation distortion. That is what we said in the first article of this series. Is there any reason why we should not apply common-sense arguments and say that by using positive feedback we shall make the frequency response less flat and shall increase the harmonic and intermodulation distortion?

There are two separate reasons for using positive feedback. One is to help control the impedance of an amplifier, and this we shall leave until we come to discuss the effects of feedback, positive and negative, on the impedance. The other reason is that we can improve the performance by the use of positive feedback, if—. And that *if* is the subject of this article.

Mathematical equations you either understand or you don't. Words, as all politicians know, can mean just what you want them to. First let us look again at Fig. 1-a, the basic circuit we had in the first article. In this, as you will remember, K is the amplifier itself, and $\beta$ is the feedback network. Instead of taking a simple amplifier in the box K, we can split this amplifier into two parts, $K_1$ and $K_2$, with feedback $\beta_1$ around $K_1$ and $\beta_2$ around both $K_1$ and $K_2$. (Fig. 1-b.) Thus $\beta_2$ is the negative feedback around K which we have in Fig. 1-a. Now the combination of $K_1$ and $\beta_1$ is a normal amplifier with feedback, having a gain of

$$K' = \frac{K_1}{1 + \beta_1 K_1}$$

This is in tandem with $K_2$, giving a gain, without allowing for $\beta_2$, of

$$K_3 = K' \times K_2$$

We can write this in full as

$$K_3 = \frac{K_1 K_2}{1 + \beta_1 K_1}$$

When we apply the extra feedback $\beta_2$, the over-all gain becomes

$$K'' = \frac{K_3}{1 + \beta_2 K_3} = \frac{K_1 K_2}{1 + \beta_1 K_1} \times \frac{1}{1 + \dfrac{\beta_2 K_1 K_2}{1 + \beta_1 K_1}} = \frac{K_1 K_2}{1 + \beta_1 K_1 + \beta_2 K_1 K_2}$$

If we have a fair amount of gain and feedback, we can simplify this to

$$K'' = K_1 K_2 / (\beta_1 K_1 + \beta_2 K_1 K_2) = K_2 / (\beta_1 + \beta_2 K_2) \text{ or}$$

in the limit, to $1/\beta_2$. This, of course, is the standard feedback formula. But let us look at this basic two-path feedback equation more closely. We have

$$K'' = \frac{K_1 K_2}{1 + \beta_1 K_1 + \beta_2 K_1 K_2}$$

When $\beta$ is *negative* feedback, $\beta K$ is a positive quantity, so that $1 + \beta K > 1$. Therefore, if the network $\beta_1$ provides *positive* feedback, $\beta_1 K_1$ will be a negative quantity. Let us take $1 + \beta_1 K_1 = 0$, which means that the loss in $\beta_1$ equals the gain in $K_1$, and the feedback is connected as positive feedback. This, by the way, is the amount of feedback which connected as negative feedback would reduce the gain by 6 db. With $1 + \beta_1 K_1 = 0$ we obviously have

$$K'' = \frac{K_1 K_2}{\beta_2 K_1 K_2} = \frac{1}{\beta_2}$$

Notice that now there is no approximation: we haven't left out any small quantities. We actually have an over-all gain which is settled only by the feedback network. Since the feedback network is assumed to be made up only of resistors it must be absolutely linear, and the distortion will be zero.

### Limitations of this result

It is obvious that the mathematics has not told us the whole story. We must examine the results more closely: let us look again at our first equation

$$K' = \frac{K_1}{1 + \beta_1 K_1}$$

We took $1 + \beta_1 K_1 = 0$ to achieve our final distortion free amplifier. This means that $K' = K_1/0 = \infty$. That's fine, we have infinite gain, so that any input at all will overload the first amplifier unit. Anyway, $K_1$ is not exactly constant, because if it were, we should have no distortion, so why worry about using any feedback. Obviously we are pushing things too hard if we take $1 + \beta_1 K_1 = 0$: let us try something a little milder. Assume that $K_1 = 100$ (40 db) at maximum tube transconductance, and 50 (34 db) with low-limit tubes. A twin triode would give about this much gain. Take $\beta_1 = -1/200$, so that $K_1 \beta_1 = 1/2$ to $1/4$. Then $K' = 2K_1$ in the maximum transconductance case, which gives $K' = 200$. Thus there is an increase in the forward gain of 6 db, and if the positive feedback has not introduced any extra distortion the over-all distortion, with $K_2$ and $\beta_2$ in circuit, will be reduced to one-half.

Even now, of course, the reader may be suspicious, because if negative feedback reduces distortion, positive feedback must increase it. Let us assume that $K_1$ consists of two single-ended stages, while $K_2$ is a push-pull stage. The second single-ended stage will produce some second harmonic, say 3%, while the push-pull stage produces mainly third harmonic, say 8%. The total

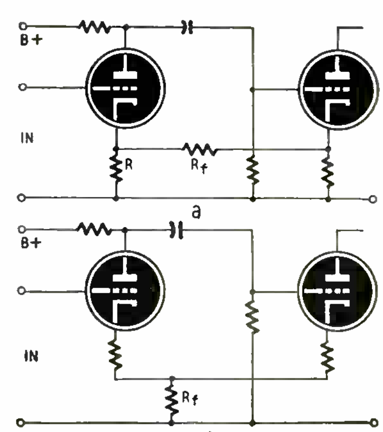



**Fig. 2—Two simple circuits for applying positive feedback to an amplifier.**

distortion in the two circuits will be $\sqrt{(3^2 + 8^2)}\% = 8.54\%$. If $\beta_2$ produces 20 db feedback the over-all distortion will be 0.854%. Now we add the positive feedback to the first two stages: we get 6 db more gain, but we get $2 \times 3\% = 6\%$ distortion here. The total distortion is now $\sqrt{(6^2 + 8^2)}\% = 10\%$. As we have the same $\beta_2$ with 6 db extra gain in the forward direction, the over-all distortion is reduced to 0.5%.

Maybe that improvement doesn't seem worthwhile. We can look at some other numbers. The first stage, $K_1$, might be kept to 1% distortion by careful design and, if you don't mind trimming it when the tubes are replaced, it would be possible to add 20 db of positive feedback. Without positive feedback, but with 20 db negative feedback, the over-all distortion would be 1.01%. With positive feedback this is brought down to 0.2%. An improvement of five times is really something, because it would cost 14 db gain to get this improvement using negative feedback only.

Here, then, is the background of the positive feedback story. The questions that remain are how to produce the feedback, what it costs in components, and what it costs in design effort. First of all, how should we produce the positive feedback? It is possible to show, though I do not propose to do it here, that we should always put negative feedback around as long a chain as possible, while we should put positive feedback around the shortest possible loop. The simplest possible circuit is that shown in Fig. 2-a, a circuit which is equivalent to Fig. 2-b. If we replace $R_f$ in Fig. 2-a, by a capacitor, we have a fairly familiar circuit, the cathode-coupled multivibrator. This multivibrator circuit corresponds to much more positive feedback than we need.

Looking at Fig. 2, we see that we have gotten rid of two cathode by-pass capacitors and substituted one resistor. That doesn't seem too expensive, especially when you remember that the performance is improved. In Fig. 2-a the extra resistor will be a fairly large one; we shall see the sort of value needed later. In the circuit of Fig. 2-b the common resistor is a small one; a few tens of ohms. As the two cathodes in Fig. 2-a will usually be at about the same potential, there will not be much d.c. in the feedback resistor $R_f$, so that it will only be a minimum wattage component. Also, the value does not have much effect on the bias.

We can calculate the size of $R_f$ approximately by the following method. Assume that the two tubes are the two halves of a 12AT7 double triode. With 1 mv applied to the input, the cathode-ground voltage for the first tube, without positive feedback, will be about ½ mv, and the plate-ground voltage about 20 mv. This is the grid-ground voltage for the second tube, and will produce a cathode-ground voltage of about 10 mv. By producing a cathode-ground voltage of 1 mv at the first tube we could keep this condition steady even without an input, so that we need $R_f = 9R$. For a 12AT7 R will be about 200 ohms, and we get a value of $R_f = 1{,}800$ ohms for infinite gain. For 6 db feedback the value will be about 4,000 ohms. This calculation is only a very rough one, to find out what size of resistor to try in the circuit, because the exact expression is rather long and the proof would occupy half my space here. It is always much easier to connect in a variable resistor and to adjust it.

There are two ways of approaching the design aspects of positive feedback. We can calculate the phase and amplitude response of $K_1$, and then calculate what happens with positive feedback. When I get around to describing the "$\mu\beta$ calculator" in a later article you will see an easy way of carrying out the calculation. The alternative is to make $K_2$ responsible for controlling the phase and amplitude out in the critical regions where the negative feedback can cause instability. We do this at low frequencies very often by keeping the output transformer inductance as the limiting factor. At high frequencies a small capacitor, or a pair for push-pull, can be used to have the same effect.

There is possible a modification of this second approach. If you look back to the December issue, which I have by me as I write, you will see the responses calculated for Mr. Williamson's amplifier. At $\omega = 64$ (about 10 c.p.s.) and $\omega = 0.5 \times 10^6$ (about 90 kc) the phase shift is only 75 to 80°. So long as the positive feedback is out of action outside the frequency band 10 to 90,000 cycles, which isn't a bad working band, the over-all stability should not be affected. Fig. 3 shows how the basic circuit of Fig. 2-a can be modified to make this happen. The shunt capacitor C1 short-circuits R at high frequencies, and we must have $\omega C1R >> 1$ at the upper end, which we saw might be as high as 90 kc. The other capacitor, C2, open-circuits the feedback path through $R_f$ at low frequencies, so that $\omega C2R << 1$ at the lower end, which might be at 10 cycles. Thus typical values could be R = 200 ohms, C1 = 0.01 μf, C2 = 1 μf. With these values we would have positive feedback over the range from 100 cycles to 10 kc, which is the most important region unless you are a super-extra-ultra-high-fidelity fan. Most orchestral power comes up in the middle of the band, and that is where we need low distortion most of the time.

There is a rather interesting modification of this circuit which has been published. This is shown in Fig. 4. V1 has a high value of cathode resistor, about 5K, which will produce a lot of local negative feedback. With the gain control potentiometer at maximum the positive feedback resistor is adjusted to compensate for this negative feedback. When the gain control is turned down to deal with a strong signal the value of $K_1$ is reduced, so that $K_1 \beta_1$ gets less, the positive feedback has less effect, and V1 is linearized by the local negative feedback.

I have discussed only the cathode-cathode feedback circuit, because I haven't found any use for any other possible positive feedback circuit. As soon as you get away from this relatively low-impedance feedback path, stray capacitances start to be important, and these bring phase problems in their train.

Some time ago Peter Sulzer described another application of positive feedback which is useful if you can make it work. This is in pentode circuits. The screen of a pentode can be regarded as either a grid, controlling the plate current, or a plate, having a current controlled by the first grid. Usually the input is zero, and the plate load also is zero, because of the decoupling capacitor. Suppose, however, that we leave out the decoupling capacitor, as we do in the tri-tet circuit. Then we have a signal at the screen. By feeding back this signal to the screen of the preceding stage, where the screen now acts as a control grid, we can introduce enough

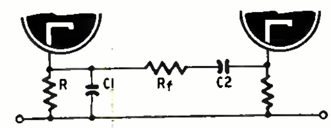



**Fig. 3—A modified version of Fig. 2-a that will provide positive feedback only in the middle of the audio range.**

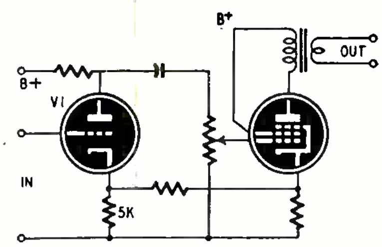



**Fig. 4—Feedback circuit for a broadcast receiver to get high gain on weak signals, low gain with strong signals.**

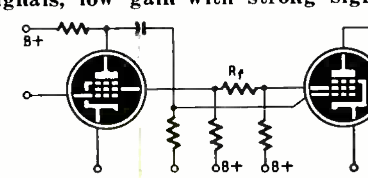



**Fig. 5—Feedback from screen to screen will eliminate the decoupling capacitor.**

positive feedback. Fig. 5 shows the sort of circuit we finish up with, and again we have saved the price of two capacitors by the use of only one resistor. The important thing in using this circuit is to avoid too much gain to the screen in the second stage, and although I have drawn only a dropping resistor I think it is essential to feed the second screen from a relatively low-resistance voltage divider.

When I started this series I said I wasn't writing an amplifier cook book. To take positive feedback out of the jam-making class—you know that tedious business of seeing if the jelly sets—you must have the means for calculating the phase and amplitude characteristics. The "$\mu\beta$ calculator" is a sort of slide rule for this job, and designing amplifiers with multiple feedback loops without it is like cooking without measures: ask the dairyman for five tablespoons of milk! But it is so easy to vary the feedback that I have no apologies.

(continued next month)

# Electronics and Music

## *Part XI—Photoelectric methods for generating tones and for producing harmonics to get a desired quality*

By
RICHARD H. DORF

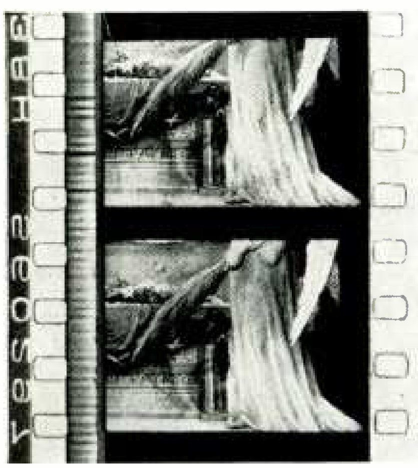
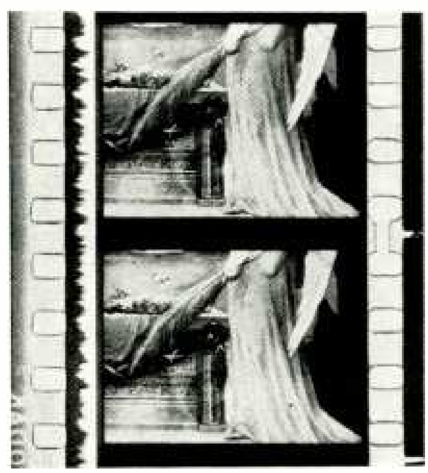



Fig. 1-a, left—A section of film with a sound track using variable density
Fig. 1-b, right—A film using the variable area method for generating sound.

BEFORE describing the Thyratone in the last two issues of RADIO-ELECTRONICS, we had concluded our discussion of electronic tone generators. The circuits shown did not, by far, exhaust the total that have been used in one way or another, but to describe them all would require several volumes. Additional generators and dividers will be shown, however, as time goes on and we go into the details of the important commercially built instruments available today.

Because this series of articles deals with *electronic* musical instruments, we shall make only passing mention of the several other methods of creating music electrically. These methods fall into two classes: electromechanical generators, and amplified acoustic generators. In the first class we find photoelectric, electrostatic, and electromagnetic generators, and instruments which employ the principle of playing back pre-recorded notes. In the second appear electric pianos, amplified reed organs, amplified guitars, most electronic chime and carillon systems, and the like. In most instruments which use acoustic generators, the design problems are largely limited to picking up and amplifying the tones. That kind of problem is very nearly standard in electronics (though, of course, special methods are sometimes necessary) and our treatment will be limited to a later description of the Wurlitzer organ, which generates its tones with banks of air-driven reeds.

*Audio Consultant, New York City

### Photoelectric generators

So far as the writer knows, only two photoelectric organs have been built for the commercial market, the German Welte organ and, very recently, one by an American manufacturer, not yet on the market. Although the principles of photoelectric tone production are not complex, the practical problems of construction and production are.

In principle, photoelectric systems are similar to sound-on-film, in which a narrow strip at the edge of the film contains a continuously varying pattern of either variable density or variable area. Fig. 1 illustrates this. In Fig. 1-a the strip at the right edge of the film varies in density as the film travels along. A steady light source in the projector shines a beam through this strip onto the cathode of a photoelectric tube. As the density or blackness of the strip varies so does the amount of light reaching the phototube. The tube's output varies accordingly. Fed into an amplifier, the output variations, which are at an audio rate, cause sound to be heard in the loudspeaker.

Fig. 1-b shows the variable-area method. In this case, the film is opaqued or blacked to a certain degree at each point along the film strip. The amount of clear film (white in the illustration) which remains at each point determines the amount of light allowed to pass to the phototube. Since this is constantly changing at an audio rate, the phototube output, fed to an amplifier, again causes the speaker to "speak."

In electronic music, however, we are concerned not with a constantly changing recording but with a steady repetition of single tones. It is standard practice, therefore, to make "re-entrant" light recordings such as the one illustrated in Fig. 2.

Fig. 2 shows a segment of a disc made of glass. The entire disc is clear except for the black waveform pictures in 18 concentric bands. If a spot of light is focused on one of these bands as the disc revolves and a photoelectric tube is placed on the other side of the disc so that whatever light passes through the disc hits it, the amount of light reaching the tube varies in accordance with the area of clear glass between the two. The tube output current varies in exact accord with the shape of the black waveform picture. If the disc is turned fast enough so that the variations are at an audio rate, the sound from the speaker will correspond to the waveform pictured and will have a frequency or pitch determined by the number of waveforms scanned each second.

This scheme is the electronic musical equivalent of variable-area film recording. A variable-density system may be used instead, by having each band consist of a strip of constant width but of varying degrees of opacity. Or, instead of a transparency on glass, the disc may be of metal, with holes in it. This is a chopper, which alternately interrupts and passes the light.

### Obtaining correct pitches

The most obvious (and the most accurate) way of providing disc scanning patterns which give the correct musical pitches for an entire instrument is to have a separate disc for each of the 12 fundamental notes of the chromatic scale, and to drive each at the right speed.

For example, the C disc must generate a tone of 65.41 cycles for the lowest C of the organ manual. If it has a single pattern on the circular strip which is to generate this note, it must revolve 65.41 times per second or 3924.6 r.p.m. The speed necessary can be reduced by any desired factor, however, if the number of patterns around the strip for that note is multiplied by the same factor. If, for instance, there are 10 patterns, the speed can be reduced to 392.46 r.p.m. and the pitch will still be 65.41 cycles.

The next band on the same disc would probably be designed to produce the next octave pitch, 130.8 cycles, which means it must have twice as many patterns for the same speed. The octave above must have twice as many patterns as that, and so on, until the outer band has enough patterns to produce the highest pitch wanted. Obviously, 12 such discs, each revolving at a different speed, are necessary. The complexity of a gearing system needed to drive 12 discs at different, yet exact, speeds is a deterrent to such designs, but the problem can be simplified to some extent by keeping in mind that pitch errors of about 0.25% or less can be neglected. This is equivalent to 1 part in 400, which means that a nominal 440-cycle note could be 441 or 439 cycles without too bad an effect. Even this error, however, can be detected by people with acute ears, and for the sake of safety the error should be limited to 0.1% or 1 part in 1,000. That means that actual frequency should correspond to nominal frequency to four significant figures, as given in the frequency chart on page 42 of the August, 1950, issue of RADIO-ELECTRONICS. To be specific, $F_{21}$, for instance, listed as 87.31 cycles, may vary only .01 cycle, or from 87.30 to 87.32; $C_{76}$, listed as 2093, may vary 1 cycle either way, from 2092 to 2094.

Mathematically, of course, there is no reason why a single speed would not be adequate for all the notes. The maximum permissible speed would be that which, in cycles per second, is a submultiple of all the desired audio frequencies. Other speeds are possible, too, if some of the discs contain a single pattern for the lowest note and others have more than one.

In a practical commercially designed organ, that speed has worked out to approximately 1 revolution every 2 seconds; the revolving element is a drum rather than a series of discs. The extremely slow speed, however, poses other problems, such as regulation, for the slower the speed, the harder it is to keep it constant.

## Keying and tone shaping

Photoelectric organs can be keyed electrically by simply closing switches in series with separate lamps which provide light sources for the pattern bands. A more common method, however, though more complex for the individual constructor, is mechanical—the keys operate shutters which cover the patterns when they are not desired.

Tone coloration may be dependent on the patterns themselves, as in Fig. 2, which is the scheme of a European organ. A separate disc is provided for each note; the 18 bands on the disc shape the waveform of the light reaching the phototube to produce 18 different tone colors, corresponding to the same number of organ stops. A system of shutters, operated magnetically by the playing keys and stop switches, allows light to pass through an appropriate part of the disc. The discs are glass, with photographic emulsion, and the patterns are printed photographically from a master negative.

In any photoelectric organ, it is important that the patterns on the discs or drum be re-entrant. That is, it is not sufficient merely to have the right number of patterns or holes in a given circular band; they must be evenly spaced. To illustrate, Fig. 3-a shows a disc with 8 holes in the first band, 16 holes in the second. If the disc is rotated at 367.5 r.p.m., the inner band will produce $G_{11}$ at 49 cycles and the outer $G_{23}$ at 98 cycles.

Fig. 3-b shows a similar disc with the same numbers of holes, but with the outer ring unevenly spaced. When the light is passing through the 16 holes in turn, a higher frequency than 98 cycles will be produced because the close spacing makes the cycles occur too quickly. When the one wide-spaced pair of holes comes around, there will be a sudden low-frequency element.

This illustrates, among other things, the fact that the number of holes in each circle must be a whole number. If the designer starts with a certain speed in mind, then figures the number of holes to be placed in each band, he will probably come out with a fractional number—say, 4.5 holes. It is impossible, naturally, to make half a hole, and the only other alternative is to space the holes as if it were possible—to lay out the design by dividing 360 degrees by the number of holes, 4.5, then drill what holes are possible and leave an uneven space in one spot.

The correct procedure is to figure on a certain number of holes, then calculate the necessary speed. A formula can easily be worked out: Frequency divided by the number of holes or patterns gives the speed in revolutions per second. This is multiplied by 60 for r.p.m. Thus:

$$\text{r.p.m.} = \frac{60f}{n}$$

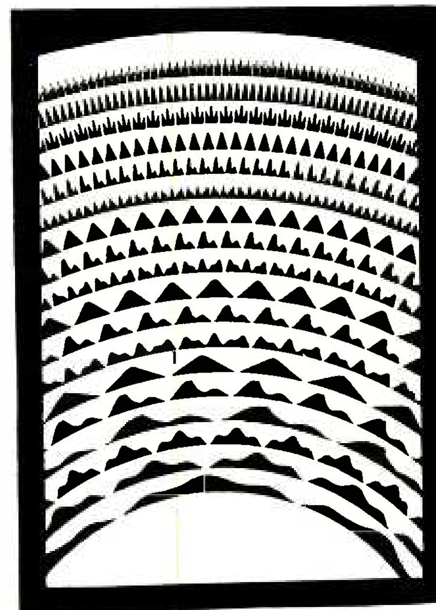


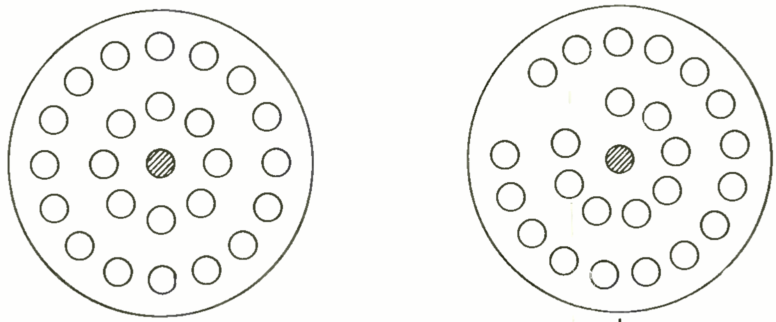
Fig. 2—Segment of tone pattern disc.

where f is the audio frequency desired and n is the number of holes or patterns. Note that the spacing of the holes from the center of the disc makes no difference in the pitch.

Another method of tone coloring is disclosed by Alexander Roth in Patent No. 2,513,109. His instrument uses a rotating-disc system to produce sine waves, one for each note. Each note is keyed by lighting a lamp, which shines through a band of slits in a disc. With switches, the player can make more than one lamp light when a key is pressed—he can light lamps of the notes corresponding to harmonics of the key he presses. Potentiometers regulate the current through the individual lamps; the amount of light determines the loudness of each harmonic, and the player can thus make up from its harmonics whatever tone color he wishes. The system is fundamentally equivalent to the Hammond Organ's harmonic synthesis system, which will be described in some detail in a soon forthcoming article.

Photoelectric organs are very difficult to build and operate satisfactorily. It can be done, however, by constructors with sufficient mechanical skill. The writer would be most interested in hearing from readers who have done so.

(continued next month)



a b

Fig. 3—A drawing showing why the pattern on a tone disc must be re-entrant.

# Non-Eavesdropping Intercom

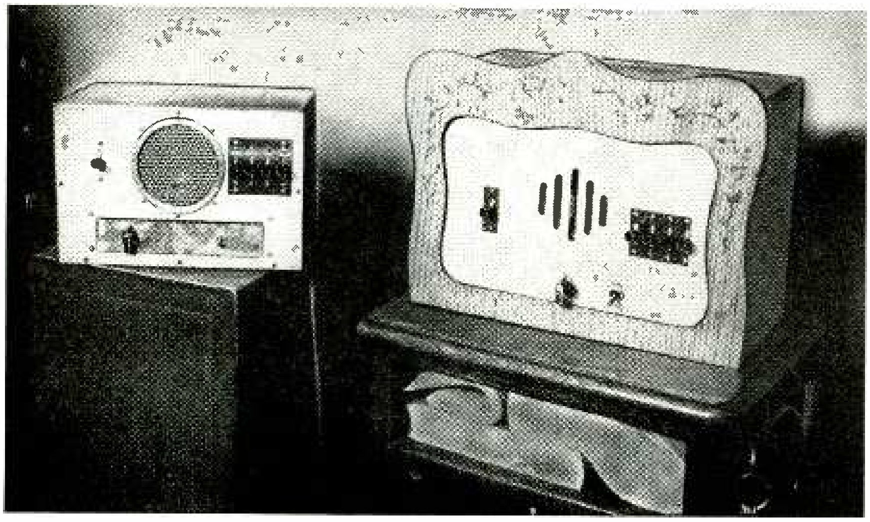


Photo A—One master is for the receptionist, the other is for the switchboard.

**Separate talk-listen switches at each station insure privacy**

By GEORGE W. BUNTON

RECENTLY an intercommunication system was installed at the Griffith Observatory in Los Angeles to connect several points in the building which did not have local telephone stations. These points are now within call of the secretary's desk. The first station was installed at the rear service entrance of the building with a signal button so delivery men might call the office. This was made a slave station with the talk-listen control on the master station in the office. Three substations in parallel were installed in the shops at convenient points so that no one need walk more than a few steps to answer a call. Other substations were installed in the darkroom and telescope dome. These could not be straight slave stations with listen control at the master station because the secretary might tune in at a time when shop slang might be flying. This type of language is not for the ears of a young lady, so a system we call "non-eavesdropping" was worked out. The difference between this type and the straight slave station is that the remote station has its own talk-listen switch.

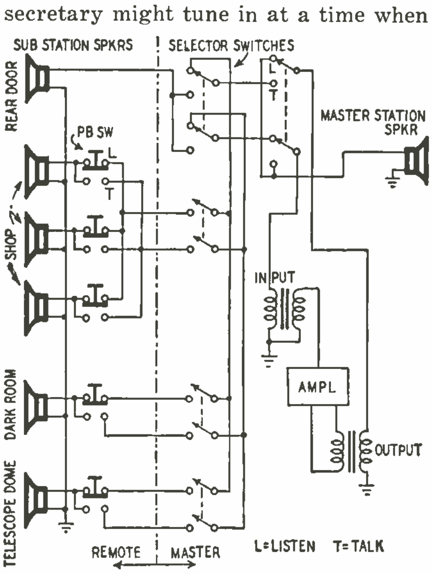



Fig. 1—Wiring diagram of the master station and the four remote stations.

Fig. 1 shows how the substations are connected. Two conductors are run to each station. One is the talk wire and the other is the listen wire. The return for each of them is made to ground. An s.p.d.t. push-button switch is used at the substation for talk-listen control. A d.p.s.t. selector switch at the master station connects the substation to the amplifier. The talk-listen switch at the master station is a d.p.d.t. unit. The master station cannot hear the substation unless the substation operator presses his talk button. The station at the rear door has no talk-listen button. One wire is used for the voice circuit and the other wire of the pair for the signal buzzer. The selector switch for the rear door is a d.p.d.t. unit which disconnects all the other selector switches when it is connected to the rear door. This is necessary to avoid eavesdropping at the other stations. Two or more stations (excluding the rear door) may be called simultaneously by throwing their selector switches.

It was later found that a second master station was needed for use in the evenings when the building was open to the public. This was installed at the information desk and connected in parallel with the master station in the office. This works out very well, as the two master stations are never used during the same part of the day. The circuit used in the master stations is shown in Fig. 2. One cabinet was made to be a piece of furniture and the other, a wrinkle-finished metal job, has a more business-like appearance. The two master stations for the system are shown in Photo A.

There is nothing unusual about the amplifier except possibly the unbypassed cathode resistors. Bypass capacitors were omitted to reduce the gain of the amplifier and to improve the quality by inverse feedback. With some of the stations over 200 feet from the master, the volume is good when speaking in a normal conversational voice as much as 10 feet from the speaker.

Certain precautions were observed in placing parts. The input and output transformers were placed as far apart as possible. One is above and the other below the steel chassis, which helps to isolate them. The input grid lead from the secondary of the transformer is short to avoid hum pickup, and the input lead to the primary is shielded and dressed to avoid feedback.

The power supply (not shown) uses a 650-volt center-tapped transformer

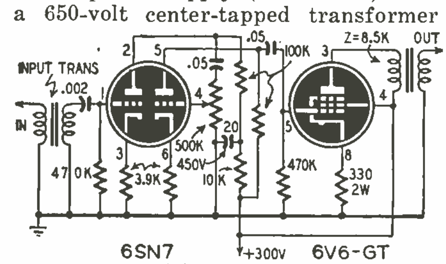



Fig. 2—Schematic of the intercom amplifier. The power supply is not shown.

and a 5Y3-GT rectifier in a conventional circuit.

No cross-talk has been noticed, although the leads to the remote stations are cabled together for approximately 50 feet. None of them are shielded.

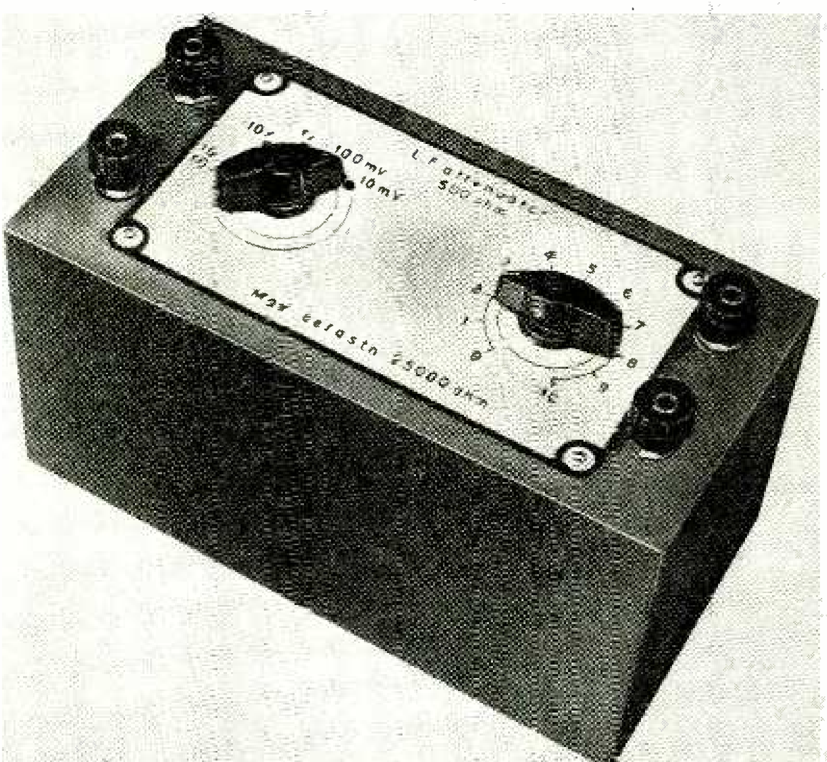
**Materials for Intercom**

**Resistors:** 1—330-ohm, 2-watt; 2—3,900-, 1—10,000-, 2—100,000-, 2—470,000-ohm, ½-watt; 1—500,000-ohm potentiometer.
**Capacitors:** 1—.002-, .05-μf, 400-volt, paper; 1—20-μf, 450-volt, electrolytic.
**Miscellaneous:** 1—intercom input transformer, 1—output transformer, 8,500-ohm primary, secondary to match speaker voice coil; 5—switches, s.p.d.t., push-button; 4—switches, 2-pole, 3-position, nonshorting, positive-index; 1—switch, 2-pole, 3-position, nonshorting, spring-return; chassis, speakers, terminal strips, sockets, tubes, etc.

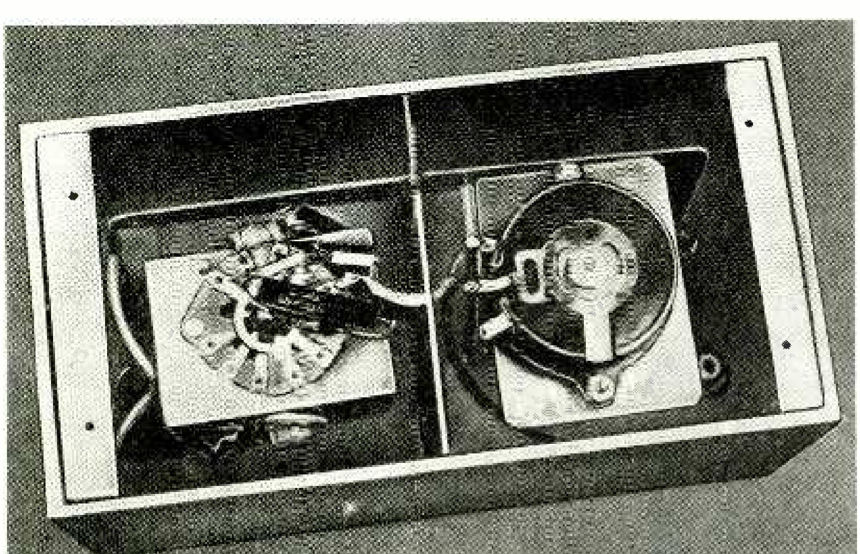
—end—

# Calibrated Attenuator For Audio Generators

By B. J. CEDERQVIST*



The attenuator. Range switch is at left; calibrated output potentiometer at right.



This inside view of the attenuator gives an excellent idea of the shielding.

VERY few of the factory-made audio generators provide for setting the output level *at a desired value*. Some of them have just a fixed low- and high-impedance output. Others have a potentiometer connected across the output so the voltage can be varied from 0 to possibly 20 volts. But you can't set the generator to, say, exactly 1 microvolt, suitable to feed into a highly sensitive amplifier.

You can't measure 1 μv with the regular tube voltmeters nowadays available in the market, but 10 volts can easily be measured with every v.t.v.m. A test on my audio generator showed that I got—across a 500-ohm resistor connected to the output—more than 10 volts on all frequencies from 30 cycles to 20 kc, which showed that if an attenuator with an input and output impedance of 500 ohms could be connected to the generator, the input voltage to this attenuator could be held at 10 volts over the above frequency range.

## The attenuator theory

Fig. 1 is the basic circuit diagram of the attenuator. The different values for R1 and R2 are easily calculated when the impedance and the input-output voltage ratio $\frac{V1}{V2}$ is known.

$$R1 = Z \left[ \frac{\frac{V1}{V2} - 1}{\frac{V1}{V2} + 1} \right] \text{ ohms}$$

$$R2 = Z \left[ \frac{2\,\frac{V1}{V2}}{\left(\frac{V1}{V2}\right)^2 - 1} \right] \text{ ohms}$$

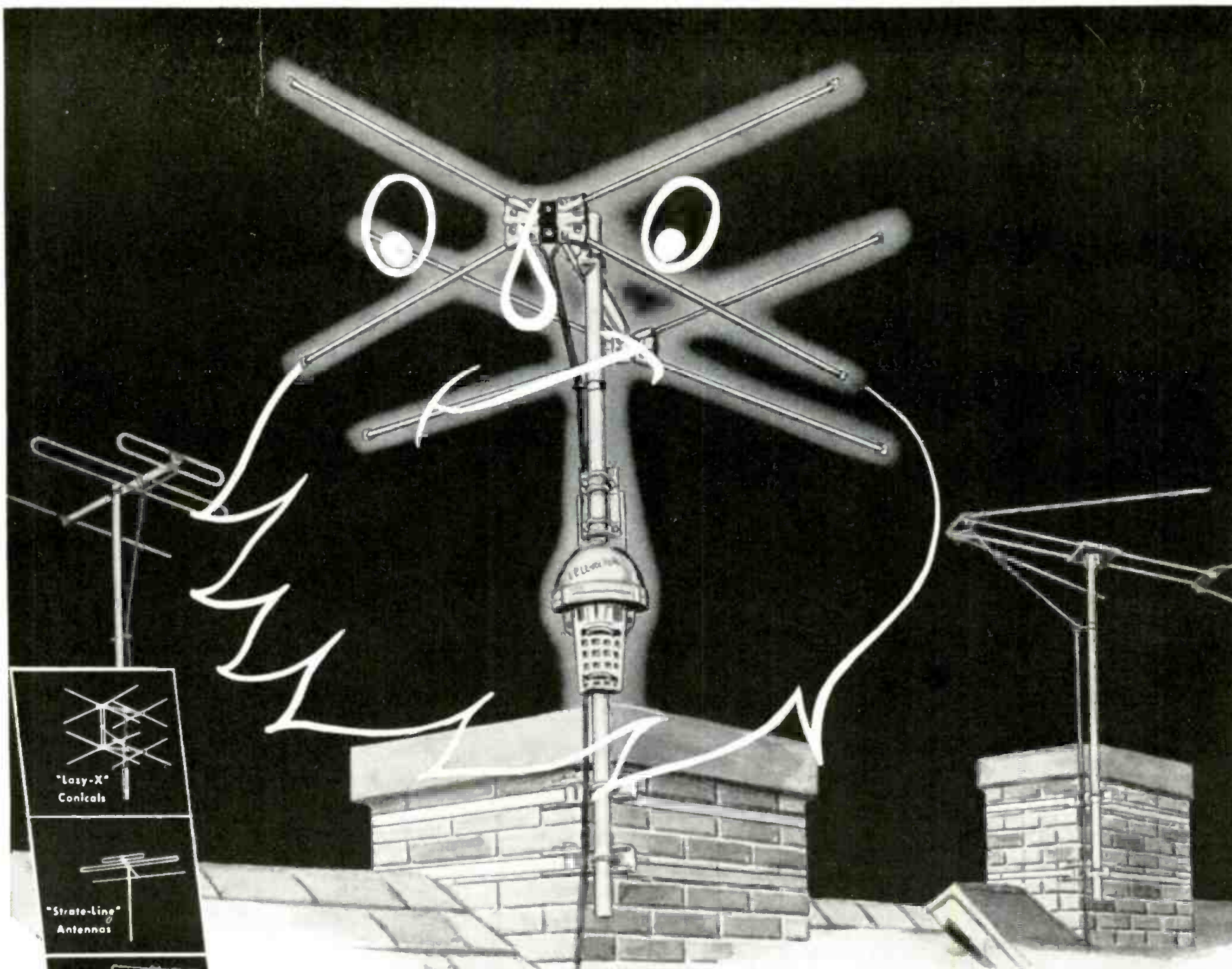
In the above equations, Z represents the attenuator impedance (500 ohms in this case). V1 is the input voltage and V2 the output voltage.

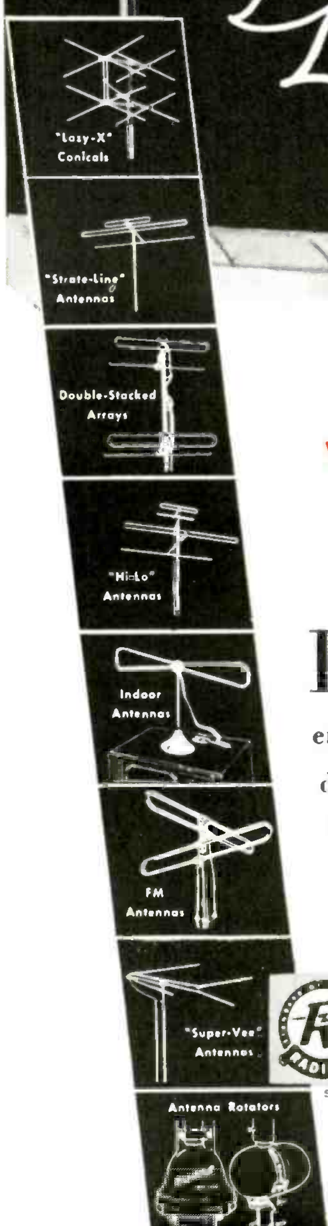
Let us first asume that we should like to have, as in the unit pictured, a constant input voltage V1 of 10 volts and an output voltage V2 of 10, 1, 0.1, and .01 volts and an impedance of 500 ohms. The caluculated values of R1 and R2 will then be (with sufficient accuracy):

| Output (V2) | $\frac{V1}{V2}$ | R1 | R2 | Sw. Pos. |
|---|---|---|---|---|
| 10 | 1 | 0 | ∞ | 1 |
| 1 | 10 | 409 | 101 | 2 |
| 0.1 | 100 | 490 | 10 | 3 |
| .01 | 1,000 | 500 | 1 | 4 |

If we now connect two 500-ohm linear wire-wound potentiometers to V2 as shown in Fig. 1, the different output voltages from V2 can be varied down to 0. Since R4 increases as R3 decreases, the output impedance remains constant at 500 ohms and independent

* Finnish Cable Works Ltd., Helsinki, Finland




"Lazy-X" Conicals
"Strate-Line" Antennas
Double-Stacked Arrays
"Hi-Lo" Antennas
Indoor Antennas
FM Antennas
"Super-Vee" Antennas
Antenna Rotators

of the output voltage. Fig. 2 shows the complete circuit diagram.

### The physical details

My attenuator is mounted in a small aluminum box 8 x 4 x 4 inches. *It is important that the attenuator be well screened.* The resistors R1 and R2 are assembled on a 4-pole 4-position switch so that the resistors R1 and R2 are on the front wafer and the resistors R1′ on the rear wafer. From this rear wafer a wire runs through the partition to the the potentiometer R3, which is at the rear. Metal screens are also mounted between the two wafers of the switch

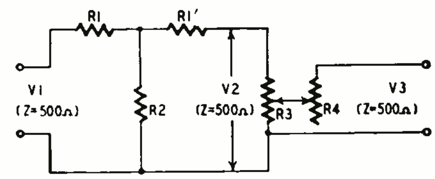



**Fig. 1—The basic attenuator circuit.**

and between the potentiometers, as shown in the inside view photo. The exact values of the resistors are obtained by connecting different resistors in parallel. For the lower values resistance wire can be bifilar-wound on a high-ohm resistor.

The instrument is finished with a panel carrying a range scale for the switch and a linear scale calibrated

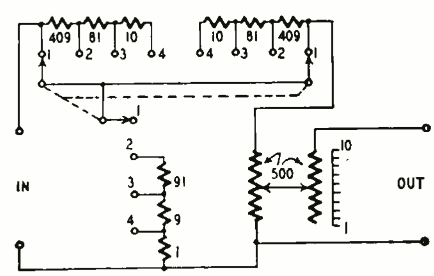



**Fig. 2—The complete circuit diagram. Odd-sized resistors can be made up by paralleling two or more. The scale by the output potentiometer represents that for the right knob on the panel.**

from 1 to 10 for the potentiometers, as shown in the photo. From the screening point of view, flush-mounted pin jacks and plugs might have been better than the pin jack binding posts used.

The attenuator is, of course, simply inserted between the audio generator and the load and the output adjusted to 10 volts in Position 1. Then the switch can be moved to the position giving the desired attenuation.

On this attenuator the maximum load is 25,000 ohms. This causes a very slight drop in voltage. It is very seldom an amplifier has so low an input impedance. For lighter loads (higher impedances) the voltage drop is negligible. The attenuator can also be calibrated in db if one would prefer using decibels instead of volts. With the equations above it is also easy to calculate the design of attenuators for different ranges or different impedances.

—end—


Front panel of the "Time Minder." The selector switches show total time.

# Automatic Electronic Timer Varies On and Off Periods

By WILLIAM H. MINOR

A FULLY automatic electronic timer has a number of practical uses. Unlike the semiautomatic timers that have appeared in various radio magazines, this one times both the on and the off periods, each independent of the other, in 1-second steps. The maximum ON period is 50 seconds, while the OFF period varies from a short pulse to 120 seconds. The circuit appears in Fig. 1.

The instrument, now called the "time minder," has a timing error of considerably less than the 10% which was originally allowed in the design. This was done by carefully selecting resistors having the least variation from the nominal value. Even at that, the error can be disregarded for many applications as long as the error itself is constant, as it is with this timer.

The timer is most useful for the photographer who makes a great number of prints from the same negative or from negatives requiring equal exposure times. In such work it saves much time and eliminates many unnecessary motions. The operator has

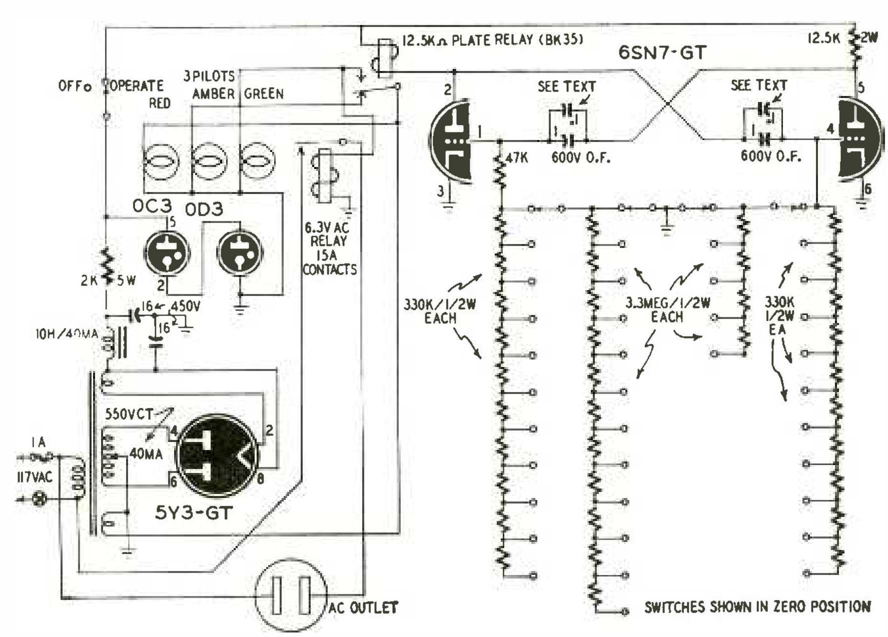



Fig. 1—The timer circuit. Accuracy is good if resistors are carefully picked.

# NEW INDICATOR ION TRAP

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## Speeds Service—Builds Profits

Rauland's new Indicator Ion Trap is winning the cheers of more service men and dealers every day—because of the time and trouble it saves in Ion Trap Magnet adjustment, and because it eliminates mirrors and guesswork.

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This important new Rauland development is incorporated in all Rauland tubes produced today—as a feature of Rauland's new Tilted Offset Gun. This gun offers the additional advantages of giving only a single Ion Trap Magnet and of maximum sharpness of focus.

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## THE RAULAND CORPORATION

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4245 N. KNOX AVENUE • CHICAGO 41, ILLINOIS only to pretime himself on the time he needs to remove and insert a new sheet of paper in the printing position and set the OFF period (with a slight margin of safety) to that time. The ON period is set to the time required to produce the proper contrast when the paper is correctly developed. After that the operator does no more than remove and insert paper while the instrument does the rest of the exposing process.

If the operator makes a mistake, he immediately opens the OPERATE switch and the enlarger lamp is extinguished. A word of caution: After resetting the switch to OPERATE position, the multivibrator should be allowed at least one full cycle to re-establish its sequence before proceeding with the process.

## About the circuit

A type 6SN7-GT dual triode is used in a conventional multivibrator with the load resistor in one section replaced with a sensitive relay (12,500 ohms). In this circuit the BK-35 relay, from a surplus marker beacon receiver BC-1033 was used since it was readily available. The resistor in the other plate should match the relay resistance. The grid circuit of either stage is coupled to the opposing plate through a parallel combination of a 1-μf and a .1-μf capacitor. The grid resistor is variable by switching to choose the series total of the 330,000-ohm and 3.3-megohm resistors. Each 330,000-ohm resistor times 1 second while the 3.3-megohm resistor, being 10 times the value, offers 10-second steps. The calibrator that shows in the front panel photo is not used.

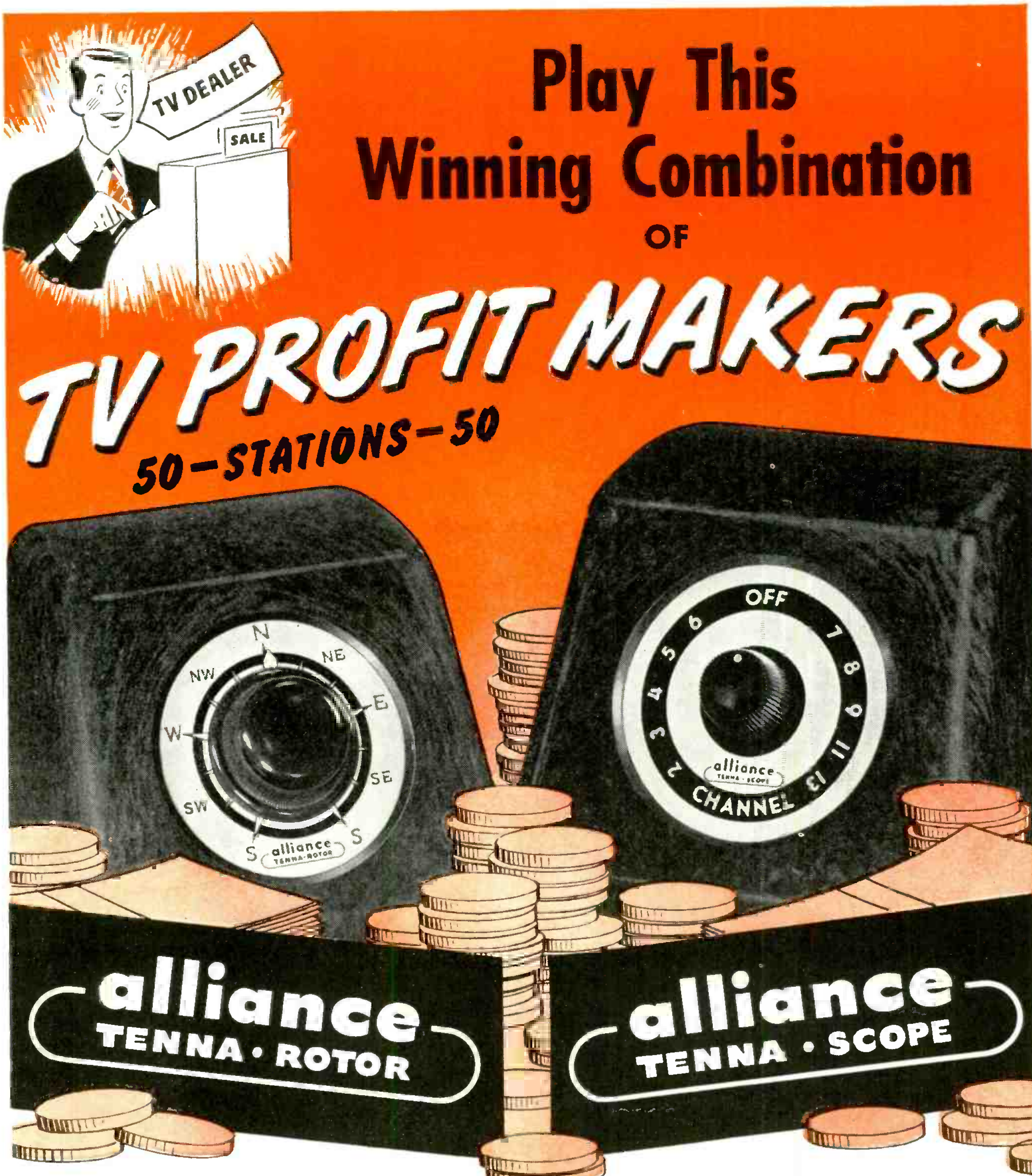
The ON period has a minimum pulse time of about 0.1 second and when the switch is set to the zero position a 47,000-ohm resistor is in the grid-to-ground circuit. This resistor is never removed from the circuit and its time adds to the selected times.

When the triode containing the load relay conducts, the relay closes and operates a 6.3-volt a.c. relay. This latter relay has contacts which will handle 15 amperes in series with the 110-volt outlet plug from which the appliance is operated. The load at 15 amperes should be noninductive. This particular arrangement was chosen so the plate relay could be made to operate the indicating pilot lamps.

To insure against frequency changes due to varying plate potentials, the tube is supplied by two voltage regulator tubes giving 255 volts d.c. The effect of regulator failure is instantly obvious if one tube is removed from its socket. Timing, though not necessarily erratic, changes from the desired value.

The circuit was completed with the exception of the .1-μf capacitor paralleling the 1-μf coupler. With the periods set to 10 seconds, timing was checked with a stop watch while different values of shunt capacitance were added. The .1-μf capacitor set the time to within 1/10 second for the 10-second period. No further calibration is necessary.

Commercially available cabinets are suitable for construction of the time

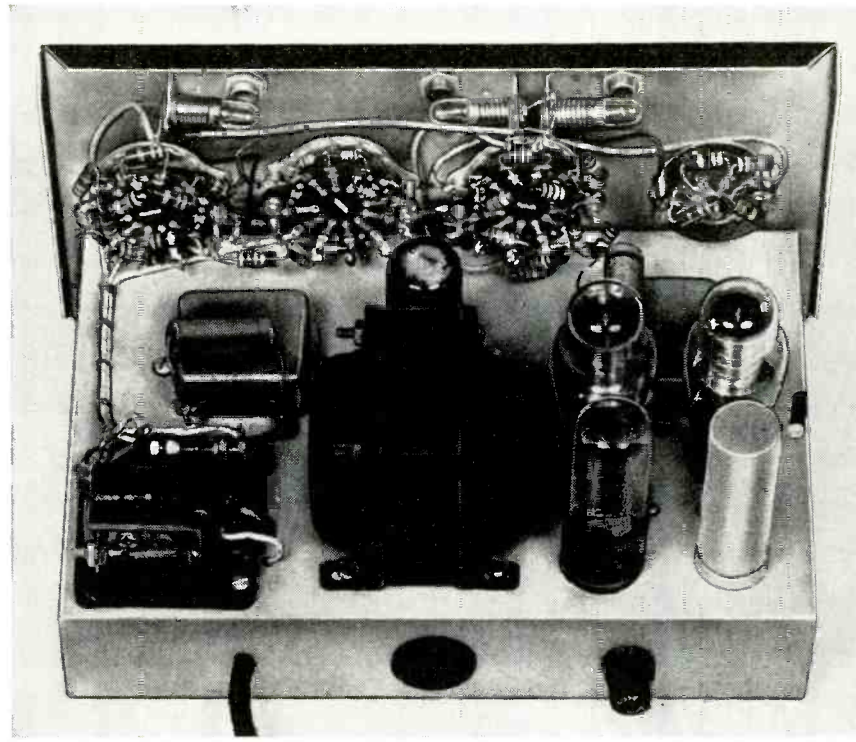



**MODEL HIR TENNA-ROTOR** is the only fully automatic rotator. Just set it and forget it. Your antenna turns to the proper position and stops. North—East—South—West—direction indicator dial shows exact antenna position at all times. Extremely accurate!

**THIS NEW TV BOOSTER** features one simple control. Automatic on-off switch gives maximum, uniform high gain on all channels—quick to install. An excellent companion item to the Tenna-Rotor. The New Alliance Tenna-Scope!

**NATION-WIDE TV ADVERTISING PRE-SELLS!** Tenna-Rotor is the only TV accessory backed by a powerful, sustained television campaign—national in scope. Alliance Tenna-Rotor offers faster installation with 4-conductor "Zip" cable. Works in any weather. 1-year guarantee. U. L. approved.

**ALLIANCE MANUFACTURING COMPANY • Alliance, Ohio**



**Rear view of the timer. All the timing resistors are mounted on the switches.**

minder. The one pictured was folded in the shop from ½ hard aluminum from the junkyard war surplus. The finish is several coats of synthetic aircraft lacquer, and commercial decals added the final touch.

The resistors of the timing circuit are soldered directly to the switches before the switches are mounted on the panel. Any and all wires in the circuit may be cabled for a neat appearance. The timing is the arithmetic sum of the values appearing on the decals.

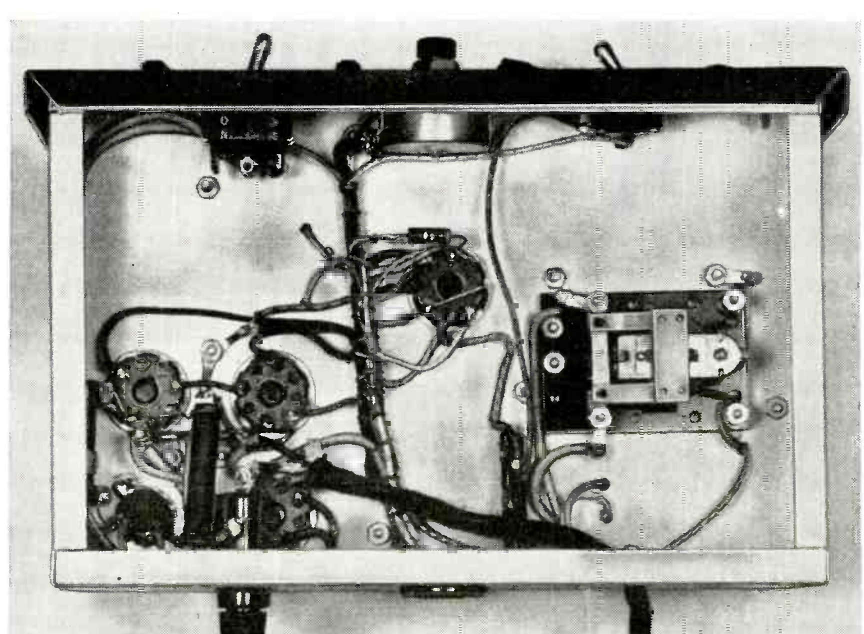
## The timing design

In the original design a choice of R and C had to be made to produce at least a rough approximation of the desired 1-second period. The tube current was assumed to be the 10 milliamperes and it was assumed that conduction would start in either tube when its grid reached the value of –4 volts.

A current flow of 10 ma creates a drop of 125 volts in the load resistor and the grid of the opposite tube would then be driven to a –125 volts, at which time the capacitor would charge toward 0 potential. Charging follows the curve:

$$e = E\varepsilon^{\frac{-t}{RC}}$$

Sufficient information is then given to solve the equation for the required R-C combination.

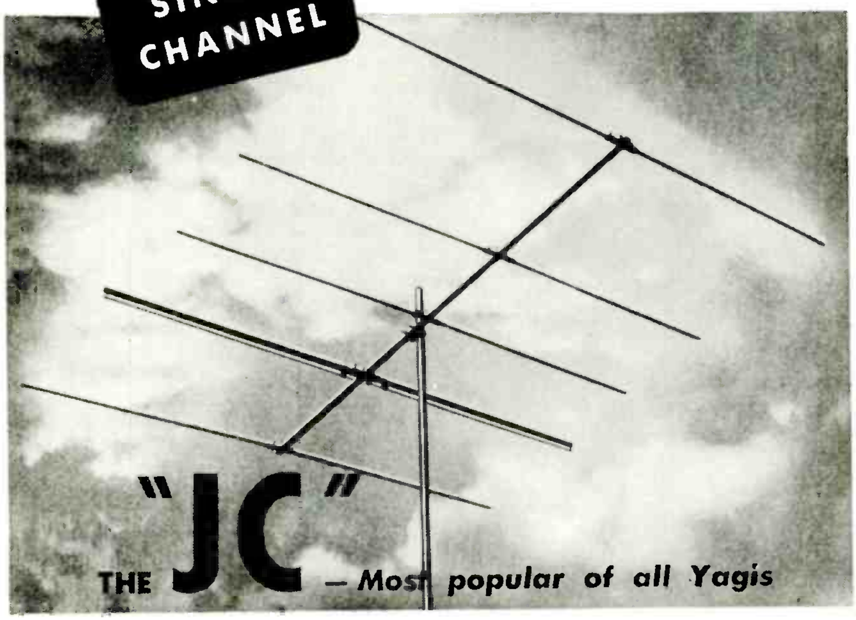


**The underside of the timer's chassis. The wiring is all cabled for neatness.**

# MOST POWERFUL

**ANTENNA COMBINATION IN TV HISTORY**

**SINGLE CHANNEL**

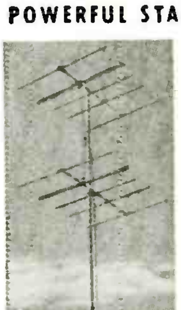



## *NEW* Stacked Arrays

## PRODUCE SHARP, CLEAR PICTURES AT AMAZING DISTANCES

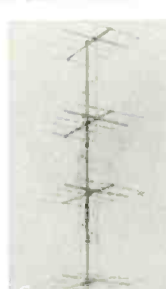
Vee-D-X – largest producer of Yagis – brings you new stacked arrays that provide still higher gain and further reduce noise interference. Perfected by Vee-D-X engineers in collaboration with a foremost authority on wave propagation, these stacked arrays make a world of difference in picture quality. In addition to the already popular double stacked array ("A" below) with half-wave spacing, you can employ double stacked arrays with full-wave spacing ("B" below) and half-wave four stacked, either vertical or side-by-side. Choice of array depends on area terrain and reception conditions.

**POWERFUL STACKED ARRAYS FOR ALL SINGLE CHANNEL REQUIREMENTS**

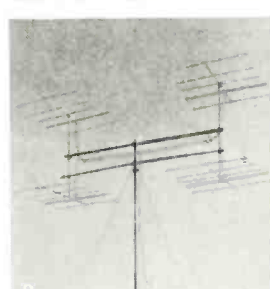


(A) *Double Stacked JC Array* with half-wave spacing. Provides additional gain and improved signal-to-noise ratio.

(B) *Double Stacked JC Array* with full-wave spacing. Provides highest possible gain in low noise areas.



(C) *Four Stacked Vertical JC Array* provides extremely high gain and excellent improvement of signal-to-noise ratio. Ideal for long distance reception areas with relatively flat terrain.



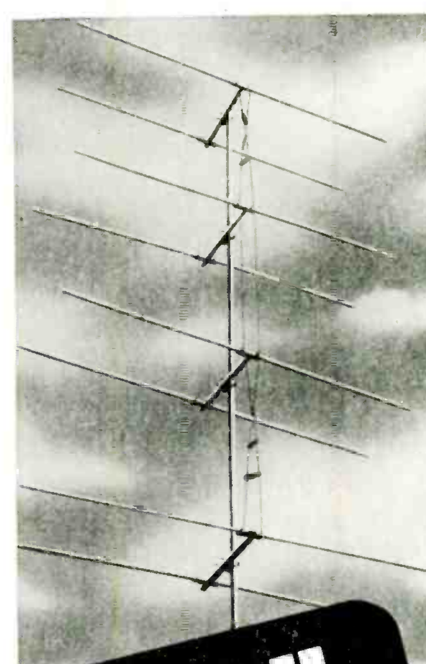
(D) *Four Stacked Side-by-side JC Array* — a radically new type of array developed for highest gain in hilly and mountainous terrain. Provides powerful long distance reception.

**ALL CHANNEL**

### COLINEAR ARRAY

*The New Favorite in Areas Where Both High and Low Channel Reception is Required*

This exclusive Vee-D-X antenna was developed to fill the need for more powerful all-channel reception in primary as well as fringe areas. Besides producing higher gain throughout the TV spectrum, the Colinear may be cut to any single high channel for sharp directivity, yet will resonate on low channels regardless of high channel selected. Like the Vee-D-X JC Yagi, the Colinear is completely pre-assembled. It is also the lowest priced four-bay array ever manufactured.



**VEE-D-X**

**THE WORLD'S MOST POWERFUL ANTENNAS**

**THE LaPOINTE - PLASCOMOLD CORPORATION, WINDSOR LOCKS, CONNECTICUT**

The capacitor which took the grid to −125 volts must charge 95% of its excursion to 0, which upon solution of the equation proves to be

$$\frac{t}{3} = RC \quad \text{(R in ohms C in farads)}$$

or RC = 0.33 when t equals 1 second since $0.33 \times 10^6 \times 1 \times 10^{-6} = 0.33$

R was taken as 330,000 ohms and C as 1 µf.

Actually the design and end results were close enough together that the timing did fall within the allowed 10% error. The addition of the .1-µf capacitor merely corrected existing errors to a closer approximation.

The timing resistors used in this instrument were selected to provide the most convenient timing intervals to suit the uses for which the timer was designed. Other constructors may find different values more useful for their particular needs. These can be calculated by using the steps given above.

More positions can be included in the OFF TIME SELECT switch. In this instrument it provides only 40 seconds total time, which was adequate for the timer's original purpose. As many as 10 positions will work satisfactorily in this circuit.

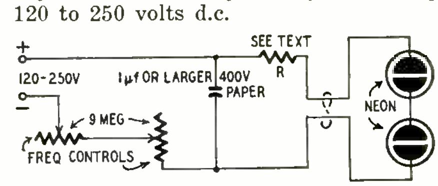
### Materials for Timer

**Resistors:** 1—47,000, 20—330,000 ohms, 16—3.3 megohms, ½ watt; 1—2,000 ohms, ½ watt; 1—12,500 ohms, 2 watts (selected from 12,000-ohm standard value to match relay resistance).
**Capacitors:** 2—0.1 µf, 600 volts, paper; 2—1 µf, 600 volts, oil filled; 2—16 µf, 450 volts, electrolytic.
**Miscellaneous:** 1—550-volt at 40 ma center-tapped transformer with 5-volt and 6.3-volt windings; 1—10-henry, 40-ma choke; 1—12,500-ohm relay (BK35); 1—6.3-volt relay with 14-amp contacts; 1—6SN7-GT, 1—5Y3-GT, 1—0C3, 1—0D3, tubes and sockets; 3—single-pole, 11 position, 1—single pole, 6 position, 2—s.p.s.t., switches; 3—pilot lamps and assembly; 1—female a.c. outlet; 1—1 amp fuse and holder; chassis, hookup wire, and assorted hardware.

—end—

## SIMPLE STROBOSCOPE

A stroboscope for studying rotary or reciprocating motion can be made from a few inexpensive parts which can probably be found on the average experimenter's workbench. It draws negligible power and can be operated from dry batteries or any supply delivering 120 to 250 volts d.c.




The circuit is basically a variable-frequency relaxation oscillator using neon tubes. These are mounted on the end of a length of 2-conductor cable so their light can be concentrated on the object in motion. A high resistance is required for a wide range, so we used two 9-megohm variable resistors in series. Two controls in series provide a sort of vernier action which makes it easier to adjust the strobo to the desired frequency. Two 10-megohm units will work just as well and will probably be easier to acquire. Resistor R protects the neon lamps. Refer to manufacturer's data for its resistance.—*O. C. Vidden*

FRANK J. MOCH,
president of the
National Alliance of Television and
Electronics Service Associations.

# Frank J. Moch says—
# "there is no other OSCILLOSCOPE like the NEW Simpson MODEL 476 MIRROSCOPE"


**Simpson's** new and completely advanced type of oscilloscope—Model 476 MIRROSCOPE—is designed to eliminate certain inherent disadvantages found in the conventional type of oscilloscope by use of the "Mirroscope principle." In this kind of construction the 5-inch cathode ray tube is mounted in a vertical position, thus reducing bench space requirements to an area of only 9″ x 8″ thereby permitting better concentration of associated equipment for any type of test procedure. The cathode ray image is reflected from an optical type front surfaced mirror mounted in the adjustable cover at the top of the cabinet bringing the viewing surface of instrument near eye level when instrument is used on benches of normal height. The mirror angle is quickly and easily adjusted to any position of the operator. The cover with integral side wings forms an effective shield against external light sources or may be closed down for protection of the tube and mirror when the instrument is not in use. The upright construction permits location of controls and connections for maximum convenience and allows for internal cathode ray tube connections at the front of the panel instead of the rear.

**SENSITIVITY:**

Vertical direct.......12 volts rms per in.
Vertical amplifier.20 millivolts rms per in.
Horizontal direct.....14 volts rms per in.
Horizontal amplifier.....38 millivolts rms per in.

**INPUT IMPEDANCE:**

Vertical direct.....10 megohms, 15 mmf.
Horizontal direct...10 megohms, 15 mmf.
Vertical amplifier.300,000 ohms, 30 mmf.
Horizontal amplifier......500,000 ohms, 15 mmf.

Horizontal trace expansion is over 4 times tube diameter. This makes it possible to examine minute portions of a response pattern for finer detail.

Linear Sweep frequency is continuously adjustable in five overlapping ranges from 15 cycles to 60,000 cycles. Internal, external or line frequency synchronization with variable amplitude is available.

Means for intensity or "Z axis" modulation is provided. Approximately 14 volts peak will blank a trace of normal intensity.

The vertical amplifier frequency response is within 3 DB from 20 cycles to over 300,000 cycles and is usable to well over three megacycles. Square wave slant and over-shoot is held to less than 5 per cent of amplitude. This response will be found adequate for all phases of television receiver service including observation and diagnosis of Sync. signals.

**TUBE COMPLEMENT:**

| | |
|---|---|
| 5UP4 | Cathode Ray Tube. |
| 4—6J6 | Horizontal and Vertical Amplifiers. |
| 1—12AU7 | Vertical pre-amplifier. |
| 1—6J6 | Linear Sweep oscillator and Sync. injector. |
| 2—6X4 | High voltage rectifiers. |

LINE VOLTAGE: 105-125 volts, 50-60 cycles.
SIZE: Height 16¼″; Width 9⅛″; Depth 8″ over all
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Hight Frequency Crystal Probe...$7.50
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# How an Electronic Brain Works

## Part VIII—The flip-flop circuit and other methods used to store information in electronic computers

By EDMUND C. BERKELEY and ROBERT A. JENSEN

IN THE previous articles of this series, we have described a simple example of an electric brain made up of relays.

We have shown that we can have a complete, and rather interesting, miniature electric brain made up essentially of the following: 16 registers, each consisting of two relays, which may store

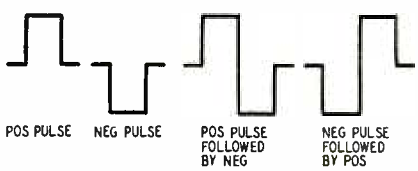


**Fig. 1—Pulses like these carry information in electronic computer circuits.**

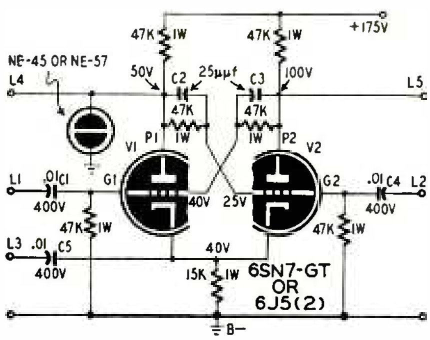


**Fig. 2—A flip-flop circuit. V1 is conducting when the voltages are as shown.**

numbers 0, 1, 2, 3, (in binary, 00, 01, 10, 11), or operations "addition," "negation," "greater-than," "selection" (codes 00, 01, 10, 11); and 1 register, consisting of 5 relays, which stores instructions (codes 00000, 00001, ..... 11111).

There are many problems which require such vast amounts of computation that they have never been attacked by human mathematicians. Relay brains have been able to handle some of these problems. But even a relay brain is too slow for the biggest problems, such as computing the aiming direction of a missile that will intercept another one (like a buzz-bomb) in time to shoot it down. The fastest that an ordinary relay can operate is about 5 or 10 milliseconds. However the fastest that an electronic tube can operate is better than a microsecond.

So, with our background of understanding how a relay automatic computer operates, we can now set out to see how an electronic brain can operate that would compute a thousand times faster than a relay brain. We must translate the ideas we have been dealing with out of the language of relays into the language of electronic tubes.

It must be remembered that no one has yet constructed a complete operating miniature electronic brain. Consequently most of the information here given is derived from work that has been done with the giant electronic automatic computers.

### Information

How shall we make electronic equipment express information? In electronic computers, just as in relay computers, the basic piece of information is a binary digit, a yes or a no, a 1 or a 0, a tube conducting or not conducting, the presence or absence of a certain change of voltage, etc. It is much easier and more direct to construct an electronic computer that operates in the pure binary system than it is to construct one that operates in the decimal system.

There are several main systems for representing information. The first system is that 1 is represented by a pulse of voltage (either positive or negative) at a certain time, and 0 is represented by the absence of a pulse at such time. A second system is that 1 is represented by a positive pulse of voltage, and 0 is represented by a negative pulse of voltage. Here, the absence of a pulse at a time when a pulse is expected becomes a useful indication that something has gone wrong. A third system makes use of a pair of pulses: a positive followed by a negative denotes a 1, and a negative followed by a positive denotes a 0. The second and third systems are more reliable, and for that reason are used in some automatic computers; but the first system is simpler and has the advantage that the presence of information is indicated by a pulse that may be either positive or negative. Fig. 1 shows the pulse arrangements. The minimum duration of a pulse depends on the time of operation of electronic tubes, which range in the neighborhood of 1 microsecond to 1/20 of a microsecond in most computer circuits.

Because of the speed of operation of an electron tube, many automatic electronic computers operate serially—that is with a bus consisting of just one line along which all pulses travel. One of those finished recently (the Bureau of Standards Eastern Automatic Com-

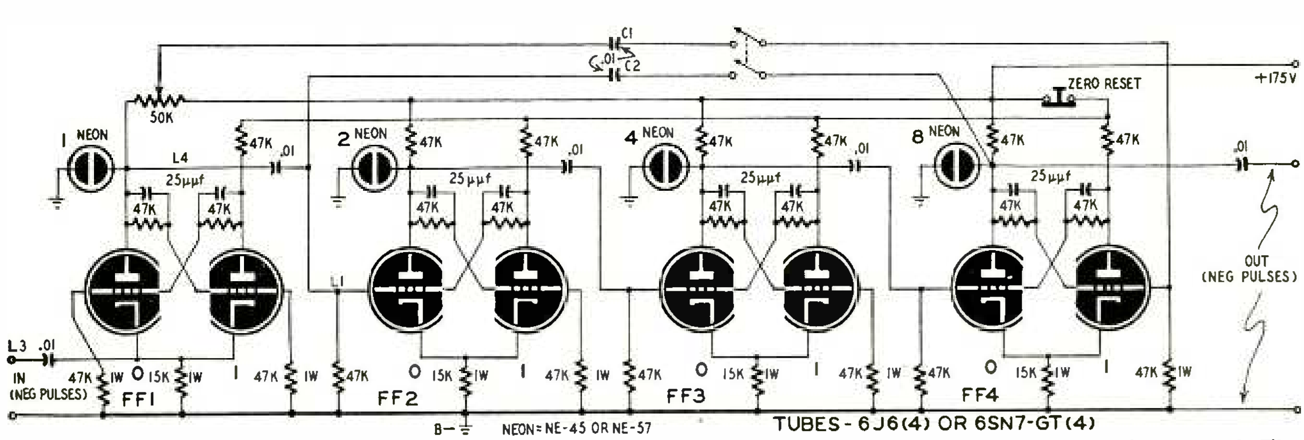


**Fig. 3—A binary decade counter. This string of flip-flops is used to count up to and store any number from 0 to 9. Then it resets, passing an impulse to a similar unit, which acts as the "tens" bank, and so to any desired number of decades.**

# We're Doing Our Best to Keep Up With the Demand

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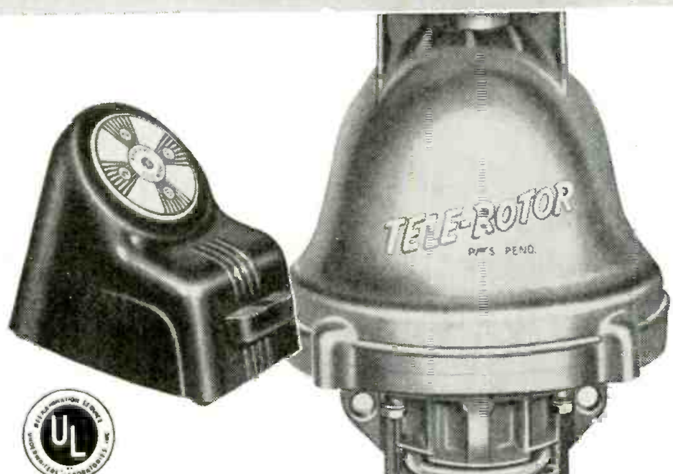
**MODEL TR-2**. . . . . rotator with "compass control" cabinet having illuminated "perfect pattern" dial . . . (uses 8 wire cable) . . . . $49.95

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**MODEL 502A**. . . . rotator with plastic control cabinet having indicating meter for "hairline" tuning. (Uses 5 wire cable) . . . . . . . . . . . $44.95

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**CORNELL-DUBILIER** SOUTH PLAINFIELD, N. J.

**THE RADIART CORPORATION** CLEVELAND 2, OHIO puter, in Washington, D. C.) is of this kind, and has a one-line bus along which all pulses travel in a series. It works with numbers of 45 binary digits, and its speed of operation is 1,100 additions or subtractions per second, or 330 multiplications or divisions per second.

But there is one electronic computer (Whirlwind I, built by the Servomechanism Laboratory at Massachusetts Institute of Technology) which uses a 16-line bus along which pulses travel in parallel. It works with numbers of 15 binary digits and an algebraic sign, plus or minus. Because of the parallel bus, this machine is able to reach the speed of 30,000 multiplications per second.

### Flip-flop

As we have already seen, the first thing we have to do with a pulse of information is to store it—hold it in such a way that we can use it later. For example, in Simon, we would feed a number into a set of relays and hold it there till we had fed another number into another set. Then we could add the two numbers together, or compare their size, or do something else with them. Without this *memory*—this ability to store a number until it is needed—a computer would be so limited that it would be almost useless.

Large computers may use relays to store information till needed, or they may use electron tubes. One type of computer (such as the International Business Machines Electronic Selective Sequence Calculator, located at 57th Street and Madison Avenue, New York City), uses tubes for very short storage periods and relays for information that has to be stored for longer periods. Information that must be remembered indefinitely is placed on long punched rolls of paper.

If we can make the counter count up to 1,001 (9 in the decimal system) and then reset when the next pulse is received, we have a *decade* counter, or one that counts in tens. (The pulse that resets the first decade is fed to a second as an integer, so that two decades can count to 99.)

One of the standard ways of storing a pulse of information electronically is the *flip-flop* circuit (see Fig. 2). It consists of two triodes (in one envelope, a 6SN7-GT, for example; or in two envelopes, two 6J5's for example), and it has two stable states: (1) triode V1 conducting and triode V2 not conducting; (2) triode V1 not conducting and triode V2 conducting.

Now let us take a look at the operation of the flip-flop. Suppose we put a negative pulse (or voltage drop) on the input lead L1. Capacitor C1 transmits this pulse, and it goes to grid G1. The negative pulse reduces the current through triode V1, and so produces a rise in the plate voltage on plate P1. This positive pulse is at once transmitted through capacitor C2 to grid G2, and starts triode V2 conducting. As it starts to conduct, the current flow lowers the plate voltage on plate P2. This voltage drop is at once transmitted as a negative pulse through capacitor C3 to grid G1, and makes grid G1 even more negative, tending to cut off triode V1. This process continues and rushes to conclusion in less than a few microseconds. Triode V2 is then conducting (at saturation) and triode V1 is cut off. As long as the power supply is on, the flip-flop records and stores the fact that a negative pulse came along on lead L1. The neon lamp lights when triode V2 is conducting, and indicates a "1" stored in the flip-flop. The lamp is off when a "0" is stored.

Another consecutive negative pulse on L1 will now have no effect, but a positive pulse on lead L1 or a negative pulse on lead L2 will cause the flip-flop to change back to its original state. In regard to lead L2, we can see that a similar description applies symmetrically.

Now let us consider lead L3, which runs through capacitor C5 to the cathodes of both triodes. A negative pulse on this lead will cause a change of state in the flip-flop, no matter which of the two triodes is conducting. So the flip-flop will actually count, 0, 1, 0, 1, 0, 1, 0, 1, 0 . . . . . ., depending on the number of negative pulses that come in on this lead. A positive pulse will have no effect. However, the shaping of these pulses may require additional components, while the shapes of the pulses used on leads L1 and L2 are not too critical.

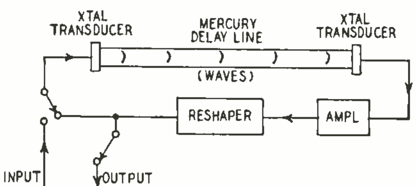



**Fig. 4—Storage circuit with a mercury delay line and two crystal transducers.**

This flip-flop is very similar to one actually used in the ENIAC, the first big automatic electronic computer. ENIAC was finished in 1946 at the Moore School of Electrical Engineering, and is now operating at the Ballistic Research Laboratories, Aberdeen, Maryland. (The ENIAC flip-flop is described further in a paper "High-Speed N-Scale Counters," by T. K. Sharpless, in *Electronics*, March 1948.)

Now suppose we hitch three more flip-flops in succession to this first flip-flop (see Fig. 3). We impulse FF1 by lead L3, so that (1) it changes state on every pulse, and (2) it puts out on output lead L4 alternately a positive pulse and a negative pulse. We connect lead L4 on flip-flop 1 to lead L1 on FF2; then only negative pulses on L4 cause flip-flop 2 to change state. We make similar connections between FF2 and FF3, and between FF3 and FF4. Then we have a binary counter that will count 0000, 0001, 0010, 0011, 0100, etc., up to 1111. Capacitors C1 and C2 are used to trip the counter back to 0000 after holding 1001. This is the principle used in the 4-tube counter decade described by John T. Potter in *Electronics* of June, 1944.

For storing one binary digit of information, a 1 or a 0, a flip-flop is decidedly expensive. Consequently it is used only in those parts of an automatic computer where a great deal of traffic with information requires the convenience and justifies the expense.

## Delay line

Another scheme for storing information in an electronic computer is the *sonic delay line* (see Fig. 4). A sonic delay line consists of material which will transmit pulses as a series of molecular vibrations, more slowly than the usual wire conductor. It may be made of a solid, or of liquid in a tube, or air, in the case of an echo.

For example, think of a long rope, one end in your hand, the other end tied, and the whole rope pulled fairly taut. You shake your hand quickly, and a wave (or pulse) will travel down the rope. As soon as one wave (or pulse) has been started down the rope (or delay line), another can be started almost immediately after it, and the second will follow the first one without interfering with it. Thus what is basically needed for a sonic delay line is any medium down which a pulse may travel. As long as the medium is built suitably, the pulse will not die out until it is needed.

Now in the case of the rope, when the wave or pulse reaches the end of the rope that is tied, the pulse is reflected, and a wave of reversed phase travels back. Of course, reflected waves are not wanted, and a sonic delay line, contrary to the rope, is designed so that reflections are eliminated or rendered unimportant.

We therefore can see that information is stored in a sonic delay line as a series of pulses and absences of pulses, a pattern of 1's (the presence of pulses) and 0's (the absence of pulses).

The pattern is retained by sending it around and around a loop. How do we "write" information in a sonic delay line? We feed a series of pulses and absences of pulses into it. How do we "read" information from the line? We send it along two channels, one the channel back to the front end of the delay line, so that the information will circulate and be remembered, and the other the channel into the part of the computer where we want to use the information, say, into a bank of flip-flops. How do we "erase" information in the delay line? We interrupt the circulating loop long enough so that all the pulses are eliminated.

A type of sonic delay line that has been used quite widely in electronic computers is the *mercury delay line* or *mercury tank* (see Fig. 4). At each end of a long tube filled with mercury is a quartz crystal in contact with the mercury. When a voltage pulse is applied to the quartz, its shape changes (piezoelectric effect). The quartz agitates the mercury, and sends a ripple down the tank. The ripple is picked up at the far end by another quartz crystal and there converted back into an electric pulse. It is somewhat smeared, and so


is amplified and reshaped, in the loop shown. A mercury tank several feet long will store a pattern of about a thousand pulses about a microsecond apart. So it is equivalent to a thousand flip-flops.

Shorter delay lines are useful for remembering numbers in a computation. Very short delay lines—such as a "one-pulse delay line"—are not of the sonic type but of the electrical type, and consist of a network of capacitors and inductors and are an essential element of the computing circuits of some of the electronic brains. The delays obtainable with a small electrical delay line are from a fraction of a microsecond to a few microseconds.

Mercury delay lines for use in giant automatic electronic computers are being manufactured by the Eckert-Mauchly Computer Corp., Philadelphia, Raytheon Manufacturing Co., Waltham, Mass., and other organizations. The details of their operation in many cases involve trade secrets, although in the literature there is some information about operating details.

It is apparent that if the power goes off, or even flickers, the computer's memory of the pattern of the pulses may be erased in whole or in part. For this reason some of the builders of electronic computers do not like to rely on delay line storage.

### Magnetic drum and tape

A compact and efficient device for storing pulses—and storing them even if the power goes off—is the *magnetic drum*. This is a rotating cylinder which may be of different sizes, but one size that has been used is about 12 inches long and 6 or 8 inches in diameter. It usually rotates at 1,800, or 3,600, or 7,200 r.p.m. The drum may be of brass or aluminum, and is coated with a compound containing magnetic particles. The compound is put on like paint, with a brush or spray gun.

Mounted almost touching the drum are small electromagnets or *magnetic heads*, very similar to magnetic tape-recorder heads. The separation between the two sides of the pole piece may be about 3/1000 of an inch, and the distance of the magnetic head from the drum may be perhaps 2/1000 of an inch. A pulse of current passed through the magnetic head causes the recording of a magnetized spot on the rapidly rotating surface of the drum. A positive pulse will cause, say, a north-south magnetization, and a negative pulse vice versa.

The number of magnetized spots in an inch along the perimeter around the drum may be 20 to 60, and the number of channels side by side along the length of the drum may be 8 or 10 to the inch. So if we can get 400 magnetized spots to the square inch, and put them on 250 square inches of drum surface, the magnetic drum will be the equivalent of 100,000 flip-flops. Magnetic drum storage is being used in automatic electronic computers that have been made by the Harvard Computation Laboratory, Cambridge, Mass., Engineering Research Associates, St. Paul, Minn., Northrup Aircraft Co., Hawthorne, Calif., and other organizations. Here again very little if any information has been published revealing the exact know-how for reading, writing, and erasing pulses on drums, and the normal procedure has apparently been for each laboratory to work out its own technique.

In general, what is needed, of course, is something that will act like the holes in Simon's program tape to connect the pulses that the pickup head senses, into effective use in the computer at the exact instant the head passes over the point which holds the desired pattern of information.

To accomplish this, the information that is on a channel of the drum is always being "read" by the pickup head whose duty is reading; but the pulses are allowed into the computer only when the computer calls for admission, and an electronic switch allows them to come in. The timing is naturally very important, and is based on a series of permanently-recorded equally-spaced pulses on the drum, called the master clock channel.

Magnetic tape wound on a reel, such as is used in magnetic sound recording, has proved to be an important, useful, and reliable means for "slow storage". By this we mean storage of large quantities of information where a relatively long time (seconds) for access to the information is permissible. Six channels across a quarter-inch width of tape, and 100 magnetized spots to an inch of length seems to be a realizable objective.

Magnetic tape is well accepted as about the best device for input, output, and slow storage in an automatic electronic computer. Raytheon Manufacturing Co. is offering for sale multichannel magnetic heads for reading (sensing), writing (recording), and

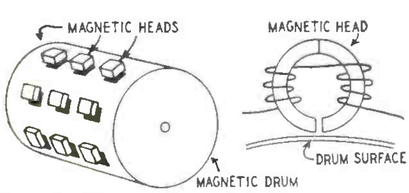



**Fig. 5—Magnetic drums make one of the most efficient ways of storing information in smaller electronic computers.**

erasing (eliminating) pulses on magnetic tape, and so undoubtedly would furnish details and know-how for using their heads.

Both the delay line and the magnetic drum have the disadvantages that the computer has to wait for the information to become available. If a delay line or a channel on a drum is storing 20 numbers, and the one you want has just gone by, you have to wait for the other 19 numbers to go by before you can pick up the number you want. In the case of a magnetic drum, you could of course put on additional reading heads and read out from that part of the periphery of the drum which is nearest to the location of the number you are interested in. But that can be troublesome. Why not have all the numbers in storage accessible practically at once?

### Electrostatic storage

In one form, the method of electrostatic storage uses a dielectric screen in a cathode-ray tube. The beam that scans the screen divides it into a pattern of, say, 32 by 32, or 1,024 separated spots. Information is stored on these spots as the presence or absence of certain electric charges. The spots are written on or read out or erased by one beam of electrons. The electric charges that have been recorded on the screen are held in their places and prevented from leaking away by another beam of electrons, a so-called "holding beam."

Electrostatic storage has proved to be rather a ticklish technique to master. F. C. Williams at the University of Manchester in England has succeeded in using electrostatic storage in the automatic electronic computer built there. Also, the Servomechanisms Laboratory at Massachusetts Institute of Technology is installing some electrostatic storage memory in Whirlwind I, which will still further raise its speed of 30,000 multiplications a second. Certainly, no miniature automatic electronic computer would be expected to make use of electrostatic storage, whereas a small magnetic drum would be a logical choice for its memory.

(continued next month)

## LISTENERS BUY FM PROGRAM

To prevent their favorite program from being interrupted by commercials, listeners to an FM music series donated practically as much as the station would have received had the series been handled on the regular commercial basis.

The station with the music-loving audience was WABF (FM) of New York City, and the program the New Friends of Music concert series. The audience was informed that "it would be inconsistent with the tone and mood of the concerts" to have them sponsored by advertisers. Instead the listeners were asked to subscribe to the series by sending the station any sums they wished. During the first weeks of the program it was announced that more than 2,000 listeners had responded, sending WABF more than 90% of the amount which would have been realized had the program been sold in the regular manner to a commercial sponsor.

## ELECTRONIC MONEY COUNTER

Eight tons of old currency—mostly one dollar bills—removed from circulation daily by the Department of Treasury is now being counted by an automatic electronic machine. Developing the counter was a difficult job as the old money is badly wrinkled and dog-eared.

# TWO-TONE SOURCE AIDS INSOMNIACS

**Readers who laughed at Mohammed U. Fip's *Hypnotron* in the April issue are invited to look at this dead-serious article on a real tone generator that puts you to sleep with a series of sound pulses.**

**By CHAS. BEAZLEY**

The Slumberbug* is a sound-producing device designed to aid insomnia sufferers. It uses no electron tubes and the sound is produced by the normal voltage variations of alternating current fed, unamplified, through an output transformer into a loudspeaker.

The Slumberbug produces a steady background hum of 60 cycles which is overridden at intervals of about 3 seconds by another slightly louder hum. The louder hum maintains itself for about 3 seconds and then cuts off, reverting to the background hum again. This cycle, loud–soft, repeats itself as long as the device is in operation. The background hum, although apparently continuous, is actually cut off when the louder hum appears. The effect is that of a background hum with a slightly louder modulating hum riding in over it. There is also an apparent change in the quality of the tone between the two hums.

When the set is working, current flows through the resistor and the entire circuit, producing a soft hum from the loudspeaker. The synchronous motor also starts to rotate. When the cam mounted on its shaft reaches the normally open switch contacts it closes them, thus shorting out the resistance. This allows more current to flow in the output transformer primary and the tone is louder at the speaker.

The shape of the cam on the motor is governed by the speed of the motor and the length of sounds desired. I use a 4-r.p.m. motor carrying a 2-lobe bakelite cam which produces a complete cycle of 7.5 seconds, or 3.75 seconds loud and the same soft. This timing is generally satisfactory although others may prefer different timing.

The indicator light is a 3-watt, 117-volt candelabra base lamp which varies brilliance with the changes in volume. It is primarily an on-off indicator, as the Slumberbug is generally operated at very low over-all volume and could easily be left turned on all day.

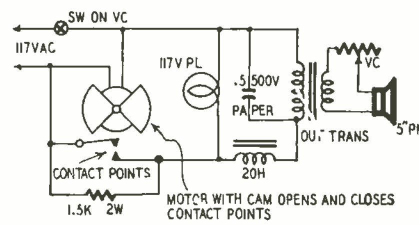
The iron core choke can be an a.c.-d.c. radio filter choke or something heavier, depending how much contact click appears at the loudspeaker. Do not try a capacitor across the points to eliminate click, as in this circuit it makes matters worse and shortens the contact life of the switch.

*Patent pending. Registered Trade Mark applied for.

A 0.1-μf capacitor will give an apparently higher pitched but rougher tone than the one shown while a 1-μf capacitor will give a smooth, bass, foghorn effect. The amount of capacitance used is limited by the output transformer used. If a better impedance match is used the loss in volume with a 1.0-μf capacitor will not make any difference and the output tone will be free of ripple. We used an output transformer for the 50L6 tube because it is generally on hand and is satisfactory. A 3-position switch can serve as a tone control by selecting capacitors.

### How it works

The Slumberbug was designed to help my wife sleep and is based on the double-toned sound of a foghorn of the type used in lighthouses and lightships. I have spent a good many years at sea as a radio operator and have always felt that a foghorn in the distance had a sleep-inducing sound. I had noticed that it interrupted any attempt at continued consecutive thought by its timed recurrences. During the few nights in my life that I have had trouble in getting to sleep my brain seemed to be spinning along at high speed with none of that drowsy, slow-down effect always experienced by the good sleeper when he rolls into bed. He *knows* he can go to sleep—and as a result he *does*.




Circuit of the double tone generator.

I believe that the brain generates energy which it supplies to the body and which the body in turn retransmits to the brain. When this energy level is lowered by slowing down of the brain action, a point is reached which I call the "sleep-level." Once the brain-energy drops below this sleep-level we automatically click over into sleep.

The Slumberbug was designed to interrupt and to retard any attempt at continuous thought. I recommend that users of the device give it at least a portion of their attention when they are in bed; that they count to themselves the length of the louder and of the softer tones. They will find that, if they count up to say 15 when they first lie down, after a few minutes they no longer will reach 15 in their count. *Their brain action is slowing down.* I also advise users to set the over-all volume at whatever level seems most pleasant but *not* to reduce it so the background hum becomes inaudible.

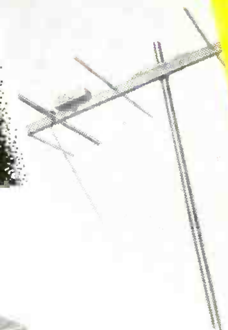
#### Materials for Slumberbug

1—1,500-ohm, 2-watt resistor; 1—100-ohm, wire-wound potentiometer; 1—0.5-or 1-μf capacitor; 1—20-henry choke; 1—output transformer for 50L6; 1—5-inch PM speaker; 1—synchronous clock motor (about 4 r.p.m.) with cam; 1—117-volt pilot lamp; 1—s.p.s.t. switch mounted on potentiometer; contact points; chassis, hookup wire, assorted hardware.

—end—

# you can have perfect reception when you know your TV A-B-C's

A



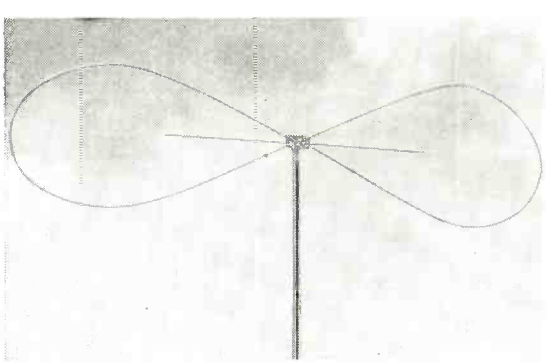
Here's the System that makes perfect TV reception available in every fringe area — and it's as simple and inexpensive as A-B-C. Your first step — A — is the famous Tel-a-Ray Model T antenna — the durable, non-corrosive antenna that consistently receives fine reception from stations as much as 200 miles away.


B

Second in the simple Tel-a-Ray A-B-C System is the Tel-a-Ray Pre-Amplifier. This ingenious, powerful pre-amplifier — the only one of its kind in the low price range — mounts right to your Model T antenna to bring in sharper, stronger, clearer images without increasing the line noise or other distracting sounds.

C

The "C" of the A-B-C System is your receiver. That's all you need to give you evening after evening of wonderful, clear television. The Tel-a-Ray A-B-C System is working for fringe area TVers throughout the country. It will work for you! Write today for complete information.



Your best bet for good primary area reception is the Tel-a-Ray Butterfly antenna. The Butterfly receives 13 channels and FM radio — is completely guaranteed against wind and weather damage. It sells for just $2.95 (suggested list).

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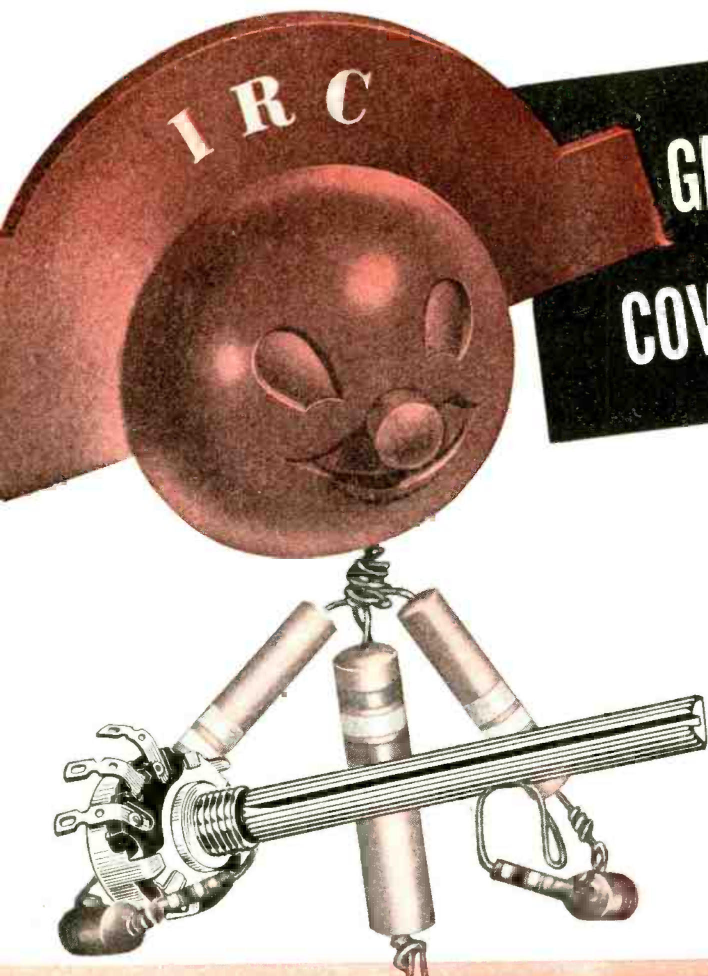
# The Most Adaptable Small Control You Ever Saw...

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60 IRC Q CONTROLS WITH *ADAPTABLE* FIXED SHAFTS cover *all* important values—give you *complete* replacement coverage with minimum stock—and slash your inventory investment to the bone. No other control line so closely meets your servicing needs. No other gives you so much for your money. Here's why...

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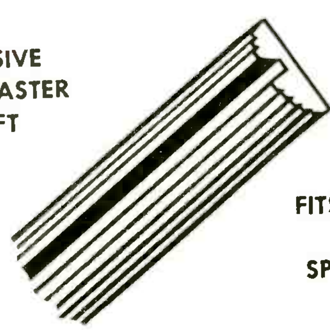


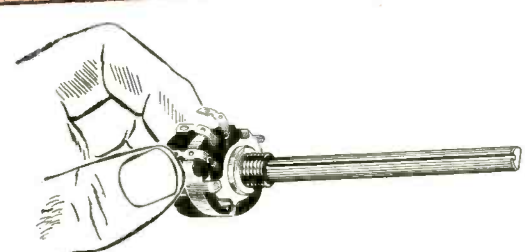
**FITS KNURLED AND SPRING-TYPE KNOB**

Here's the shaft you've dreamed of for years—a shaft that will fit virtually all your standard knob requirements without inserts or modification—a shaft you can just cut to length and use.

IRC's Knob Master Shaft is shown in exploded view above. Note these points of construction:

1. Substantial portion of shaft is knurled. It readily fits most knurled knobs without slotting of shaft. Either tight or loose knobs may be fitted by slotting shaft for 3/8'' and adjusting ends by spreading or compressing.
2. Flat of shaft accommodates all spring-type push-on knobs requiring normal 3/32'' deep flat.
3. Groove simulates narrow flat for spring-type knobs requiring 1/32'' deep flat. Also provides guide for slotting where needed.

Knob Master Shaft is standard with *all* Type Q Replacement Controls. Eliminates need for stocking several different controls of the same value because of shaft differences. Far more expensive to make than ordinary replacement shafts, Knob Master is exclusive with IRC.



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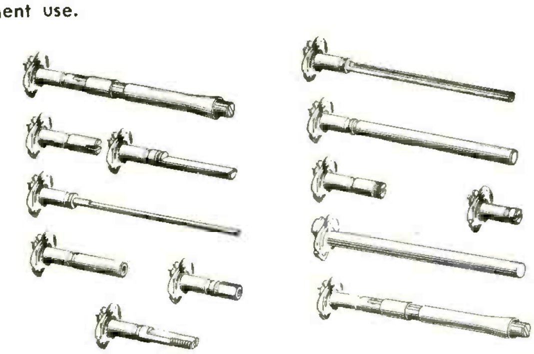

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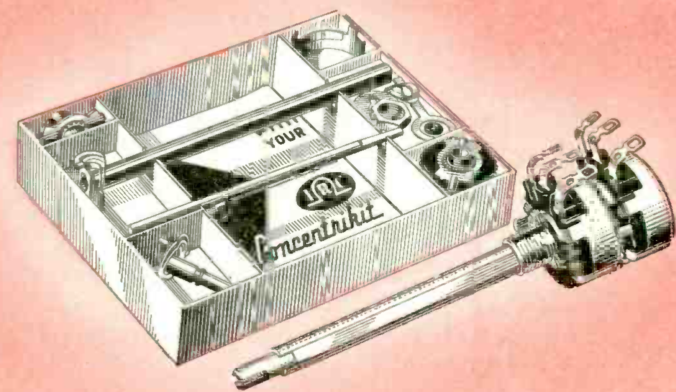


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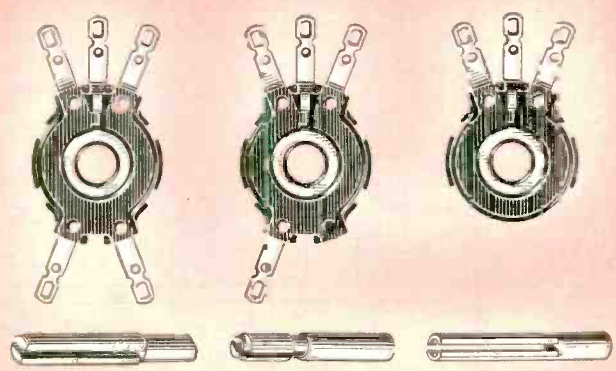

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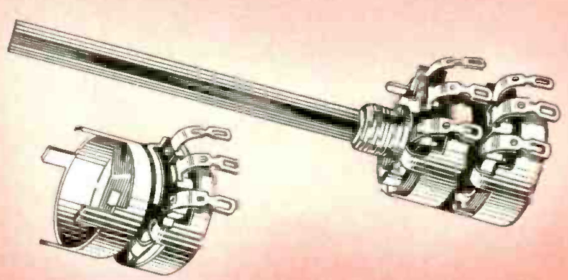

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# FM Set Uses New Type Detector

## The induction detector is easy to align and requires no special or costly tubes

By J. J. J. FAKKELDY*

ALTHOUGH it uses no basically new circuits, this little FM receiver is believed to be the first practical realization of the induction detector. Developed at the Amroh laboratories in the Netherlands, it uses only four tubes plus rectifier; it is easily aligned with the simplest signal generator, and no special or costly tubes are needed. Its circuit appears in Fig. 1.

The detector circuit itself is very much like the gated-beam tube discriminator (see "Gated-Beam Circuits," RADIO-ELECTRONICS for February, 1951), except that any common pentagrid or triode-hexode converter tube type can be used. Performance is practically the same as with the gated-beam tube under normal operating conditions.

The multigrid converter tubes have two separate control grids statically shielded from each other by positive screen grids. If a signal is applied to the first grid, nearest the cathode, the electron stream is modulated. After passing the first positive screen grid, this stream is retarded by the second negative control grid and an electron cloud is formed whose density depends on the supply of electrons from the cathode.

Because there is a capacitance effect between the electron cloud and the second control grid, a small capacitive current flows in this grid circuit. This current is increased by tuning the grid circuit to the frequency of the input signal, and this produces a substantial high-frequency voltage at the second control grid 90° out of phase with the input voltage.

If the frequency of the input voltage varies, as in the case of FM, the phase difference of both grids also varies. Both grids control the final plate current, and their combined effect depends on this phase difference, so that the plate current varies as the input signal frequency increases or decreases. Fortunately this relation can be made linear by very simple means. If the auxiliary tuned circuit in the second control-grid circuit has the correct Q and is tuned to the FM carrier, the circuit will work nicely.

The linearity of the detector depends on the Q of the auxiliary circuit, and this is easily adjusted by using a parallel resistor. A more elaborate method is to apply feedback from the plate to the auxiliary circuit to provide the required damping without loss of gain.

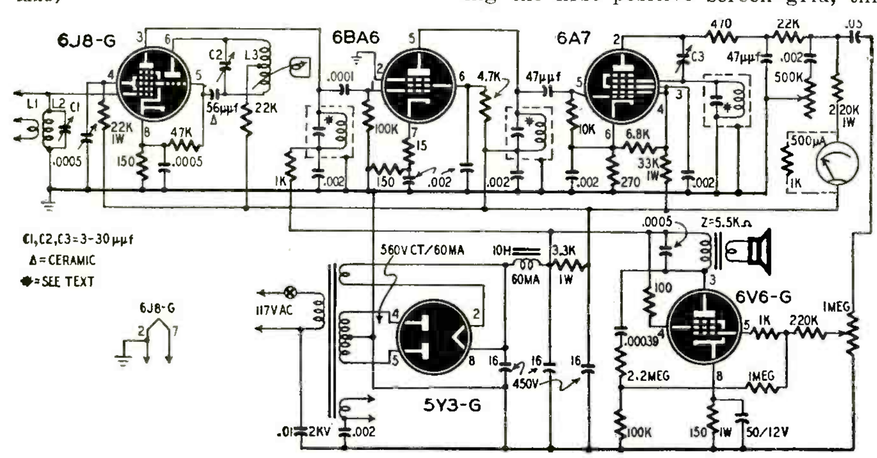


Fig. 1—Circuit of the FM receiver. Its novel feature is the detector, which uses a multigrid converter in a circuit like that of a gated beam discriminator.

* Associate Editor, *Radio Bulletin* (Bussum, Holland)

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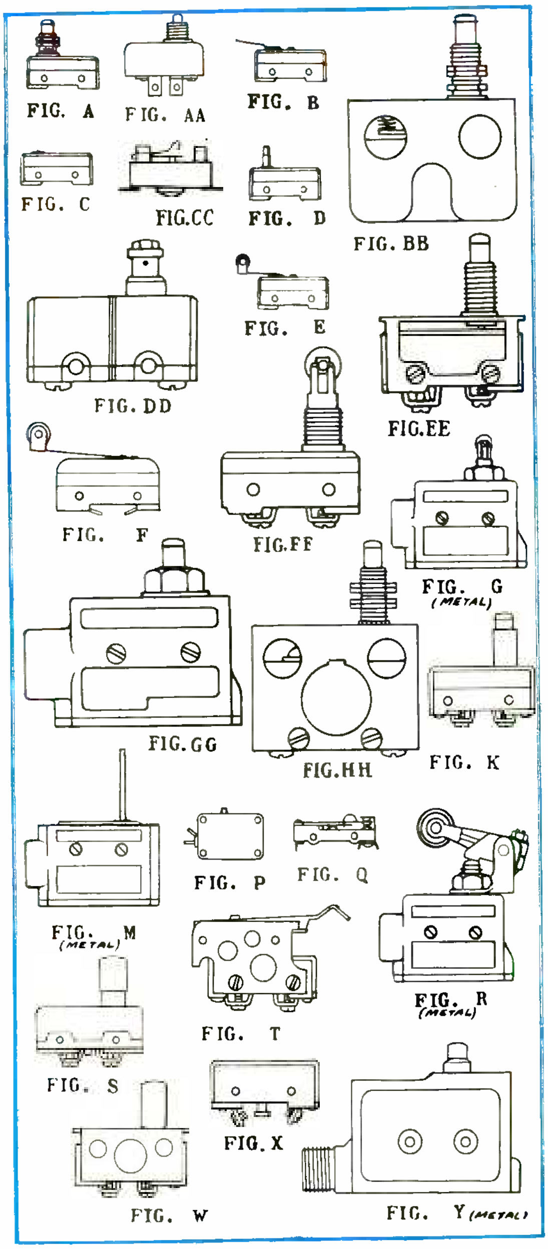


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| 41MC2 | ACRO | 2MO3.1A | NO | P | .50 |
| 41MM2 | MU | ACZ101BB | SPOT | W | .85 |
| 41MC6 | MU | APB236 | SPDT | A | 1.15 |
| 41MC26 | MU | APG210 | NO | A | .80 |
| 41MC17 | MICRO | B-1 | NC | Y | 1.45 |
| 41MC16 | MICRO | B-1T | NC | DD | .90 |
| 41MC7 | MICRO | B-14 | NO | HH | 1.70 |
| 41MD62 | MICRO | B-R | SPDT | C | .70 |
| 41MD46 | MICRO | B-RL18 | SPDT | B | .95 |
| 41MD63 | MICRO | B-RS36 | SPDT | D | .80 |
| 41MD23 | MICRO | BD-RL32 | SPDT | B | .95 |
| 41MLH | MICRO | BZRQ41 | SPDT | W | .85 |
| 41MD51 | MICRO | BZ-R37 | SPDT | C | .70 |
| 41MD2 | MICRO | BZE7RQT2 | SPDT | GG | 1.70 |
| 41MO21 | MICRO | BZ-7RST | SPDT | D | .80 |
| 41MO38 | MICRO | BZE2RQ9TN1 | SPOT | G | 2.65 |
| 41MO6 | MU | CUM 24155 | NO | E | .80 |
| 41ML1 | MU | O | NO | BB | 1.50 |
| 41MC12 | MICRO | D in case | NC | Y | 1.45 |
| 41MD34 | KLIXON | ES692070 | NC | CC | .50 |
| 41MO65 | MICRO | G-R26 | NO | C | .60 |
| 41MO60 | MICRO | G-RL | NO | B | .80 |
| 41MC11 | MICRO | G-RL 5 | NO | B | .80 |
| 41MD61 | MICRO | G-RL35 | NO | B | .80 |
| 41MD41 | MICRO | G-RL43 | NO | B | .80 |
| 41MD64 | MICRO | G-RS | NO | D | .55 |
| 41MD66 | MICRO | G-RS36 | NO | D | .60 |
| 41MC32 | ACRO | HRO 7.1P2TSPI | NO | K | .65 |
| 41MC19 | ACRO | HRO 7.4P2T | NO | S | .60 |
| 41MO8 | ACRO | HRRC 7.1A | NC | C | .55 |
| 41MD27 | ACRO | HRRO 7.1A | NO | C | .60 |
| 41MC31 | MICRO | LN-11 HO3 | SPDT | M | 1.70 |
| 41MC18 | MU | MLB 321 | SPDT | B | .95 |
| 41MD1 | MU | MLR 643 | NC | B | .70 |
| 41MD55 | PHAO. | PS 2000 | SPDT | C | .85 |
| 41MC28 | ACRO | RC71P2T | NC | A | .70 |
| 41MD45 | ACRO | RO1P2T | ND | A | .80 |
| 41MD22 | ACRO | RO2M | NO | E | .80 |
| 41MD28 | ACRO | RO2M12T | NO | E | .80 |
| 41MC25 | MICRO | R-RS | NC | D | .50 |
| 41MD47 | MICRO | R-RS13 | NC | D | .50 |
| 41MD9 | MICRO | SW-186 | NC | D | .50 |
| 41MC10 | MICRO | WP3M5 | NC | AA | 50 |
| 41MC4 | MICRO | WP5M3 | NC | AA | .50 |

| Stock # | Mfr. | Type # | Contact | Fig. | Price |
|---|---|---|---|---|---|
| 41MD53 | MICRO | WP5M5 | NC | AA | .50 |
| 41MC27 | MICRD | WZ2RST | NC | D | .55 |
| 41MD48 | MICRO | WZ2RT | NC | C | .65 |
| 41MD33 | MICRO | WZ3PW2 | NC | F | .80 |
| 41MD16 | MICRO | WZ7R | NC | C | .55 |
| 41MD43 | MICRO | WZ7RQ1T | NC | A | .70 |
| 41MC15 | MICRO | WZ7RQT2 | NC | A | .70 |
| 41MD36 | MICRO | WZ7RST | NC | D | .55 |
| 41MC24 | MICRO | WZE7RQTN | NC | Y | 1 45 |
| 41MC23 | MICRO | WZE7RQTN | NC | R | 3.75 |
| 41MD54 | MICRO | WZR8X | NC | X | .80 |
| 41MC9 | MICRO | WZR31 | NC | C | .65 |
| 41MD57 | MICRO | WZR31 | NC | T | .70 |
| 41MD31 | MICRO | WZRD | NC | C | .55 |
| 41MD19 | MICRO | WZRL8 | NC | B | .70 |
| 41ML3 | MICRO | WZRQ41 | NC | W | 65 |
| 41ML2 | MICRO | WZV7RQ9T1 | NC | G | 2 25 |
| 41MC21 | MICRO | X757 | NC | C | .55 |
| 41MO37 | ACRO | XC1A | NC | C | .55 |
| 41MC5 | ACRO | XO45L | SPOT | B | .95 |
| 41MD4 | MICRO | YZ | NO | C | .75 |
| 41MO40 | MICRO | YA2RLE4D13 | NO | B | .70 |
| 41MD24 | MICRO | YZ2YLTC1 | SPDT | B | .95 |
| 41MC1 | MICRO | YZ2YST | SPDT | D | .60 |
| 41MD13 | MICRO | YZ3R3 | NO | C | .60 |
| 41MD56 | MICRO | YZ3RLTC2 | NO | B | .80 |
| 41MC14 | MICRO | YZ3RW2T | NO | F | .90 |
| 41MD49 | MICRO | YZ7RQ9T6 | NO | FF | .85 |
| 41MO32 | MICRO | YZ7RST | NO | D | .60 |
| 41MC13 | MICRO | YZ7RA6 | NO | EE | 1.00 |
| 41MD25 | MICRO | YZRQ1 | NO | A | .80 |
| 41MC20 | MICRO | YZRQ4 | NO | S | .60 |
| 41MD59 | MICRO | YZRQ41 | NO | W | .75 |
| 41MD20 | MICRO | YZ7RQT | NO | K | .65 |
| 41MD42 | MICRO | YZRTX1 | NO | X | .95 |
| 41MC27 | MU | Z | NC | Y | 1.45 |
| 41MD44 | ACRO | Blue Stripe | SPDT | C | .70 |
| 41MD52 | MU | Blue Dot | SPDT | E | .90 |
| 41MC8 | MU | Red Dot | NC | C | .65 |
| 41MD18 | MICRO | Open Type | SPOT | Q | .50 |
| 41MD39 | MU | Green Dot | NO | B | .80 |
| 41MC29 | MU | Green Dot | NO | D | .55 |
| 41MD26 | MAXSON | Preeision | SPDT | B | .95 |

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The limiting action of the induction detector is rather good, although it may be that the gated-beam tube is still better in this respect. Nevertheless, a separate limiter stage is an unnecessary luxury if sufficient signal strength is available to cause plate current variation of 0.2 ma or more. The audio output is sufficient to drive the output stage directly, and if a high-transconductance tube is used, there is enough output to spare for application of frequency-corrected negative feedback.

## Types of tubes to use

As to suitable tube types, the Philips AK2 is best. In American types, the 6K8 is just about as good, but requires slightly higher screen voltage. The 6A7 works nicely, but its output is lower. This is no disadvantage if the receiver is to be used with an existing amplifier. Several other tube types with the required succession of grids probably will also do the job, but it is essential that the capacitance between the control grids be as low as possible.

Although a t.r.f. circuit could be used with the induction detector, a superheterodyne circuit is more efficient because of the high frequencies used for FM broadcast. On the other hand, the detector works best at a rather high frequency. At 20 to 25 mc, single-tuned tube handles FM signals well in the given circuit. As this receiver was designed in Europe, where most areas are served by only one FM station, ganged tuning is not used. Rough tuning is done by the air trimmer C2. The actual tuning is obtained by rotating a shorted turn in the field of the oscillator coil L3. The shorted turn is mounted on the tuning shaft at 45° and inside the oscillator coil, which is fixed to the chassis but also at 45° to the tuning shaft as shown in Fig. 2. L3 itself is 4 turns of No. 15 wire spaced over ⅜ inch and ⅜ inch in diameter. The antenna is pretuned to the signal by C1 and needs no retuning unless the antenna is

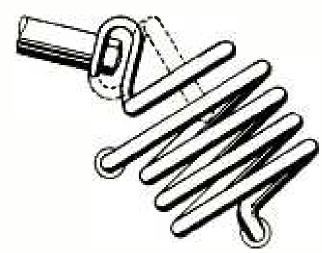


Fig. 2—Detail drawing of the coil L3.

changed. L2 is 3 turns of No. 18 wire, ½ inch in diameter and spaced over ⅜ inch. L1 is 2 turns inside L2.

The i.f. circuits can be tuned either

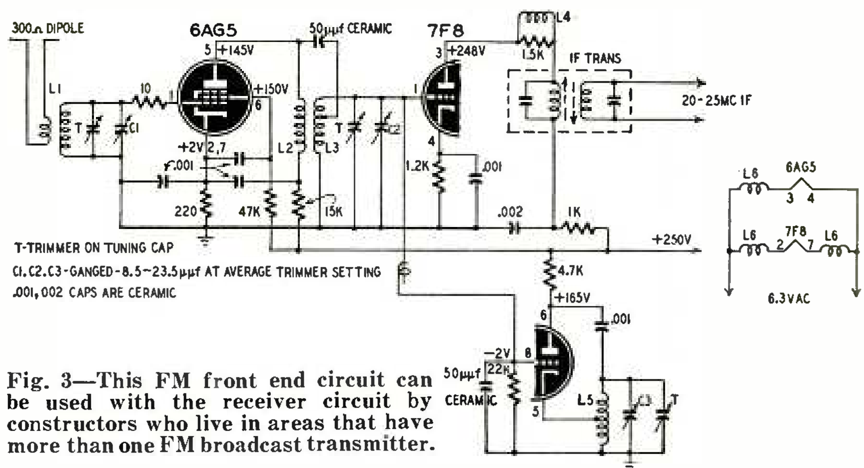



**Fig. 3—This FM front end circuit can be used with the receiver circuit by constructors who live in areas that have more than one FM broadcast transmitter.**

i.f. circuits of practical Q are wide enough to pass the FM signal without undue sideband cutoff. This i.f. falls within the range of ordinary test generators, and the required inductance values are about the size of those used for the short wavebands. High-transconductance tubes are preferable for the i.f. stage, although a small cathode resistor may be needed for stability.

Noise problems do not arise in this receiver, and almost any modern mixer with slugs, with fixed capacitors matching the input and output capacitances of the tubes, or with trimmers. The required inductance is about 1.5 μh.

(This receiver is designed to pick up only one station at a frequency of about 100 mc. Constructors in areas having more than one FM broadcast station may wish to use the front-end circuit shown in Fig. 3, which is from "Simplified FM Receiver Uses Crystal Detector," RADIO-CRAFT for June, 1948. Coil

**Table I—Coil data for circuit of Fig. 3**

| Coil | Turns | Tap (from hot end) | Wire | Form |
|---|---|---|---|---|
| L1* | 2½ | | No. 14 tinned | 3/8-in. inside dia. |
| L2 | 50 | | No. 30 enam. | 5/32-in. dia., 100,000-ohm resistor |
| L3 | 2½ | ½ | No. 14 tinned | 3/8-in. inside dia. |
| L4 | 15 | | No. 22 enam. | 3/16-in. dia., 1,500-ohm resistor |
| L5 | 1½ | ½ | No. 14 tinned | 3/8-in. inside dia. |
| L6 | 25 | | No. 26 enam. | 68,000-ohm, ½-watt resistor |

* Primary is 1½ turns hookup wire inside of L1.
L1, L3, L5 are self-supporting.

data is given in Table I. Another excellent tuner is described in "Low-Noise Front End," in the June, 1950, issue of RADIO-ELECTRONICS. Television sound i.f. transformers, which usually tune either to 21.25 or 21.75 mc, would work well in this circuit. The oscillator, of course, must tune higher than the incoming signal by an amount equal to the i.f. In most front-end circuits, the oscillator adjustment will have sufficient range to do this so that altering the coils is not necessary.—*Editor*)

The induction detector is sensitive to stray hum fields, so that the power transformer must be carefully placed. Grounding the transformer primaries through capacitors will remove some of the hum. Mounting a small horseshoe magnet near the detector will help to remove the final traces of hum. A tuning indicator is essential with this receiver, and a meter is best. Normal current runs between 0.5 and 1 ma in this circuit.

## Tuning and alignment

To align the set, apply a modulated signal between 20 and 25 mc. Tune the grid and plate circuits of the i.f. tube until they peak and the signal is heard. The meter reading will also vary. When both circuits are brought to resonance, tune the auxiliary circuit. The meter will jump suddenly when the i.f. is passed. For the present, tune to the lowest meter reading with the anode feedback trimmer set at minimum capacitance.

Now try to find the FM signal. Tune the antenna circuit and adjust the antenna position and coupling so that the meter reads at least 0.1 ma below the no-signal level. By small variations in the tuning of both tuned circuits of the detector, the deflections above and below the no-signal value should be made the same number of scale divisions on the meter when the receiver is tuned through the FM signal. With too small a signal, the up-scale deflection is greater. Even then, good reception is possible, but not entirely free from noise and interference as an FM signal should be.

Once the set is aligned, the tuning is easy. The correct tuning point is midway between the lowest and the highest meter reading. At the two peaks the sound is distorted and weak. During the first quarter of an hour or so, the oscillator may drift somewhat. After that, no retuning of the receiver is necessary.

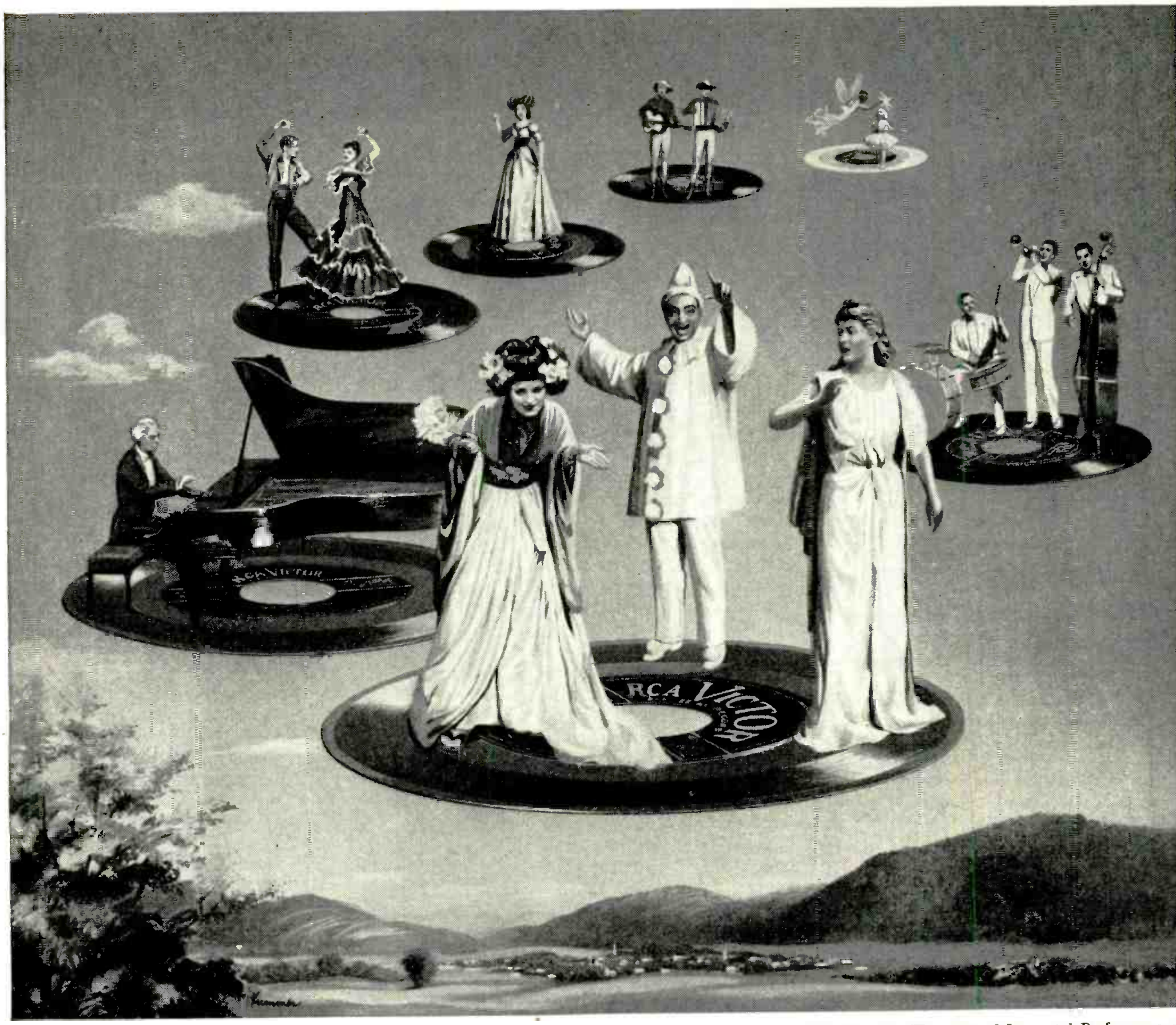
### Materials for Receiver

**Resistors:** 1—15, 1—100, 2—150, 1—270, 1—470, 2—1,000, 1—4,700, 1—6,800, 1—10,000, 2—22,000, 1—47,000, 2—100,000, 1—220,000 ohms, 1/2 watt; 1—1, 1—2.2 megohms, 1/2 watt; 1—3,300, 1—22,000, 1—33,000, 1—220,000 ohms, 1 watt; 1—150 ohms, 1 watt, 5%; 1—500,000 ohms, 1—1 megohm, potentiometers.

**Capacitors:** 1—56 μμf, ceramic; 2—47, 1—100, 1—290, 1—500, 7—2,000 μμf, mica or ceramic; 2—500 μμf, mica; 1—.002, 1—.05 μf, 400 volts, paper; 1—.01 μf, 2,000 volts, paper; 3—16 μf, 450 volts, 1—50 μf, 15 volts, electrolytic; 3—3-30 μμf, trimmers.

**Miscellaneous:** 1—6A7, 1—6F6-G, 1—6BA6, 1—6V6-G, 1—5Y3-G, tubes and sockets; 1—560-volt c.t., 60-ma power transformer with 5- and 6.3-volt windings; 1—10-henry, 60-ma choke; 1—output transformer, 6V6-G plate-to-voice coil; chassis, hookup wire, assorted hardware.

—end—

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## CATHODE-RAY MONOFORMER GENERATES ANY WAVEFORM

The monoformer is a basically new type of cathode-ray tube. Its output varies in any desired manner when a linear input is applied. For example, the output may be controlled to vary as the logarithm, cosine, square root, or any other function of the input that may be desired.

The basic principle of the monoformer, shown in the diagram, is described in Patent No. 2,528,020 issued to D. E. Sunstein and assigned to the Philco Corporation.

A sawtooth wave is applied the horizontal deflectors of the cathode-ray tube. A mask bounded by the desired curve is placed between the tube and a photocell. A lens focuses the flying spot onto the cell. Amplified output is fed back to the vertical deflectors of the tube. The amplifier (not part of the monoformer) should have high sensitivity. Its d.c. output polarity depends upon input-signal strength. When input is zero, A is positive and B is negative. The vertical plates are biased so the spot is at the top of the screen with no input. With maximum input A is negative and B positive. The amplifier has no output when the input is midway between these extremes.

The beam is deflected horizontally by the input voltage. If the spot is *above* the mask boundary at any instant, maximum light strikes the cell. The amplifier drives the upper vertical deflection plate negative, and the spot is driven *downward*.

If the spot is *below* the boundary no light hits the photocell. The polarity of the amplifier output (and vertical deflectors) is reversed. Now the force on the spot is *upward*. Between these two conditions is a position of equilibrium, with the spot centered on the edge of the mask. Because the electron beam has practically no inertia, it will follow the shape of the mask as it is swept across the screen.

The amplifier output is also the output of the system. It is always proportional to the vertical deflection of the spot (voltage across the vertical deflecting plates). If the mask has the shape of some mathematical curve, for example a logarithmic curve or a sine, the monoformer output will be a logarithmic or sine voltage, if the horizontal sweep is linear.

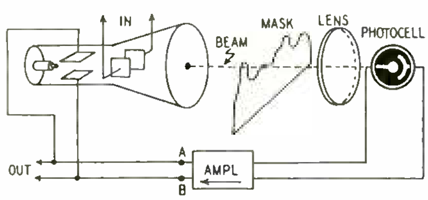
An external mask is convenient because it can be changed or replaced at will. If it is to remain fixed at all times it is better to position it *within* the tube. This simplifies the equipment and eliminates the need for a photocell. In the practical form of Philco monoformer (quantizing tube) the curve is photographically printed on a metal target *within* the tube. This target emits secondary electrons freely. Below the curve the target is treated with a carbon compound to reduce emission. The target is connected to the amplifier which feeds the vertical deflectors of the cathode-ray tube.

The Philco monoformer has a maximum output error of about 2%. Maximum input signal is 50 volts. A maximum output of about 250 volts can be obtained.

The monoformer has many practical applications. Among them are:

1. **Wave analyzer.** The mask can be cut to follow the curve to be analyzed. As the beam follows its path it generates an output proportional to the wave amplitude. This *electrical* output may be analyzed by any electronic analyzer to determine the component frequencies of the curve.

2. **Calculator.** The curve may be drawn to provide an output of any function. For example, it may be the logarithm, cosine, square root, or any other complex function of the input. Two or more monoformers may be connected to add or subtract outputs. Because adding logarithms is equivalent to multiplying numbers, monoformers can be used to multiply, square and do other calculations.

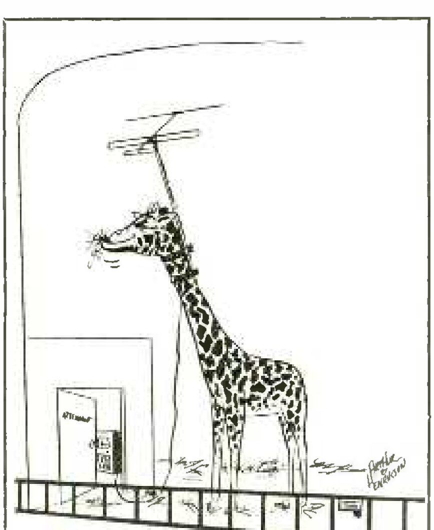



**A diagram to illustrate the monoformer.**

3. **Speech scrambler.** A mask of any complex or usual shape may be used for this purpose. An input speech wave becomes garbled at the output. Unless the mask shape is known, there is little likelihood of unscrambling the speech even with another monoformer.

4. **Compensator.** A known nonlinearity may be corrected or compensated for by introducing the opposite type of error. The required mask may be designed by cut-and-try or calculation to make this correction.

5. **Tone generator.** Tone or timbre depends upon the number and amplitude of harmonics present. By using the proper shape of mask an input frequency remains unchanged, but any number of harmonics may be added as desired.

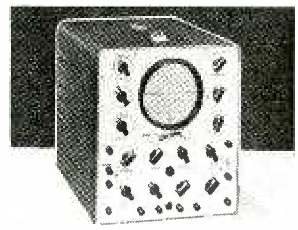


*Suggested by Arthur Henrikson, Chicago, Ill.*

## NEW OSCILLOSCOPE

Hickock Electrical Instrument Co.
Cleveland, Ohio

Intended for general purpose industrial and electronic laboratory use, the model 640 5-inch oscilloscope features high stability and sensitivity. Its wide-band amplifier has a response from d.c. to 4.5 mc (3 db down) and a sensitivity of 10 mv per inch. Maximum input potential is 1,000 volts peak, and input



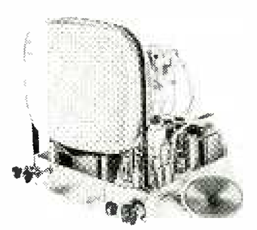
impedance is 2 megohms, 50 μμf. Recurrent and driven sweeps range from 2 cycles to 30,000 cycles, and provision is made for supplying external sweeps of 10 seconds or slower. Sweeps of 30 and 7,875 cycles are provided for observing television patterns.

The instrument is fully shielded, shock-mounted, and has built-in calibrating voltages. An expandable sweep (6 times expansion) is an additional feature.

## TV RECEIVER KIT

Tech-Master Products Co.
New York, N. Y.

Improvements in the 630 type circuit used in these kits bring them up to date as the latest in TV engineering. The major features of the circuit are quick action keyed a.g.c., "hi-sweep" voltage-multiplier system, 12-channel turret tuner, and full 4-mc bandwidth.

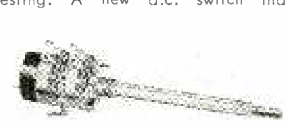


Carefully planned schematic and pictorial diagrams, as well as simple-to-follow instructions, are included. Top quality, circuit aligned components minimize the amount of final adjustments necessary. This kit comes in two models: the de luxe kit, model 630D19, has the principal components mounted in place, while the standard kit, model 630S19, comes unassembled. Both kits are supplied with all components, picture-tube mounting brackets, speaker, and all tubes (less kinescope, wire, and solder.) The chassis measures 21¾-inches wide by 15¾-inches deep.

## DUAL POTENTIOMETERS

P. R. Mallory & Co.
Indianapolis, Ind.

To attain maximum coverage of a great variety of television and auto radio receivers, these dual controls are being sold in subassembly form. The service technician can complete the assembly in less than five minutes, combining control sections of specified ratings for his particular application. The control sections are supplied in factory-assembled form, making possible complete factory inspection and testing. A new a.c. switch makes



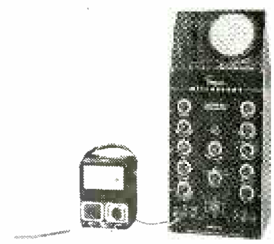
attachment simple and sure by positive indexing and design that permits secure locking in position without removing the control housing.

It has also been announced that the single-section Mallory Midgetrol is now supplied with a permanently fixed, tubular brass shaft that can be adapted in a few sections for split-knurl or flatted type knobs by inserting one of two steel shaft ends contained in every package. The purpose of the new design is to make installation by the serviceman as fast and simple as possible, without sacrificing the stability of a permanently secured shaft.

## SPACE-SAVING SCOPE

Simpson Electric Co.
Chicago, Ill.

The Model 476 Mirroscope is designed to save space on the testing bench. The 5-inch cathode-ray tube is mounted in a vertical position. This construction reduces bench requirements to an area of only 9 x 8-inches. The cathode-ray image is reflected from a high-grade mirror mounted in the adjustable cover at the top of the cabinet; thus the viewing surface is brought near the eye level when the instrument is used on benches of normal height. Mirror and wing sides at top—for deflecting light—fold into the cabinet when it is not in use. Height is 16¼ inches and width 9⅛ inches.

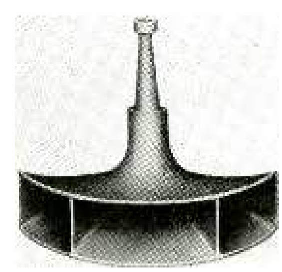


## COBRA-TYPE HORN

Racon Electric Co.
New York, N. Y.

The COB-11 is a cobra-type horn for public address systems requiring a maximum concentration of sound in a horizontal plane. It provides a uniform sound field over a horizontal angle of 120° and a vertical angle of 40°. It is exponentially flared for maximum transfer of energy and has a low-frequency cutoff design point of 250 cycles.

The horn consists of heavy two-piece non-vibratory aluminum casting, designed to withstand severe use both indoors and outdoors. It has a rib reinforced two-section serrated mounting bracket (not illustrated) for coupling to a standard 1¼-inch mounting flange. The horn has a standard thread size to permit attachment of any standard 25-35-watt driver unit.



The COB-11 may also be used as a middle register or high-frequency horn in high-quality audio systems using two or three loudspeakers. The combination of high efficiency, wide angular coverage and low cutoff make it well suited for this purpose.

## POLYPHASE REPRODUCER

Audak Co.
New York, N. Y.

The L-6 G single magnetic unit will play any and all lateral recordings at

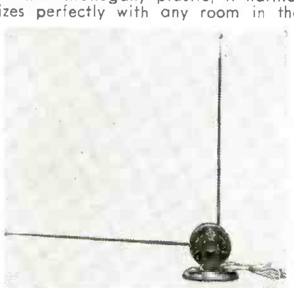
speeds of 33-1/3, 45 or 78 r.p.m. A special connector is available which permits the unit to be plugged into the Garrard changer arm. Once the unit has been plugged in, it becomes a permanent part of the arm, thus eliminating repeated adjustments on the arm.

The point pressure is 8 grams for all discs. The output is approximately 20 mv. Response is from 20 to over 10,000 c.p.s. The sapphire or diamond stylus is easily replaceable.

## INDOOR TV ANTENNA

JFD Manufacturing Co.
Brooklyn, N. Y.

A uniquely designed base, perfectly balanced and weighted, prevents the JFD "Tip-Proof" indoor antenna from tipping or rocking despite full extension of dipoles. Made of engraved satin-finish mohogany plastic, it harmonizes perfectly with any room in the



home. Three-section, triple-chrome-plated telescopic dipoles can be adjusted from 15 to 41 inches for quick and easy orientation. A tension design holds dipoles at any position—collapsed or extended. A felt pad cushions the base of the antenna and protects the finest furniture surfaces.

## WINDOW ANTENNA

Veri-Best Television Products, Inc.
New York, N. Y.

The Bazuka is a high Q single-element coaxial type antenna that works into a 300-ohm input, or into a 72-ohm input with a matching transformer. The bandwidth is broad enough to cover the entire TV band. It has a rising characteristic in the 88- to 108-mc FM band. The distributed capacitance between the inner rod and the outer section tends to lower the effective resonance frequency of the system, similar to end-loading of an antenna by the use of L and C. The efficiency tends to fall slowly around 80 mc on the single Bazuka model W836. It is recommended for locations up to 10 miles from station location.

## OUTPUT TRANSFORMER

Partridge Transformers, Ltd.
Surrey, England

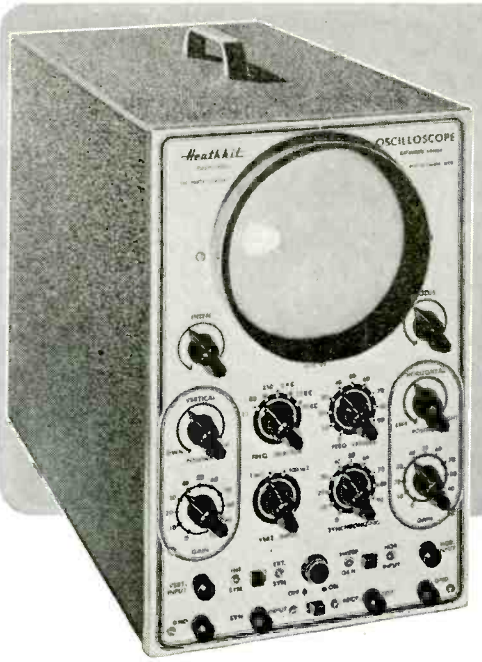
The CF8 series of audio transformers use the latest grain-orientated strip-wound C cores and are built to the highest standards for equipment reproducing the full audio bandwidth with very low distortion. They will satisfy all the requirements of the Williamson circuit, and the 15-octave bandwidth ensures a greater margin of stability, or alternatively, allows a greater degree of feedback.

Power rating is 60 watts from 30 to 30,000 cycles with less than 1% distortion with no negative feedback. The 10,000-ohm primary has a d.c. resistance of 88 ohms in each half and will carry 180 ma continuously. The transformer is hermetically sealed, weighs 10 pounds, and is finished with a durable stove-enamel bronze. Many of the larger American distributors now carry Partridge audio transformers in stock.

## U.H.F. ANTENNA

Workshop Associates, Inc.
Needham Heights, Mass.

The model 6HW is a high-gain beacon antenna for 450 to 470 mc. Over-all gain is nearly 8 db. the vertical radiation pattern is narrowed to concentrate energy on the horizon, and horizontal radiation is nondirectional. Impedance is 50 ohms with a voltage standing-wave ratio of less than 2 to 1. The antenna is designed especially for u.h.f. mobile service where higher-gain antennas are required.




# *Heathkit* MODEL 0-6 . . . PUSH-PULL . . . 5" OSCILLOSCOPE KIT

The new Heathkit 5" Push-Pull Oscilloscope Kit is again the best buy. No other kit offers half the features — check them.

Measure either AC or DC on this new scope — the first oscilloscope under $100.00 with a DC amplifier.

The vertical amplifier has frequency compensated step attenuator input into a cathode follower stage. The gain control is of the non frequency discriminating type—accurate response at any setting. A push-pull pentode stage feeds the CR tube. New type positioning control has wide range for observing any portion of the trace.

The horizontal amplifiers are direct coupled to the CR tube and may be used as either AC or DC amplifiers. Separate binding posts are provided for AC or DC.

The multivibrator type sweep generator has new frequency compensation for the wide range it covers: 15 cycles to over 100,000 cycles.

The new model 0-6 scope uses 10 tubes in all, including 5" CR tube. Has improved amplifiers for better response useful to 2 megacycles. Tremendous sensitivity .04V RMS per inch horizontal — .09V RMS per inch vertical. Only Heathkit Scopes have all the features.

New husky heavy duty power transformer has 50% more laminations. It runs cool and has the lowest possible magnetic field. A complete electrostatic shield covers primary and other necessary windings and has lead brought out for proper grounding.

The new filter condenser has separate sections for the vertical and horizontal screen grids and prevents interaction between them. An improved intensity circuit provides almost double previous brilliance and better intensity modulation.

A new synchronization circuit allows the trace to be synchronized with either the positive or negative pulse, an important feature in observing the complex pulses encountered in television servicing.

Model 0-6............ Shipping Wt. 24 lbs.

**$39.50**

The magnetic alloy shield supplied for the CR tube is of new design and uses a special metal developed by Allegheny Ludlum for such applications.

The kit is complete, all tubes, cabinet, transformer, controls, grid screen, tube shield, etc. The instruction manual has complete step-by-step assembly and pictorials of every section. Compare it with all others and you will buy a Heathkit.

## NEW INEXPENSIVE *Heathkit* ELECTRONIC SWITCH KIT

The companion piece to a scope — Feed two different signals into the switch, connect its output to a scope, and you can observe both signals — each as an individual trace. Gain of each input is easily set (gain A and gain B controls), the switching frequency is simple to adjust (coarse and fine frequency controls) and the traces can be superimposed for comparison or separated for individual study (position control).

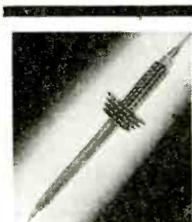
Use the switch to see distortion, phase shift, clipping due to improper bias, both the input and output traces of an amplifier, — as a square wave generator over limited range.

The kit is complete; all tubes, switches, cabinet, power transformer and all other parts, plus a clear detailed construction manual.

Model S-2
Shipping Wt. 11 lbs.

**$19.50**

## *Heathkit* 30,000V DC PROBE KIT



A new 30,000 V DC Probe Kit to handle high voltages with safety. For TV service work and all other high voltage applications. Sleek looking — Two color molded plastic — Red body and guard — jet black handle. Comes with connector, cable, and PL55 type plug. Plugs into Heathkit VTVM so that 300V scale is conveniently multiplied by 100. Can be used with any standard 11 megohm VTVM.

**$5.50**

No. 336 High Voltage Probe Kit........Shipping Wt. 2 lbs.

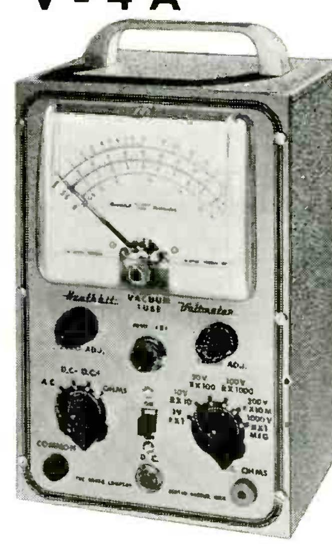
## *Heathkit* RF PROBE KIT

This RF Probe Kit comes complete with probe housing, crystal diode detector, connector, lead and plug and all other parts plus clear assembly instructions. Extends range of Heathkit VTVM to 250 Mc. ± 10%. Works on any 11 megohm input VTVM. Specify No. 309 RF Probe Kit.

Shipping Wt. 1 lb.

**$5.50**

## *New* MODEL V-4A *Heathkit* VTVM KIT




The new Heathkit Model V-4A VTVM Kit measures up to 30,000 Volts DC and 250 megacycles when used with accessory probes — think of it, all in one electronic instrument more useful than ever before. The AC Voltmeter is so flat and extended in its response (± 1 db from 20 cycles to 2 megacycles) that it eliminates the need for separate expensive AC VTVM's.

The new 200 microampere, 4½" streamline meter with quality Simpson movement (five times as sensitive as the commonly used 1 MA meter) has a shatter proof plastic meter face for maximum protection. Meter has all the desirable scales and indicates AC volts, DC volts, ohms, db (direct reading), and even has a special zero center marking for quick FM alignment.

There are six complete ranges for each function. Four functions give total of 24 ranges. The 3 volt range allows 33⅓% of the scale for reading 1 volt, as against only 20% of the scale on the 5 volt types.

New ½% ceramic precision resistors are the most accurate commercial type available — you find the same make and quality in the finest laboratory equipment selling for thousands of dollars. The entire voltage divider decade uses these ½% resistors.

Model V-4A ..... Shipping Wt. 8 lbs.

*Note New Low Price*

**$23.50**

Both AC and DC voltmeter measurements use a push-pull electronic voltmeter circuit, and the meter circuit makes the meter burn-out proof. Electronic ohmmeter circuit measures resistance over the amazing range of 1/10 ohm to one billion ohms, all with internal 3 volt battery. Ohmmeter batteries mount on the chassis in snap-in mounting for easy replacement.

Voltage ranges are full scale — 3 Volts, 10 Volts, 30 Volts, 100 Volts, 300 Volts, 1000 Volts. Complete decading coverage without gaps.

The DC probe is isolated for dynamic measurements. Negligible circuit loading. Gets the accurate reading without disturbing the operation of the equipment under test. Kit comes complete: cabinet, transformer, Simpson meter, test leads, complete assembly and instruction manual.

EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 E. 40th ST.
NEW YORK CITY (16)
CABLE: ARLAB-N.Y.

**The HEATH COMPANY**

**. . . BENTON HARBOR 20, MICHIGAN**

NEW

# *Heathkit* TV ALIGNMENT GENERATOR KIT

Here is an excellent TV Alignment Generator designed to do TV service work quickly, easily, and properly. The model TS-2 when used in conjunction with an oscilloscope provides a means of correctly aligning television receivers.

The instrument provides a frequency modulated signal covering, in two bands, the range of 10 to 90 Mc. and 150 to 230 Mc. — thus, ALL ALLOCATED TV CHANNELS AS WELL AS IF FREQUENCIES ARE COVERED.

An absorption type frequency marker covers from 20 to 75 Mc. in two ranges — therefore, you have a simple, convenient means of frequency checking of IF's, independent of oscillator calibration.

Sweep width is controlled from the front panel and covers a sweep deviation of 0-12 Mc. — all the sweep you could possibly need or want.

And still other excellent features are: Horizontal sweep voltage available at the front panel (and controlled with a phasing control) — both step and continuously variable attenuation for setting the output signal to the desired level — a convenient instrument stand-by position — vernier drive of both oscillator and marker tuning condensers — and blanking for establishing a single trace with base reference level. Make your work easier, save time, and repair with confidence — order your Heathkit TV Alignment Generator now!

**$39.50**

Model TS-2
Shipping Wt. 20 lbs.

## *Heathkit* SIGNAL GENERATOR KIT

The new Heathkit Signal Generator Kit has dozens of improvements. Covers the extended range of 160 Kc to 50 megacycles on fundamentals and up to 150 megacycles on useful calibrated harmonics; makes this Heathkit ideal as a marker oscillator for TV. Output level can be conveniently set by means of both step attenuator and continuously variable output controls. Instrument has new miniature HF tubes to easily handle the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The kit is transformer operated and a husky selenium rectifier is used in the power supply. All coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers. Comes complete, all tubes, cabinet, test leads, every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator.

Model SG-6
Shipping Wt. 7 lbs.

**$19.50**

## *Heathkit* SIGNAL TRACER and UNIVERSAL TEST SPEAKER KIT

The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — finds defective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast, FM, or TV receivers. The test speaker has an assortment of switching ranges to match either push-pull or single output impedances. Also tests microphones, pickups and PA systems. Comes complete: cabinet, 110V 60 cycle power transformer, tubes, test probe, all necessary parts, and detailed instructions for assembly and use.

Model T-2
Shipping Wt. 7 lbs.

**$19.50**

## *Heathkit* CONDENSER CHECKER KIT

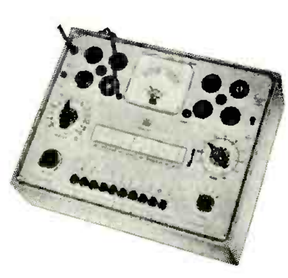
Checks all types of condensers — paper, mica, ceramic, electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power factor of electrolytics between 0% and 50% and reads resistance from 100 ohms to 5 megohms. The magic eye indicator makes testing easy.

The kit is 110V 60 cycle transformer operated and comes complete with rectifier tube, magic eye tube, cabinet, calibrated panel and all other parts. Has clear detailed instructions for assembly and use.

**$19.50**

Model C-2 .......... Shipping Wt. 6 lbs.

## *Heathkit* TUBE CHECKER KIT



Test your tubes the modern way — dynamically — the simplest, yet fastest and surest method — your Heathkit has a switch for each tube element and measures that element — no chance for open or shorted elements slipping by, all the advantages of the mutual conductance type without the slow cumbersome time consuming setups. Checks for opens, shorts, each element individually, filament and filament tap continuity, and emission.

This Tube Checker has all the features — beautiful 3 color BAD-?-GOOD meter — complete selection of voltages — roller chart listing hundreds of tubes including the new 9 pin miniatures — finest quality Centralab lever switches — high grade birch, counter-type cabinet — continuously variable line adjust control — every feature you need to sell tubes properly. The most modern type tube checker with complete protection against obsolescence. Uses only the best of parts — rugged oversize 110V 60 cycle power transformer, finest of Mallory and Centralab switches and controls, complete set of sockets for all type tubes with blank spare for future types. Fast action, gear driven roller chart quickly locates the setting for any type tube. Simplified switching cuts necessary testing time to a minimum and saves valuable service time. Simple method allows instant setup of new tube types without waiting for factory data. No matter what the arrangement of tube elements is, the Heathkit flexible switching method easily handles it. Order your Heathkit Tube Checker Kit today and see for yourself that Heath again saves you two-thirds and yet retains all the quality. Complete with instructions, all parts, and cabinet.

Model TC-1
Shipping Wt. 12 lbs.

**$29.50**

## NEW *Heathkit* HANDITESTER KIT

A precision portable volt-ohm-milliammeter. Uses only high quality parts — All precision ½% resistors, three deck switch for trouble-free mounting of parts, specially designed battery mounting bracket, smooth acting ohm adjust control, beautiful molded bakelite case, 400 microamp meter movement, etc.

DC and AC voltage ranges 10-30-300-1000-5000V. Ohms range 0-3000 and 0-300,000 Range Milliamperes 0-10 Ma. 0-100 Ma. Easily assembled from complete instructions and pictorial diagrams.

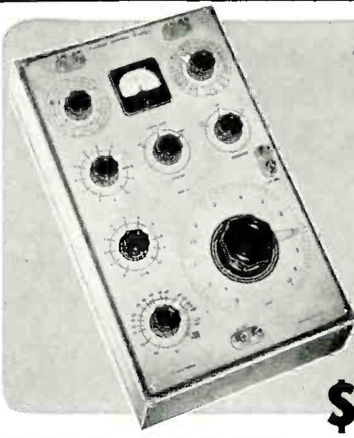
**$13.50**

Model M-1 .......... Shipping Wt. 3 lbs.

EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 E. 40th ST.
NEW YORK CITY (16)
CABLE: ARLAB-N.Y.

# *The* HEATH COMPANY

... BENTON HARBOR 20, MICHIGAN



## NEW *Heathkit* IMPEDANCE BRIDGE KIT

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 megohms, capacitance from .00001 MFD to 100 MFD, inductance from 10 microhenries to 100 henries, dissipation factor from .002 to 1, and storage facror from 1 to 1000. And you don't have to worry about selecting the proper bridge circuit for the various measurements — the instrument automatically makes the correct circuit when you set up for taking the measurement you want. Bridge utilizes Wheatsone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and General Radio 1000 cycle hummer. No external generator required — has provisions for external generator if measurements at other than 1000 cycles are desired.

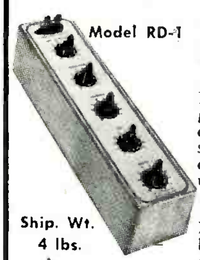
Kit utilizes only highest quality parts. General Radio main calibrated control, General Radio hummer, Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, ½% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

Take the guesswork out of electrical measurements — order your Heathkit Impedance Bridge Kit today — you'll like it.

**$69.50**

Model IB-1B....Shipping Wt. 15 lbs.

## *Heathkit* LABORATORY RESISTANCE DECADE KIT



Model RD-1

Ship. Wt. 4 lbs.

**$19.50**

An indispensable piece of laboratory equipment — the Heathkit Resistance Decade Kit gives you resistance settings from 1 to 99,999 ohms IN ONE OHM STEPS. For greatest accuracy, ½% precision ceramic-body type resistors and highest quality ceramic wafer switches are used.

Designed to match the impedance bridge above, the Resistance Decade Kit has a beautiful birch cabinet and attractive panel. It's easy to build, and comes complete with all parts and construction manual.

## *Heathkit* LABORATORY POWER SUPPLY KIT

Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source.

Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts — Ma switch provides choice of output metering. A large, plainly marked, and direct reading meter scale indicates either DC voltage output in volts or DC current output in Ma. (Range of meter 0-500V DC, 0-200 Ma DC). Instrument has convenient stand-by position and pilot light.

Comes with power transformer, filament transformer, meter, 5Y3 rectifier, two 1619 control tubes, completely punched and formed chassis, panel, cabinet, detailed construction manual, and all other parts to make the kit complete.

LIMITS:

| | |
|---|---|
| No load | Variable 150-400V DC |
| 25 Ma | Variable 30-310V DC |
| 50 Ma | Variable 25-250V DC |
| Higher loads | Voltage drops off proportionally |

Model PS-1
Ship. Wt. 20 lbs.

**$29.50**

## *Heathkit* BATTERY ELIMINATOR KIT

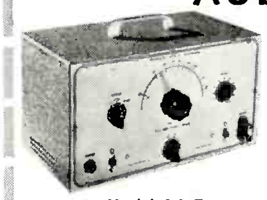
Model BE-2
Ship. Wt. 19 lbs.

**$22.50**

A few auto radio repair jobs will pay for the Heathkit Battery Eliminator Kit. It's fast for service. The voltage can be lowered to find sticky vibrators or raised to ferret out intermittents. Provides variable DC voltage 5 to 7½ Volts at 10 Amps. continuous or 15 Amps. intermittent.

Also serves as storage battery charger. A well filtered, rugged power supply uses heavy duty selenium rectifier, a husky choke, and a 4000 MFD electrolytic condenser for clean DC. 0-15V voltmeter indicates output which is variable in eight steps. Better be equipped for all types of service — it means more income.

## NEW *Heathkit* SINE and SQUARE WAVE AUDIO GENERATOR KIT



Model AG-7
Ship. Wt. 15 lbs.

**$34.50**

We proudly present the NEW MODEL Sine and Square Wave Audio Generator Kit. Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed waveshapes right at your fingertips — the sine wave and the square wave.

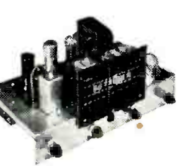
The range switch and plainly calibrated frequency scale give rapid and easy frequency selection, and the output control permits setting the output to any desired level.

A high-low impedance switch sets the instrument for either high or low impedance output — on high to connect to high impedance load, and on low to work into a low impedance transformer with negligible DC resistance.

Coverage is from 20 to 20,000 cycles, and distortion is at a minimum — you can readily trust the output waveshape.

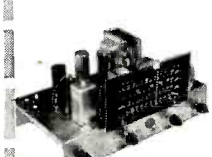
6 tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, ½% precision resistors in the frequency determining circuit, and all other parts come with the kit — plus, a complete construction manual. A tremendous kit, and the price is truly low.

## TWO HIGH QUALITY *Heathkit* SUPERHETERODYNE RECEIVER KITS



Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt. 10 lbs.

**$19.50**



Model AR-1 3 Band Receiver Kit covers 55 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt. 10 lbs.

**$23.50**

Two new Heathkits. Ideal for schools, replacement of worn out receivers, amateurs and custom installations.

Both are transformer operated quality units. The best of materials used throughout — six inch calibrated slide rule dial — quality power output transformers — dual iron core shielded I.F. coils — metal cased filter condenser. The chassis has phono input jack, 110 Volt output for phono motor, and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.

## *Heathkit* FM TUNER KIT

Model FM-2

Ship. Wt. 9 lbs.

**$22.50**

The Heathkit FM Tuner Model FM-2 was designed for best tonal reproduction. The circuit incorporates the most desirable FM features — true FM.

Utilizes 8 tubes: 7E5 Oscillator, 6SH7 mixer, two 6SH7 IF amplifiers, 6SH7 limiter, two 7C4 diodes as discriminator, and 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. Has ready wound and adjusted RF coils, and 2 stages of 10.7 Mc IF (including limiter). A calibrated six inch slide rule dial has vernier drive for easy tuning. All parts and complete construction manual furnished.

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## VARIABLE GROOVE SPACING

To get full dynamic range of music in disc recording, ample space must be left between adjacent grooves for the greater lateral cutting during the loudest passages. However, in most music, the loudest passages occur only occasionally, so that most of this space between adjacent grooves is wasted.

The German physicist Eduard Rhein has developed an electronic brain which computes the groove spacing and controls the cutter so that the spacing is continuously variable and is correct for the actual requirements of the music at any instant. (Another device for variable pitch recording was described in "Unusual Techniques in Sound Recording" in RADIO-ELECTRONICS for May, 1950.)

The problem with such a device is that the electronic brain must compute its instructions a fraction of a second in advance so that it can warn the cutter to keep clear of the preceding groove as a loud passage is about to occur, or so that it can allow the cutter to approach the preceding groove without risk. This particular system operates by having volume level of the music previously recorded. This recording controls the computing device which in turn controls the cutter.

With the Rhein system, the playing time of the average dance record is increased appreciably, a 10-inch record becoming about equivalent to a 12-inch record of standard type. In symphonic music, the dynamic range can be increased to the point where it is equivalent to that of the live music.

## 14-TUBE TELEVISER

A new television receiver design using only 14 tubes and having a 17-inch rectangular picture tube was announced recently by the Air Marshal Corporation of Brooklyn, N. Y. The result of considerable engineering work, the new set is said to have ample sweep and brightness for a 20-inch tube. It will be available in both console and table models.

One feature of the Air Marshal is what is called a "universal service plan." Dealers or distributors will have spare chassis available. Should trouble develop, the repairman need only remove four screws, slip out the chassis and replace it with a spare. This permits all repair work to be done at a central shop where complete equipment and specialized technicians will be available. Distributor plans for the new receiver are not yet complete, but several have already been appointed.

## PLASTIC PROJECTION LENS

A plastic lens, 22½ inches in diameter, has been designed by the Polaroid Company to project a 15 x 20-foot TV picture on a screen. Said to be the largest ever manufactured commercially for the Schmidt optical system, the lens has already been installed in about a dozen theater systems. The cost of such a plastic lens is only a fraction of the cost of a similar glass unit.

# DESIGN TECHNIQUES FOR V.H.F. AND U.H.F.

By B. E. PARKER*

V.H.F. and u.h.f. design, construction, and service use techniques which are completely ignored at shortwave and broadcast frequencies. These techniques are not complicated, though at times it may appear that those "in the know" are trying to make them so.

Actually it is a matter of adjusting our thinking to include such things as distributed capacitance, inductance, etc., in the v.h.f. design or service problem. We can still make capacitors behave as capacitors instead of inductors, and r.f. chokes still appear as inductances instead of capacitors, if we select the proper types.

Distributed capacitance, distributed inductance, etc., sound like formidable engineering terms, but we need not use the engineering approach if we accept the fact that every piece of wire regardless of how short or long, has distributed capacitance and distributed inductance. The best example is the familiar hairpin coil used on television tuners and by hams in their v.h.f. transmitters.

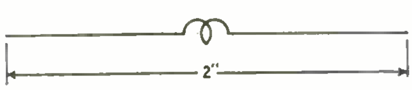



Fig. 1—A 2-inch lead has significant self inductance at v.h.f. and u.h.f.

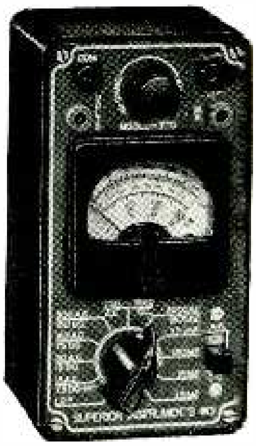
Fig. 1 illustrates schematically, the inductance of a piece of wire 2 inches long. The inductance is small; in fact, so small that it can be ignored completely in the broadcast band. Take that same inductance of this piece of wire and insert it in the screen bypass circuit of a v.h.f. or u.h.f tube as shown in Fig. 2. This is exactly the same as inserting an r.f. choke in series with the bypass capacitor which destroys all r.f. bypassing action of the capacitor, and causes oscillations or instability. From this, we readily deduce that capacitors with inch-long leads have no place in v.h.f. circuits.

**V.h.f. and u.h.f. capacitors**

We have reached the conclusion that v.h.f. and u.h.f. capacitors should not have long leads because of the effective series inductance. Commercially available capacitors may have even more effective series inductance due to their construction. Paper capacitors are perhaps the worst offenders of built-in inductance because they are wound. This increases the inductance in the same way as winding a straight piece of wire into several turns.

Paper capacitors are not usable above 30 mc because of this inherent inductance. They also have another disad-

*Engineering Head, V.H.F. Dept., Gates Radio Co., Quincy, Ill.



*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 I Mil. D'Arsonval type meter. Some 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. **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.

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

**$14.90 NET**

*Superior's New Model 670*

# 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 Amperes
**RESISTANCE:** 0 to 500/100,000 Ohms 0 to 10 Megohms
**CAPACITY:** .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
**REACTANCE:** 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
**INDUCTANCE:** 1.75 to 70 Henries 35 to 8,000 Henries
**DECIBELS:** — 10 to + 18 + 10 to + 38 + 30 to + 58

**ADDED FEATURE:**

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

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

**$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.
- Tests for "shorts" and "leakages" up to 5 Megohms.
- 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.

**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 leakage even when the frequency is one per minute.

***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 external connections.***

***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. Size 11½" x 13" x 6". Shipping Weight 15 lbs.***

**$47.50 NET**

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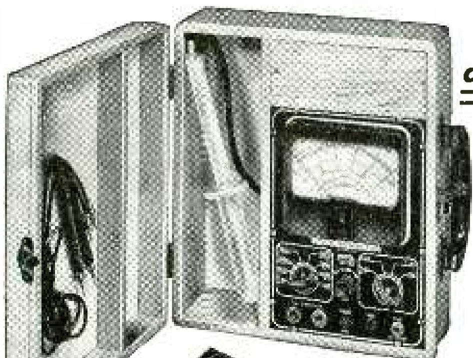
**GENERAL ELECTRONIC DISTRIBUTING CO.** DEPT. RC-5, 98 PARK PLACE NEW YORK 7, N. Y.

*Superior's New Model TV-20*



Ultra H. F. Voltmeter Probe converts Model TV-20 into Negative Peak-Reading H. F. Voltmeter.

# 20,000 OHMS PER VOLT MULTI-METER and TELEVISION KILOVOLTMETER

The Model TV-20 was designed to provide all the multi-meter measurement requirements of A. M., F. M. and Television. Unlike other recent models, which are actually standard V.O.M.'s converted to test the new Television Voltages, the Model TV-20 is a completely new unit. It provides the sensitivity, ranges and accessories which are needed to service F. M. and Television in addition to A. M. Radio. The High Voltage Probe for example, with a range of 50,000 volts and designed to withstand 100,000 volts, is an integral part of the instrument with a special compartment for housing it when not in use.

**SPECIFICATIONS**

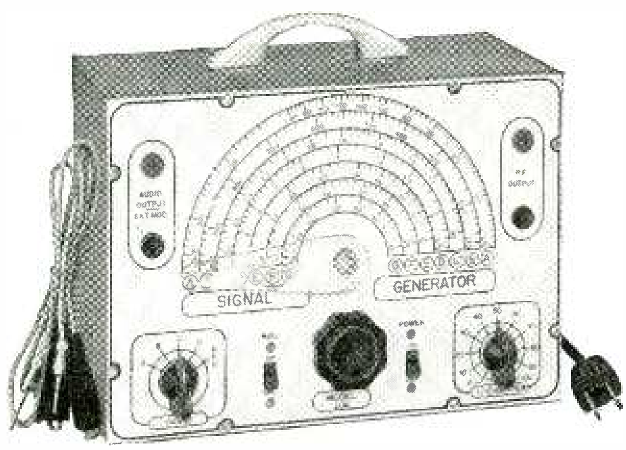
- 9 D. C. VOLTAGE RANGES: (At 20,000 ohms per Volt) 0-2.5/10/50/100/250/500/1,000/5,000/50,000 Volts
- 8 A. C. VOLTAGE RANGES: (At 1,000 ohms per Volt) 0-2.5/10/50/100/250/500/1,000/5,000 Volts
- 5 D. C. CURRENT RANGES 0-50 Microamperes, 0-5/50/500 Milliamperes, 0-5 Amperes
- 4 RESISTANCE RANGES: 0-2,000/20,000 ohms, 0-2/20 Megohms,
- 7 D. B. RANGES: (All D. B. ranges based on ODb = 1 Mv. into a 600 ohm line)
  — 4 to + 10 db + 8 to + 22 db + 28 to + 42 db + 42 to + 56 db
  + 22 to + 36 db + 36 to + 50 db + 48 to + 62 db
- 7 OUTPUT VOLTAGE RANGES: 0 to 2.5/10/50/100/250/500/1,000 Volts

The Model TV-20 operates on self-contained batteries. Comes housed in beautiful hand-rubbed oak cabinet complete with portable cover. Built-in High Voltage Probe. H. F. Probe. Test Leads and all operating instructions. Measures 4½" x 10¼" x 11½". Shipping Weight 10 lbs.

**$39.95 NET**

*The New Model 200*

# AM and FM SIGNAL GENERATOR




★ **R.F. FREQUENCY RANGES:** 100 Kilocycles to 150 Megacycles.

★ **MODULATING FREQUENCY:** 400 Cycles. May be used for modulating the R.F. signal. Also available separately.

★ **ATTENUATION:** The constant impedance attenuator is isolated from the oscillating circuit by the buffer tube. Output impedance of this model is only 100 ohms. This low impedance reduces losses in the output cable.

★ **OSCILLATORY CIRCUIT:** Hartley oscillator with cathode follower buffer tube. Frequency stability is assured by modulating the buffer tube.

★ **ACCURACY:** Use of high-Q permeability tuned coils adjusted against 1/10th of 1% standards assures an accuracy of *1% on all ranges from 100 Kilocycles to 10 Megacycles* and an accuracy of 2% on the higher frequencies.

★ **TUBES USED:** 12AU7—One section is used as oscillator and the second is modulated cathode follower. T-2 is used as modulator. 6C4 is used as rectifier.

The Model 200 operates on 110 Volts A.C. Comes complete with output cable and operating instructions.

**$21.85 NET**

*Superior's New Model TV-30*

# TELEVISION SIGNAL GENERATOR


**ENABLES ALIGNMENT OF TELEVISION I. F. AND FRONT ENDS WITHOUT THE USE OF AN OSCILLOSCOPE!**

**FEATURES** Built-in modulator may be used to modulate the R. F. Frequency, also to localize the cause of trouble in the audio circuits of T. V. Receivers.

Double shielding of oscillatory circuit assures stability and reduces radiation to absolute minimum. All I. F. frequencies and 2 to 13 channel frequencies are calibrated direct in Megacycles on the Vernier dial. Markers for the Video and Audio carriers within their respective channels are also calibrated on the dial.

Stability assured by cathode follower buffer tube and double shielding of component parts.

**SPECIFICATIONS** Frequency Range: 4 Bands—No switching; 18-32 Mc., 35-65 Mc., 54-98 Mc., 150-250 Mc.

Audio Modulating Frequency; 400 cycles (Sine Wave). Attenuator: 4 position, ladder type with constant impedence control for fine adjustment.

Model TV-30 comes complete with shielded co-axial lead and all operating instructions. Measure 6" x 7" x 9".

**$33.95 NET**

# MONEY BACK GUARANTEE!!

**GENERAL ELECTRONIC DISTRIBUTING CO.** DEPT. RC-5 98 PARK PLACE, NEW YORK 7, N. Y. Phone REctor 2-1677

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vantage which is apparent at high frequencies. Their insulation is less effective and the power factor increases. From an r.f. viewpoint, the poor power factor might make the capacitor appear as in Fig. 3-a, 3-b or even 3-c. Obviously, a bypass capacitor which has a series resistor has little value as an r.f. bypass.

Molded mica capacitors have less built-in inductance but they must be used cautiously in v.h.f. bypass circuits. A typical molded mica capacitor of .002 μf with leads less than ¼ inch long has a resonant circuit *within itself* at approximately 40 mc. This resonance is due to the short leads and the small amount of inductance inherent in its construction. At all frequencies above 40 mc, this capacitor behaves toward r.f. as if it were a small coil or inductance.

Molded mica capacitors have somewhat better power factor than paper units. The actual power factor depends on the material used for molding the case. Cases of low-loss v.h.f. material, of course, have much better power factors.

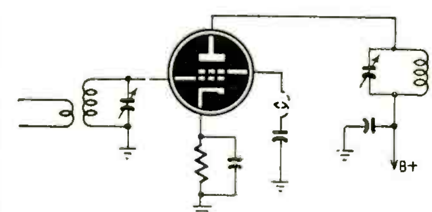



Fig. 2—Schematic showing the effect of lead length in a screen bypass circuit.

Ceramic capacitors find wide use in v.h.f. and u.h.f. circuits since they can be built economically to have very low inductance and good power factor. In fact, a typical ceramic bypass capacitor of 100 μμf with ¼-inch leads may have a self-resonant frequency as high as 400 or 500 mc. Ceramic capacitors have another desirable characteristic: they take up very little space on the chassis. New v.h.f. and u.h.f. designs use ceramic capacitors in both front end and i.f. stages.

In tuned circuits, ceramic capacitors are useful as drift-compensating elements as they can be built to have almost any drift characteristic. With proper selection of the ceramic mixture the capacitance can be increased in direct relation to an increase or decrease in temperature. For the most part, ceramic capacitors of the large-value bypass type have a negative temperature coefficient. Their capacitance decreases as the temperature increases. In service and maintenance this factor must be considered if the capacitor is used in a tuned circuit; otherwise, drift and detuning will result.

## Resistors for v.h.f.

Resistors in tuned circuits or r.f. circuits at v.h.f. are no longer purely resistive elements. A typical carbon resistor schematically appears as in Fig. 4. The shunt capacitance is due

largely to the capacitance between the carbon granules and the end terminations.

In a typical 1-watt, 100,000-ohm resistor the effective resistance or impedance may fall as low as 40,000 ohms at 150 mc. The higher the resistance value, the greater the deviation from the actual value as the frequency is increased. A typical 50-ohm resistor may not decrease below 30 or 40 ohms at 150 mc, while a 500,000-ohm unit of the same type would decrease to 200,000 or 300,000 ohms—a much greater percentage.

Generally a ½-watt resistor suffers less from this than does its larger 1-watt brother of the same brand. This sensitivity to frequency varies from brand to brand, and even somewhat from batch to batch of the same brand.

Because of frequency sensitivity of

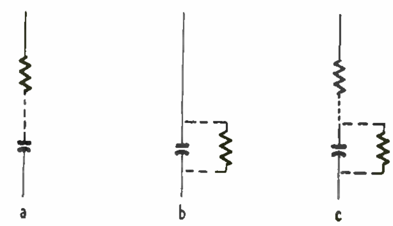



**Fig. 3— Capacitor losses and power factor due to the material and construction**

resistors, the exact replacement, both brand and wattage, should be used in v.h.f. equipment if the resistor carries r.f. or is closely related with an r.f. circuit.

## R.f. chokes

In v.h.f. design and servicing, r.f. chokes are selected according to frequency. A good r.f. choke at 60 mc may

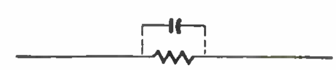


**Fig. 4—At v.h.f., a carbon resistor has in effect a capacitor in parallel.**

be worthless at 150 mc. In fact, it probably will be capacitive. It is becoming practice to rate r.f. chokes according to their effective frequency range. Fig. 5 illustrates the frequency ratings of a typical line of r.f. chokes.

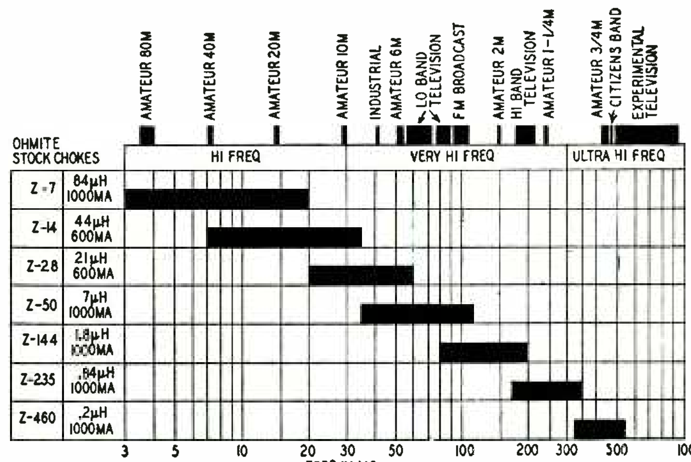
The reason for rating r.f. chokes is apparent if we examine them closely. Between each adjacent turn of wire and all other turns is a certain amount of capacitance. Fig. 6-a illustrates this effect. Collectively, these capacitances might be represented as one value as in Fig. 6-b. The frequency at which this distributed capacitance and the normal inductance of the choke form a parallel resonant circuit is the frequency where the choke is most effective. It offers the highest impedance to this frequency. Below this frequency, the choke acts as an inductance but at higher frequencies it acts like a capacitor. Obviously we must choose r.f. chokes to avoid this capacitive effect. This is the reason for rating r.f. chokes according to frequency range in addition to the usual inductance value.

## Insulation material

Bakelite, which is a good insulator in the broadcast and shortwave bands, is a rather poor insulator for v.h.f. and u.h.f. For this reason, other materials must be used for sockets, coil forms, variable capacitor support, etc. Mica-filled bakelite, while not the best, performs well at v.h.f. Sockets made from this material have relatively low loss and still have the mechanical strength and convenience of the Bakelite socket. Ceramic properly glazed is a good v.h.f. insulator and is used rather extensively for sockets and insulation.

Polystyrene is an excellent insulator easily molded into sockets and insulators. For sockets it has the handicap that heat developed in soldering to the socket terminals may melt the polystyrene. Soldering must be done very carefully. This is not too much of a handicap for the service technician or ham, but it does hamper fast production and assembly line techniques.

Glass-bonded mica, marketed under the trade names of Mycalex and Mykroy, is another good v.h.f. and u.h.f. insulator. It is easily molded, yet is resistant to heat under 800 to 1,000°.



*Courtesy Ohmite Mfg. Co.*

Fig. 5—Chart of frequency ranges of stock Ohmite chokes.

## Chassis material

Chassis material is very important at v.h.f. and u.h.f. because of skin effect. At high frequencies current tends to travel on the surface or skin instead of throughout the entire material thickness as it does at low frequencies. Therefore we must use high-conductivity chassis material if we use the chassis as a return circuit.

Silver is the best material but is too costly for most uses. Silver plating, however, is used extensively. It is usually as good as solid silver since the v.h.f. and u.h.f. currents do travel on the surface. Coils and capacitors in high-performance commercial equipment are often plated.

Since plating is hardly feasible for the average experimenter or service technician, the next best is copper with a mirror-smooth surface. To preserve this surface and prevent oxidation, a coat of clear lacquer is used. Clear fingernail polish or linoleum lacquer is satisfactory.

Aluminum is the next best material for chassis. Relatively inexpensive, it can be worked with simple hand tools. A *polished* aluminum surface is an excellent v.h.f. and u.h.f. conductor as well as one of the best v.h.f. shielding materials. Modern TV transmitters use much aluminum for shielding.

## Lead lengths

One point often overlooked by both the experimenter and service technician in v.h.f. equipment is short lead lengths. This cannot be overemphasized. A long lead, of say 3 inches, in the grid of an r.f. stage operating on TV channel 13 would have appreciable inductance. This appears as a coil inserted between the tube grid and the tuned circuit as shown in Fig. 7. This length of wire may have an inductance as high as 0.5 microhenry—a sizeable impedance on channel 13. To get the most gain from the r.f. stage we cannot afford such an impedance in the grid circuit.

Suppose we have a long lead in the screen grid bypass circuit. This lead length shows up as an inductance in series with the bypass capacitor and lessens or, in some cases, destroys all bypass action. Most of us have experienced oscillations when a screen grid bypass capacitor opened. Screen bypass leads must be kept as short as possible to minimize series inductance.

One good approach has been ceramic bypass capacitors built right into the socket proper. The tube pin makes direct contact with the inside of the tubular ceramic capacitor while the outside of the capacitor is connected directly to the socket mounting ring.

The cardinal rule is simple. *Keep all lead lengths to an absolute minimum.* In servicing, note the lead length used by the manufacturer before cutting a defective component from the circuit. In making the replacement use the same lead length as the original and put the new part in the same space occupied by the original.

The larger the wire size, the smaller the distributed inductance. Flat, wide straps have less inductance than wire, but this may be offset in grid and plate circuits due to the increased capacitance of the strap to ground.

We can summarize h.f. techniques with:

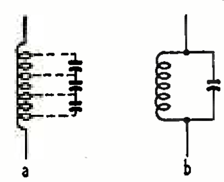



**Fig. 6—Capacitance between the turns of an r.f. choke is important at v.h.f.**

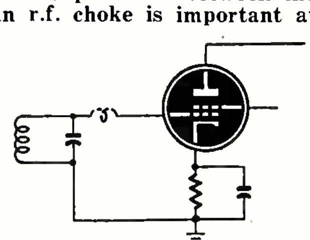


**Fig. 7—Long grid leads may introduce too much inductance in an r.f. circuit.**

1. Select v.h.f. and u.h.f. components specifically built for these frequencies.
2. Use insulating materials having low loss factor.
3. Keep lead lengths as short as possible. If we keep these rules in mind, the same general concepts apply at v.h.f. as at broadcast frequencies.

By following these simple rules we can make high-frequency circuits behave just as easily as lower frequency circuits. Most important, we keep at a minimum those many unpredictables that are due to faulty wiring and inadequate components.

—end—

## IMPORTANT TO VETERANS

Veterans who plan to enter school or enroll for correspondence school training must act quickly. The great majority of World War II veterans must start their training—actually be enrolled in the school of their choice—by July 25, 1951, or they will lose their educational benefits. Veterans discharged after July 25, 1947, have four years from discharge date to start their training.

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## ELECTRONIC SWITCH HANDLES MANY SIGNALS

Patent No. 2,521,952
Richard G. Stephenson, Santa Fe, N.M.
(Assigned to the United States of America as represented by the Sec'y of the Navy)

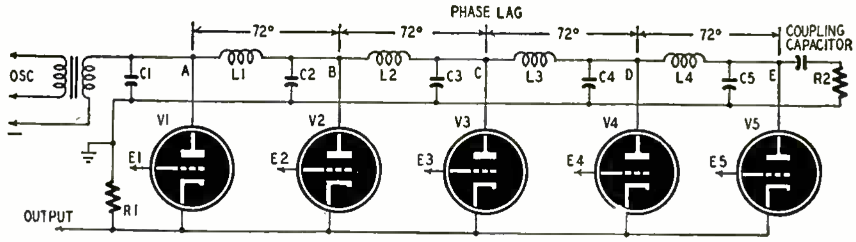
This circuit can switch as many signals as desired transferring one signal at a time to a common output. As an example, it can be used to display several signals, one at a time, on an oscilloscope. With sufficiently rapid switching all signals become visible at once and are easily compared.

An a.f. oscillator is coupled to a lowpass filter through a transformer. There are as many filter sections as signals to be switched, 5 in this figure. Within the passband (from d.c. to cut-off) there is no attenuation but phase is shifted by each filter section. Each section is designed for a shift of 360/N, where N is the number of filter sections. Therefore the figure shows a shift of 1/5 of a.f. cycle or 72°.

E1, E2, etc. are the signals to be switched to the output. Each signal is connected to the grid of a separate cathode follower, V1, V2, etc. Only one triode conducts at a time. Conduction can occur only while the positive crest of each a.f. cycle exceeds the negative bias at the transformer secondary. The bias is adjusted for a conduction interval of 1/N of each a.f. cycle.

During the 1/5 cycle that A goes positive, V1 conducts. If R1 is large enough the output is nearly equal to E1. During this time all other tubes are blocked. Since the phase at B lags A by 1/5 cycle, B goes positive as soon as A becomes negative again. For the next 1/5 cycle V2 conducts and the output is nearly equal to E2.

The positive crest of the a.f. wave thus travels down the filter making the successive points A, B., C. etc., positive. Each tube conducts for 1/5 cycle and transfers its input signal to the output during that interval.




## U.H.F. OSCILLATOR TUBE USES NO TUNED CIRCUITS

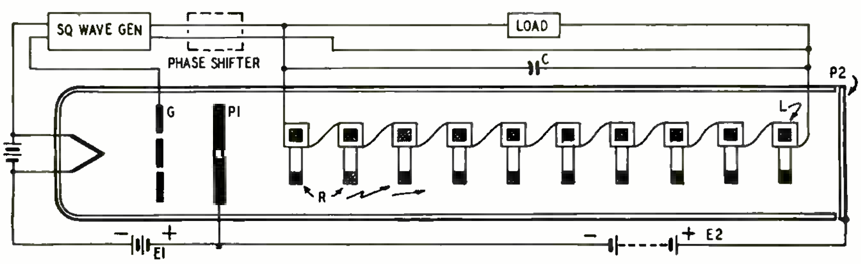
Patent No. 2,520,383
Palmer H. Craig, Gainesville, Fla.
(Assigned to Invex, Inc.)

Oscillation at a frequency determined by the speed with which electrons move through the tube instead of L or C values, is the feature of this invention.

Electrons from a cathode move toward G, the grid. A square-wave generator switches the electron stream on and off so that electrons move to the right in groups or bunches. They are speeded up by the voltage E1 on the first anode P1. Later they come under the field due to E2 on the accelerator P2.

After passing through the aperture in the center of P1, the electron bunches move through a series of magnetic rings, R. Each ring is made of permalloy or other high-permeability metal and has a coil L wound over it. As the electrons approach and pass each ring they generate a magnetic field in it. This varying field induces a voltage in the coil. The voltage of each coil feeds the output load.

The frequency of the induced voltage is determined by the speed with which electrons move. If desired, C may be added to resonate with coils L. The phase shifter is adjusted to time the electron bunches for maximum output across the oscillator load.



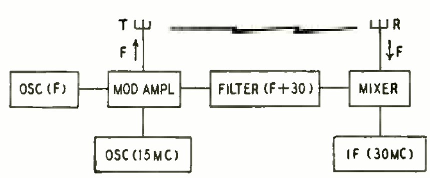

## AUTOMATIC I.F. CONTROL FOR RADAR

Patent No. 2,519,369
William W. Hansen and John R. Woodyard, Garden City, L. I.
(Assigned to Sperry Corp.)

At the very high frequencies used in radar, even very slight instability or drift in the carrier frequency produces relatively large shifts in the i.f. at the receiver. For this reason, the receivers must use a wide-band i.f. strip.

This invention uses a signal from the transmitter to control the receiver i.f. so that a sharply-tuned i.f. strip can be used, giving the advantages of low noise, high gain, and peak efficiency. The figure shows a simplified version. The modulator mixes the second harmonic of the 15-mc oscillator with the carrier frequency F. The sum frequency passes a filter and is fed to the receiver. The carrier is transmitted to the target through antenna T.

At the receiver, R intercepts the echo signal and feeds it to a mixer. Here the sum frequency (F + 30) mixes with the carrier to produce the desired beat, which is 30 mc regardless of moderate variations in the carrier frequency.




This system is particularly adaptable to radar systems where the receiver and transmitter are usually at the same location. It could be used just as well with any similarly situated equipment operating in the v.h.f. and u.h.f. regions where i.f. stability is an important factor.

## EXPANDED SCALE METER

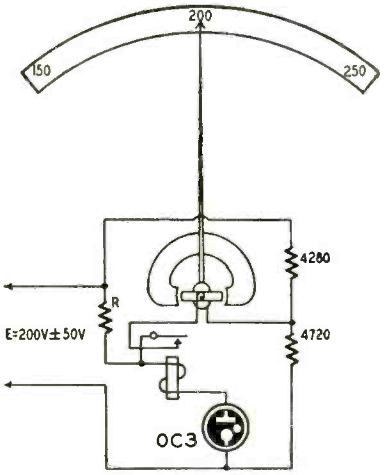
Patent No. 2,526,329

Harvey H. Chamberlain, Marblehead, Mass.

(Assigned to General Electric Co.)

This d.c. meter has an expanded scale to provide more accurate readings.

A zero-center instrument is used with its coil across a bridge circuit. One arm is an 0C3 tube. R is a dropping resistor. The other two arms are chosen to balance the bridge when the input is 200 volts.




With an input less or greater than 200 volts, the pointer deflects in one direction or the other due to bridge unbalance. The milliameter shown has an internal resistance of 3,000 ohms and a full-scale current of 5 ma. With the circuit values shown the meter current may be calculated from:

$$I_m = \frac{4720\,E - (105)\,(4280 + 4720)}{(4280 + 4720)\,R_m + (4280)\,(4720)}$$

where Rm is the meter resistance.

When the input drops to less than about 200 volts, the regulator tube is extinguished. Then excessive current may flow through the meter and damage the pointer. To prevent this, a relay opens the circuit, and the VR tube stops conducting.

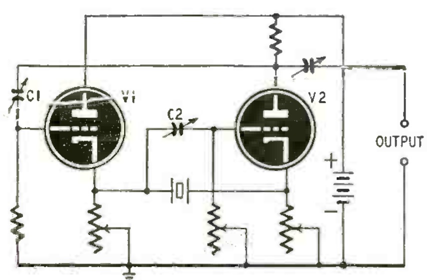
## IMPROVED OSCILLATOR

Patent No. 2,510,868

James R. Day, Peconic, N. Y.

(Assigned to Press Wireless, Inc.)

This oscillator has unusual stability. Frequency is determined almost solely by the crystal itself since changes in the circuit have negligible effect. V1, a cathode-follower, has low impedance output and cannot be affected by variations in the following stage. V2 is a cathode-fed amplifier (with respect to the signal). Its stability is high because of the shielding effect of its grid.




The crystal itself is series resonant at some frequency. Because of the low impedance near this frequency, practically the entire voltage output of V1 is transferred to V2. At frequencies removed from series resonance the impedance rises sharply and only a fraction of the signal is applied to V2. The output of V2 is in phase with the input to V1, and the feedback through C1 causes oscillation.

Because of the capacitance of the crystal holder there is also a parallel-resonant frequency of the crystal. This frequency is *rejected* while the series-resonant frequency is *accepted*. The phasing capacitor C2 neutralizes the capacitance of the crystal holder. This is done by passing r.f. through C2 to the *grid* of V2 while the holder capacitance permits r.f. to flow to its *cathode*.

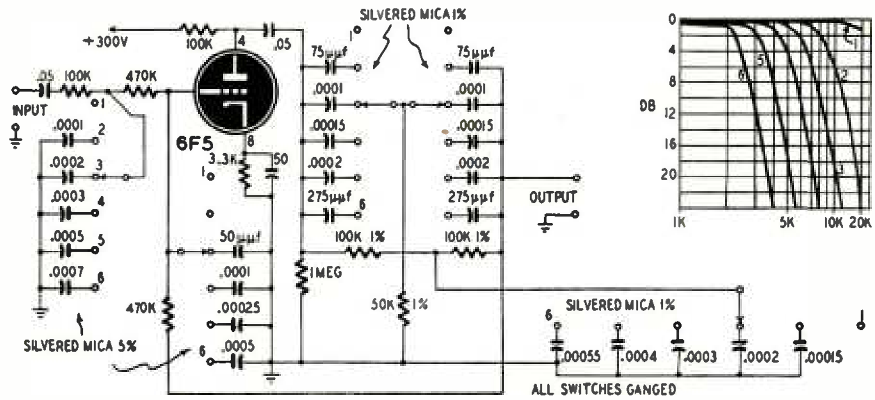
—end—

## HIGH-FREQUENCY CUTOFF CONTROL

Sometimes annoying buzzes and rattles are noticed when playing records on wide-range reproducing systems. This effect—most often noticed immediately following a sharp transient—can be traced to poor tracking, worn records and needles, and in some instances, to defects in the record. Fortunately these noise frequencies are concentrated in the upper end of the audio spectrum where they can be considerably attenuated or entirely eliminated with a low-pass filter.

In the equalizer for the original Williamson amplifier, a parallel-T network in the feedback loop of a triode-connected EF37 amplifier provided high-frequency cutoff at 5,000, 7,000, 10,000, and 13,000 cycles. Writing in *TSF Pour Tous* (Paris, France) Jacques Lignon shows how he modified the circuit to use a 6F5 tube and to provide an additional position for cutoff at 2,500 cycles for records which are extremely bad.

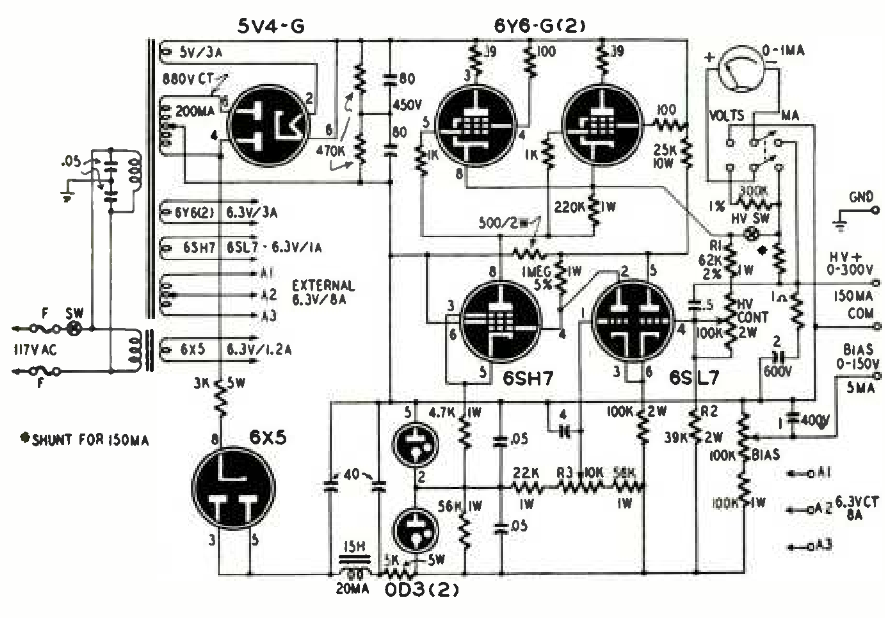
The modified diagram and the high-frequency response for various settings of the switch are shown. This circuit can be inserted after a triode stage in a preamplifier or in the main amplifier. It is not worth while to construct this circuit if you do not have facilities for running response curves. Many components are so critical that normal tolerances, erroneous markings, and changes in value because of overheating or physical damage can seriously affect the performance of the circuit. Silvered mica capacitors are recommended for the switched circuits. Those in the parallel-T should be carefully matched or have 1% tolerances, as should the two 100,000-ohm resistors. The 50,000-ohm resistor has a tolerance of 1%.




## VARIABLE-VOLTAGE REGULATED SUPPLY

Most laboratory and experimental power supplies are designed to deliver variable voltages which must be manually adjusted for different loads or to deliver one or more fixed voltages which are regulated over a comparatively narrow current range. This circuit, reprinted from catalog TR-51 issued by Triad Transformer Mfg. Co., delivers from 0 to 300 volts which is regulated within ½% from 20 to 300 volts with loads varying from 0 to 150 ma and line voltages ranging from 105 to 125. It also delivers continuously variable bias of 0 to 150 volts at currents up to 5 ma.

The circuit is easy to build and operate. High-quality components should be used throughout. R1 and R2 have 2% tolerances and should be either wire-

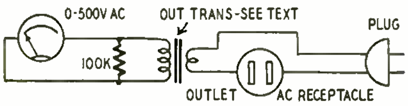


wound or spiral-cut carbon types. The 100,000-ohm high-voltage and bias controls should be linear units rated at 2 watts or more.

Set the high-voltage control to maximum, then adjust R3 so the output is exactly 300 volts. The high-voltage control will then cover from 0 to 300 volts.

### WATTMETER SUBSTITUTE

Useful and easy to build, this wattmeter will check the power consumed by radios, TV sets, and various a.c. appliances. Short circuits and overloads can be detected by comparing the meter reading with the manufacturer's rating on the device. Most service technicians do not have an a.c. ammeter but they do have a reliable a.c. volt meter which can be used.



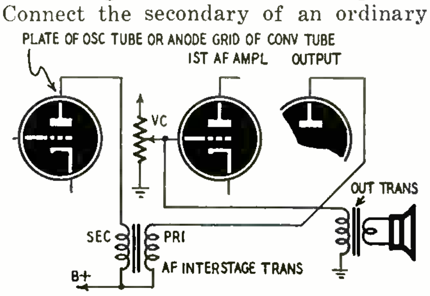

Select a husky output transformer which has a secondary consisting of few turns of heavy wire or use one having a tapped secondary. Connect an a.c. receptacle and line cord in series with the secondary and shunt the primary with a 100,000-ohm resistor and a 500- or 1,000-volt a.c. meter. The resistor is to prevent arcing across the primary.

When a set or other appliance is plugged into the outlet, the meter will show a voltage which can be converted to watts. Plug different size lamps into the receptacle and record the voltage and wattage ratings. Use the tap on the transformer which makes the meter read nearest 100 volts with a 100-watt lamp. When a number of checks have been made, record the data on a chart or graph.

To check a radio or TV set, plug it into the wattmeter and let its tubes come to operating temperature. Convert the meter reading to watts and compare this figure with the manufacturer's wattage rating. Shorted filter or bypass capacitors in a receiver or amplifier will cause a noticeable increase in wattage. Open transformers, resistors, etc., will cause the wattage to be low. Excessive current in a motor will probably be caused by shorted turns in a winding or by an excessive load.—*G. L. Garvin*

### HOME BROADCASTER

It is easy to convert a standard superhet receiver into a home broadcaster. Disconnect the primary of the output transformer from the output tube. Ground one end and connect the other to the arm of the volume control or to the grid of the first a.f. amplifier. Connect the secondary of an ordinary

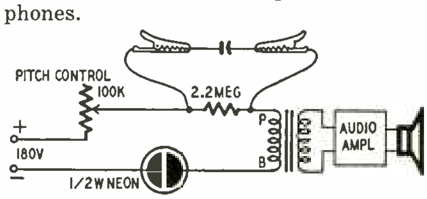


interstage audio transformer in series with the oscillator plate or the anode grid of the converter tube. Insert the primary of the transformer between B-plus and the plate of the power amplifier stage.

With this setup, the speaker becomes a microphone. Set the dial of the broadcaster approximately 456 kc (assuming a 456-kc i.f.) below the frequency of the receiver used with it.—*Ambrose Fisher*

## CAPACITOR CHECKER

This circuit can be used to check the quality and approximate capacitance of the most common values of electrolytic and paper capacitors. The circuit consists of a relaxation-type oscillator transformer-coupled to an audio amplifier and speaker or a pair of headphones.




With the values shown, the neon tube oscillates readily with good capacitors having values as low as approximately .005 µf. Capacitor values are determined by comparing the tone produced by the unit under test with that of a standard capacitor. If the capacitor is open, the lamp will not oscillate and no sound will be heard. A shorted capacitor causes the lamp to glow continuously. The capacitors are connected to the unit by flexible leads fitted with alligator clips.—*H. Desforges*

## GARAGE-DOOR OPENER

This radio-control transmitter and receiver is designed for controlling garage doors from an automobile, but it can be used for almost any other operations which require that an external circuit be opened or closed. Most circuits of this type operate in the v.h.f. band where they sometimes cause interference to TV and other services. The possibility of interference is practically nonexistent in this transmitter because it operates at approximately 420 kc with negligible power input.

The transmitter shown in Fig. 1 gets its operating voltages from the auto-

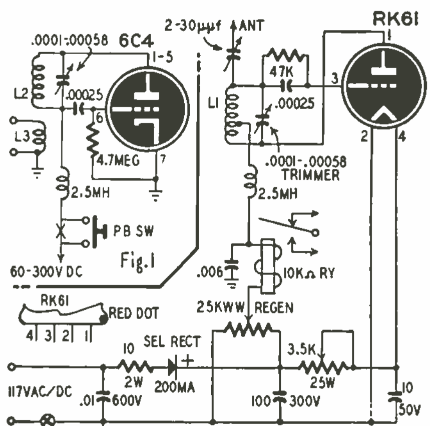



Fig. 1

Fig. 2

mobile radio and is small enough to be mounted inside some sets. It also can be constructed as a separate unit and installed under the dashboard. A push-button switch in series with the B-plus lead turns the control on and off. A toggle switch may be inserted in the heater lead to reduce the battery drain by 150 ma when the transmitter is not in use.

The receiver is a superregenerative detector using an RK61 gas triode. The resting plate current of approximately 1.5 ma drops to 0.5 ma when a signal is received. This drop in current is sufficient to release the relay in the plate circuit. The relay is a sensitive unit having s.p.d.t. contacts and a coil of approximately 10,000 ohms. We use the contacts to control two electric motors which open and close the garage doors.

L1 and L2 are each 70 turns of No. 22 d.c.c. wire close-wound on 1¼-inch forms. L1 is tapped at 7 turns from the plate end. L3 is a 10-turn winding over L2.

The transmitter may be coupled to a whip-type automobile antenna. The receiving antenna should be the shortest one that permits reliable control operation at a distance of 50 feet. A short piece of wire will usually do.

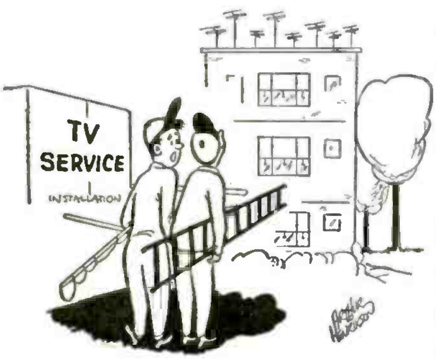
The receiver operates from a transformerless type supply. Make sure that the 3,500-ohm resistor is set for maximum resistance when the unit is turned on for the first time. With a d.c. voltmeter across the RK61 filament, gradually reduce the resistance until the meter reads 1.5 volts. Adjust the 25,000-ohm regeneration control for maximum sensitivity.—*Edwin Kucharski*

—end—

### AID FOR TV STUDENTS

To keep up with fast-changing television circuits, students at the Milwaukee School of Engineering begin their TV studies with a complete set that is built on 11 different chassis, each containing one of the major sections of the receiver. Thus the beginning student can study each block by itself without being confused by the maze of tubes and wiring of a complete 25- or 30-tube set. He then can correlate the various units and study their interaction. Many of the units are interchangeable with others that perform the same function but use different circuits, and each unit is easily modernized as TV circuits are improved.

—end—

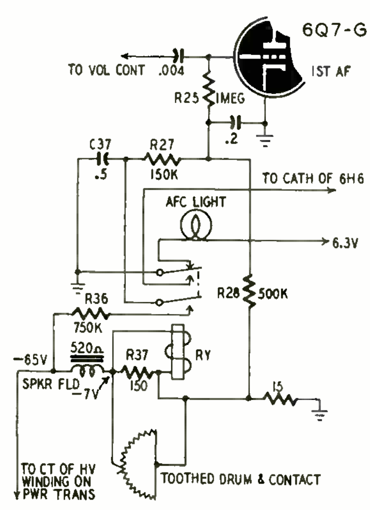


## REWINDING A RELAY

? *I want to replace the coil in the flash-tuning relay in a Silvertone model 4587 receiver. Can you tell me the length and size of the wire to use? I am also interested in knowing the voltage, current, and resistance of the coil so I can get the correct replacement.—F. C. B., Detroit, Mich.*

**A.** We do not have any technical data on the relay used in this set. Servicing data which we have indicates that the drain on the B-supply is approximately 100 ma and the drop across the relay coil and the 150-ohm resistor shunting it is approximately 5.5 volts. Manufacturer's instructions state that the relay should pull in at 60 ma.

The size of the magnet core or the force needed to pull in the armature are not known, so we cannot provide data on wire size. If the core is intact and the winding is damaged, remove the old wire. Count the number of turns in at least one layer and count the number of layers. Use the same size wire to rewind the coil. Try to put on as many turns as were on the original winding. Check the coil by putting it in series with a 6-volt battery and a 100-ohm wire-wound potentiometer. Adjust the pot and the spring tension so the relay pulls in at 60 ma.



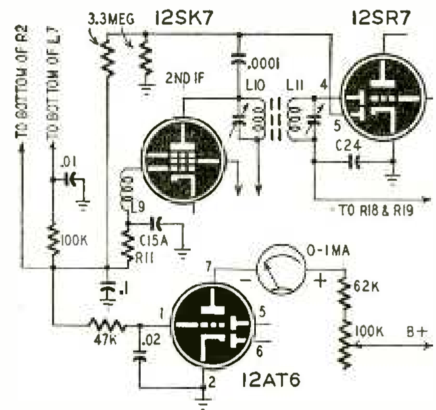

If the relay is missing from the circuit, try to find a 6-volt d.c. relay which has double-pole, double-throw contacts and a coil of 55 ohms or more. The diagram shows the basic circuit, including the relay. If the relay coil is approximately 55 ohms, shunt resistor R37 should be omitted. For other values, select a value for R37 which will produce a drop of 5.5–6 volts across the coil and resistor combination so the relay will operate properly.

## S-METER FOR BC-454

? *I would like to add an S-meter to my BC-454 receiver. Please print a diagram showing how I may do this.—J. W. S., Utica, N. Y.*

**A.** An S-meter is not practical unless the receiver has a.v.c. The unused diode in the 12SR7 (pin 5) may be used as the a.v.c. rectifier. The diagram shows the alterations which must be made. This diode develops the a.v.c. voltage which is applied to the control grids of the r.f. and i.f. stages. The 12AT6, the S-meter tube, is a simple v.t.v.m. which measures the a.v.c. voltage.

The 100,000-ohm variable resistor sets the meter to zero (full scale) for

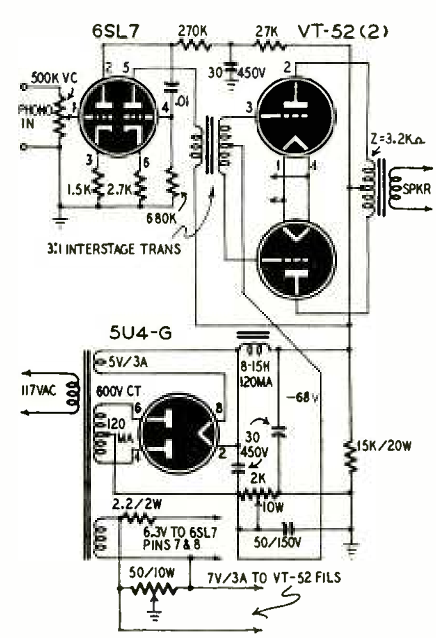



no signal input. Vary the B-plus voltage on the 12AT6 and the value of the 62,000-ohm resistor so the needle is against the left-hand pin on a powerful local station.

## AMPLIFIER FOR VT-52'S

? *I would like to have the diagram of a transformer-coupled phono amplifier using VT-52's in push-pull. Can you supply me with such a circuit?—J. G. H., Saginaw, Mich.*

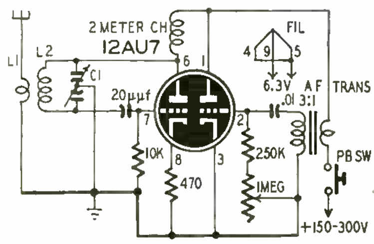
**A.** According to the information we have, a VT-52 is the same as a standard 45 with the exception of the heater rating which is 7 volts at 1.18 amp. A diagram of an amplifier designed for these tubes is shown. If expense is a factor in the selection of tubes, you may find that the cost of a power transformer having a 7-volt winding or a separate 7-volt filament transformer will amount to considerably more than the money you save by using surplus VT-52's instead of standard 45's, 2A3's, 6B4's, or similar tubes. This circuit will work for any of these tubes when used with the correct filament voltage.



## CONTROL TRANSMITTER

**?** *I have a BC-1023-A receiver which I want to use for remote-control purposes. I want a diagram of a simple tone-modulated transmitter which I can use in my automobile to transmit a signal to control my garage doors. Can you help me?—R. C. T., Bay City, Mich.*

**A.** The diagram shows a 75-mc transmitter which may be installed in your automobile. A simple push-button switch applies plate voltage to the r.f. and a.f. sections of the tube and puts the signal on the air to operate the control receiver.



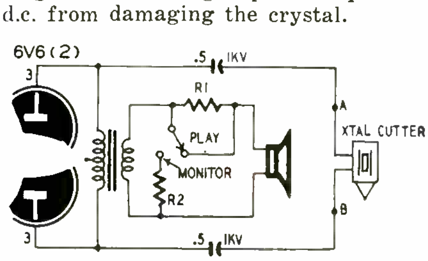

One triode of the 12AU7 is a 75-mc oscillator. C1 is a 15-μμf split-stator tuning capacitor, L2 has 7 or 8 turns of No. 18 wire on a ¾-inch form. The spacing between turns should be adjusted so the desired range can be covered with the tuning capacitor. L1 consists of 1 to 3 turns of wire around the center of L2.

It is advisable to adjust the frequency of the transmitter and receiver to avoid the possibility of interfering with aircraft marker beacons. Keep the transmitting antenna as short as possible to restrict radiation to the immediate area.

## RECORDING FROM RADIO

**?** *I have a disc recording unit which has a crystal cutter. Please show how this can be connected to my SX-42 receiver so I can make recordings off the air.—C. B. C., Toronto, Ont.*

**A.** The circuit shows how the crystal cutter can be connected to the output of the SX-42 or to any receiver or amplifier having a push-pull output stage. The blocking capacitors prevent d.c. from damaging the crystal.



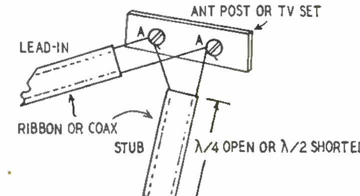

An attenuator pad comprising R1 and R2 may be switched into the speaker circuit to reduce the speaker level to approximately 11 db below that of the cutter. R1 is 10, 15, or 20 ohms and R2 is 4.5, 8, or 11 ohms when the speaker impedance is 3.2, 6, or 8 ohms, respectively.

To prevent overcutting, a volume-level indicator should be connected across points A and B. This may be a 150-volt a.c. meter having a resistance of 1,000 ohms per volt or more for satisfactory results.

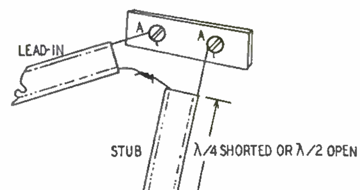
## INTERFERENCE STUBS

? *A friend says that a shorted quarter-wave or open half-wave stub will prevent FM interference from affecting the picture on a TV set. I bet him that he is wrong. I say that an open quarter-wave or shorted half-wave stub should be used. Who wins?—A. V. B., Los Angeles, Cal.*

**A.** Better call it a draw if neither of you specified how the trap should be connected. A shorted end quarter-wave stub or trap offers a very high impedance, and a similar stub open at the end will appear as a short circuit at its resonant frequency. The opposite is true of half-wave stubs. If the stub is connected across the lead-in as at *a*, it should appear as a short circuit at the interference frequency. Therefore you should use an open quarter-wave or a shorted half-wave stub.




a




b

When in series with one side of the line as at *b*, the trap should present a high impedance to the interference, therefore a shorted quarter-wave or open half-wave stub is required.

The actual length of a quarter-wave stub (open or shorted) may be found from: $L = 2952 \times V.P./f$, and a half-wave stub from $L = 5904 \times V.P./f$, where L is in inches, f is frequency in mc. V.P. (velocity of propagation) may be taken as 82% for 300- and 77% for 150-ohm ribbon lines; and 65.9% for all coaxial cables except RG-21/U.

Cut the stub a little long and experiment to get the correct length. For shorted stubs, use a razor blade or sharp needle to short the conductors at different spots to locate the point of minimum interference. Short the line permanently at this point. Merely snip off small pieces on open stubs.

## TRANSFORMER SPECIFICATIONS

? *Please give specifications on the output transformer used in the sound alarm described on page 31 of the October, 1950, issue.—E. H., Columbus, Ohio.*

**A.** Any plate-to-voice coil output transformer will do the job. However, it is advisable to use one having a primary impedance of 20,000 ohms or more. Your best bet will be to use a standard intercom input transformer which may have a secondary impedance of 38,400 ohms or higher.

—end—

### SAVE OLD RECTIFIERS

Don't discard defective selenium rectifiers after removing them from a circuit. Lay them aside until you have time to dismantle them. One brand of rectifier contains nine metal washers. two fiber washers, two grounding straps or lugs, one 3/16 x 1-inch eyelet, and one 1/4 x 1-inch paper coil form. Keep these parts in your spare-parts box. They will come in handy sooner than you think.—*Edward Tanrath*

### HANDY TV SERVICING TOOL

A 1/4-inch nut driver or Spintite wrench is required to remove the cover of the high-voltage cage in most TV sets. Why not convert yours for use as a high-voltage indicator as well? Take a 1/4-inch hex nut driver and soften its plastic handle in hot water so the bit can be pulled out. Solder one terminal of a small neon lamp (NE-2 or similar) to the handle end of the bit. Drill the hole in the handle deep enough to accommodate the lamp on the end of the bit. Reheat the handle and insert the bit back in place.

The next time you suspect trouble in a high-voltage supply, use the wrench to remove the cover, then touch the bit to the plate of the high-voltage oscillator or cathode of the rectifier tube. Presence of high voltage is indicated by a glow in the neon lamp.—*O. G. Brickey*

### REPAIRING VOLUME CONTROLS

On page 78 of the December, 1950 issue, a contributor described a tool for removing retaining rings used on switches, volume controls, etc. This system works O.K. but I'll still stick with my method.

I take two beer-can openers and grind the points down so they are very thin. Insert the points of the openers into the gap in the C-ring. Apply slight pressure on the handles and the washer slips off.

These tools are very handy to have around the workbench. When you are not using them to repair controls, you can always use them for their original purpose.—*Eugene Brunaccioni*

### HOLDERS FOR TEST LEADS

My workbench looks much neater since I made clips to hold my various test leads when I'm not using them. Large holders for cartridge-type fuses supplied the necessary clips. I simply removed them from their base and screwed them to the wall over the bench.—*O. C. Vidden*

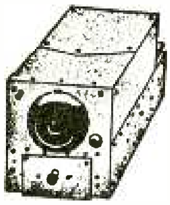
### BUYING EXPERIMENTAL PARTS

Be sure to select units having terminal lugs rather than flexible leads when purchasing audio or power transformers, filter chokes, electrolytic capacitors, radio- and intermediate-frequency coils, and other parts commonly used in radio and electronic circuits. Leads are almost invariably cut to the correct length for the first project and are usually too short for the next one. Components with terminal lugs are harder to mount because mounting hole spacing is critical but you will find that they last longer in experimental service.—*Charles Erwin Cohn*

—end—

# INDUSTRIAL! EXPERIMENTERS! Look at these terrific buys.

## ARMY AIRCRAFT RECEIVER— BC-946-B



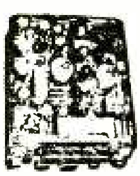
Covers 520 Kc to 1500 Kc Broadcast Band. 6 Tubes: 3 — 12SK7, 1 — 12SR7, 1 — 12A6, 1 — 12K8. Designed for dynamotor operation; can be easily converted to 110 volt or 32 volt use. Two IF Stages. Three-gang tuning con. BRAND NEW, in sealed carton, with tubes and instruction manual, less dynamotor .................. **$35.00**

Dynamotor DM-32A ...................... 3.95

### SMASH VALUES IN RADIO RECEIVERS

| | | | | | | |
|---|---|---|---|---|---|---|
| BC | 453 | Rcvr. | Used | $17.95 | New | $35.00 |
| BC | 454 | Rcvr. | Used | 9.95 | New | 16.50 |
| BC | 455 | Rcvr. | Used | 8.95 | New | 11.95 |
| BC | 456 | Mod. | Used | 3.95 | New | 6.95 |
| BC | 457 | Xmtr. | Used | 7.95 | New | 12.95 |
| BC | 458 | Xmtr. | Used | 8.95 | New | 13.95 |
| BC | 459 | Xmtr. | Used | 16.95 | New | 29.50 |
| BC | 696 | Xmtr. | Used | 16.95 | New | 24.95 |

## BC-645 XMTR RECEIVER 15 Tubes 435 To 500 MC



The electronic equipment that saved many lives in the war. Set can be modified to use for 2-way communication, voice or code, on following bands: ham band 420-450 mc, citizens radio 460-470 mc, fixed and mobile 450-460 mc, television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4 — 7F7, 4 — 7H7, 2 — 7E6, 2 — 6F6, 2 — 955 and 1 — WE316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs.

**BRAND NEW $18.95 each**

**PE-101C DYNAMOTOR for above BC-645** .............. **$3.95**

**UHF ANTENNA ASSY. for above BC-645** ............... **$2.45**

## BC148 RECEIVER-TRANSMITTER

Built for Sig. Corps by Farnsworth. Range 3960 to 4360 Kc. Complete two-way communications. Operates on batteries or hand generator. CW operation, handkey on base. Entire unit in two hinged parts. (Xmtr & Rcvr, and Battery compartment) closes down to 15½" x 14½" x 8½" overall. Less tubes and batteries. Operating instructions included. Used, clean. Each ............................. **$5.95**

## SETCHEL-CARLSON Beacon Radio Receiver BC-1206-C

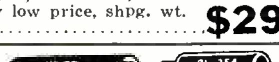
Receives A-N beam signals, operates on 24-28 V DC. 5 Tubes: 3—14H7, 14R7, 28D7. Tunes 195 to 420 Kc. Size 4"x4"x6⅝" wide. 4 lbs. In original carton.

New ......... **$9.95**

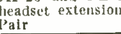
Used .............. **$7.95**

## TRANSMITTER BC-223-AX

Ideal for 80-meter band! 801 osc., 801 P.A., 2—46 modulators, 1—46 speech amp., 4 xtal freq. and master osc., on selector switch. 10 to 30-watt output. tone, voice or C.W. Black wrinkle case, complete with freq. chart and tubes in original cases, less xtals, BRAND NEW, sensationally low price, shpg. wt. 80 lbs. ...................... **$29.50**



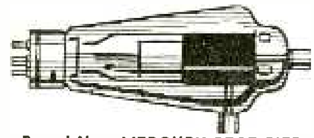

JK-26 and PL-354—JACK & PLUG combination, for headset extension, etc. Pair ............................ **35c**




PL-55—Standard 2-circ. phone plug, fits all phone jacks. Each .......................... **29c**


PL-68—Standard 3-circ. mike plug, fits all 3-way mike jacks. Each .......................... **22c**

## GE THYRATRON FG-105



**Brand New MERCURY RECTIFIER**

Individually boxed in factory sealed cartons. List Price $40. Your cost ...

**While They Last!** **$18.95 each**

For continuous rectifier and welder control service. Tetrode type, indirectly heated cathode; 10000 V peak. 10000 V peak inverse. Av. Max. current 6.4 amps continuous, 2 4 to 4 amps welder control service.

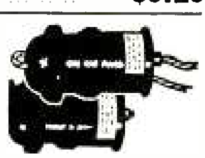
### SAVE ON THESE STANDARD TUBES

| | | | | | |
|---|---|---|---|---|---|
| 1H5GT | 1.12 | 6L6G | 1.65 | 12SJ7 | .95 |
| 1LA4 | 1.45 | 6Q7 | .75 | 12SK7 | 1.35 |
| 1LA6 | 1.45 | 6SA7 | 1.25 | 12SL7 | 1.10 |
| 1LB4 | 1.45 | 6SC7 | 1.20 | 12SN7 | 1.75 |
| 1LC5 | 1.45 | 6SF5GT | 1.10 | 12SQ7 | 1.25 |
| 1LC6 | 1.45 | 6SF7 | .97 | 12SR7 | .90 |
| 1LD5 | 1.65 | 6SG7 | .95 | 12Z3 | .85 |
| 1LE3 | 1.55 | 6SJ7 | 1.20 | 14A7 | 1.05 |
| 1LG5 | 1.55 | 6SK7 | .95 | 14B6 | 1.05 |
| 1LH4 | 1.45 | 6SL7GT | 1.35 | 14F8 | 1.35 |
| 1LN5 | 1.35 | 6SN7GT | 1.65 | 14F7 | 1.20 |
| 1N5GT | 1.20 | 6SQ7 | .90 | 14J7 | 1.35 |
| 1Q5GT | 1.45 | 6SS7 | .95 | 14H7 | 1.10 |
| 1R5 | 1.20 | 6T8 | 2.20 | 14N7 | 1.35 |
| 1S4 | 1.20 | 6V6GT | 1.20 | 14Q7 | 1.05 |
| 1S5 | 1.00 | 6W4 | 1.50 | 14R7 | 1.25 |
| 1T4 | 1.10 | 6X5GT | 1.30 | 19 | .49 |
| 1T5GT | 1.25 | 6Y6G | 1.25 | 24A | .80 |
| 1U4 | 1.10 | 7A4/XXL | 1.20 | 25L6 | .90 |
| 1V | .90 | 7A5 | 1.20 | 25Z5 | .85 |
| 2A3 | 1.45 | 7A6 | 1.20 | 25Z6GT | 1.20 |
| 2A5 | 1.15 | 7A7 | 1.20 | 26 | .59 |
| 2A6 | .95 | 7A8 | 1.20 | 27 | .65 |
| 2A7 | .95 | 7B4 | 1.20 | 28D7 | 1.35 |
| 2B7 | .95 | 7B5 | 1.20 | 30 | .75 |
| 2X2A | 88 | 7B6 | 1.20 | 31 | .55 |
| 3Q5GT | 1.10 | 7B7 | 1.20 | 32 | .55 |
| 3S4 | 1.05 | 7B8 | 1.20 | 33 | .59 |
| 3V4 | 1.05 | 7C4 | 1.25 | 34 | 1.20 |
| 5T4 | 1.75 | 7C5 | 1.25 | 35/51 | .75 |
| 5U4G | 1.20 | 7C6 | 1.25 | 35A5 | .90 |
| 5V4G | 1.85 | 7C7 | 1.10 | 35B5 | 1.25 |
| 5W4 | .95 | 7E6 | 1.10 | 35C5 | 1.25 |
| 5X4G | 1.10 | 7E7 | 1.10 | 35L6GT | 1.25 |
| 5Y3GT | 1.00 | 7F7 | 1.00 | 35W4 | 1.05 |
| 5Y4G | .85 | 7F8 | 2.15 | 35Y4 | .95 |
| 5Z3 | .95 | 7H7 | 1.75 | 35Z3 | .88 |
| 5Z4 | 1.20 | 7K7 | 1.30 | 35Z4 | .75 |
| 6A3 | 1.35 | 7L7 | 1.30 | 35Z5 | 1.20 |
| 6A6 | 1.25 | 7N7 | 1.65 | 36 | .65 |
| 6A7 | 1.15 | 7Q7 | 1.10 | 37 | .65 |
| 6A8 | 1.10 | 7V7 | 1.30 | 38 | .65 |
| 6AC5GT | 1.30 | 7Y4 | .90 | 39/44 | .65 |
| 6AC7 | 1.90 | 117L7/M7 | 1.70 | 41 | .75 |
| 6AG5 | 1.90 | 117N7 | 1.70 | 42 | .75 |
| 6AH6 | 2.50 | 117P7 | 1.70 | 43 | .82 |
| 6AJ5 | 1.65 | 117Z3 | .85 | 45 | .75 |
| 6AK5 | 2.60 | 117Z6 | 1.40 | 46 | .85 |
| 6AK6 | 1.90 | 12A | .85 | 47 | .95 |
| 6AL5 | 1.65 | 12A6 | .95 | 48 | 2.75 |
| 6AL7 | 1.95 | 12A8GT | .95 | 49 | .95 |
| 6AQ5 | 1.75 | 12AH7GT | 1.30 | 50A5 | 1.25 |
| 6AT6 | 1.30 | 12AT6 | 1.30 | 50B5 | 1.40 |
| 6AU6 | 1.70 | 12AT7 | 2.25 | 50C5 | .95 |
| 6AV6 | 1.30 | 12AU6 | 1.25 | 50L6GT | 1.25 |
| 6BA6 | 1.50 | 12AU7 | 1.95 | 50Y6 | 1.05 |
| 6BE6 | 1.50 | 12AV6 | 1.30 | 53 | 1.25 |
| 6BG6G | 2.20 | 12AW6 | 1.90 | 56 | .70 |
| 6BH6 | 1.75 | 12BA6 | 1.45 | 57 | .85 |
| 6C4 | 1.10 | 12BE6 | 1.55 | 58 | .85 |
| 6C6 | .85 | 12J7 | .95 | 59 | 1.75 |
| 6D6 | .85 | 12K7 | 1.05 | 70L7 | 1.65 |
| 6E5 | 1.00 | 12K8 | 1.60 | 71A | .90 |
| 6F5 | .80 | 12Q7 | .85 | 75 | .75 |
| 6F6 | 1.20 | 12SA7 | 1.10 | 76 | .75 |
| 6F6GT | 1.00 | 12SC7 | 1.60 | 77 | .75 |
| 6J5 | .75 | 12SF7 | 1.00 | 78 | .75 |
| 6J6 | 1.85 | 12SG7 | .90 | 80 | 1.05 |
| 6J7GT | 1.25 | 12SH7 | .95 | 82 | 1.35 |
| 6K6GT | 1.15 | | | 83 | 1.25 |
| 6K7 | .85 | | | 83V | 1.35 |
| 6K8 | 1.45 | | | 84/6Z4 | .90 |
| 6L6 | 1.95 | | | 85 | 1.05 |

## DC AMMETER 0-15 Amps

A terrific buy! 3½" easy reading scale. 75 divisions. Black plastic case 4½"x5¼"x2¼". Rubber covered test clip leads plus black metal carrying case with hinged cover. **Brand new.** Wonderful for automotive, battery charging, general test work. Value $25. All yours for only ................................ **$5.25**

## SELSYN 2J1G1



Operates from 57½ V 400 cycles. Suggested wiring for 110 V 60 cycle included. Used, tested.

Price per pair ..... **$4.50**

## BC 605 INTERPHONE AMPLIFIER

Easily converted to an ideal intercommunications set for office—home—or factory. Complete w/conversion diagram for 110V operation.

BRAND NEW ............. **$4.95**

**Please include 25% Deposit with order—Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.**

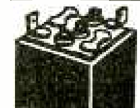
**G & G GENUINE MAJESTIC RADIO PARTS SERVICE**
**53 VESEY STREET · NEW YORK 7, N.Y.**

## TERRIFIC VALUE 24-VOLT STORAGE BATTERY, BRAND NEW 17 AMP. HRS.


Made by Delco. 12 cells, heavy duty, very rugged. Shipped dry, uses standard sulphuric acid electrolyte.

VERY SPECIAL **$17.95**

## 6-VOLT STORAGE BATTERY



Navy Standard BRAND NEW. 15 ampere-hour rating ...... **$7.95**

## ASTATIC R-3 CRYSTAL HANDMIKE

with 6-ft. R. C. Mike Cable ...... **$5.95**

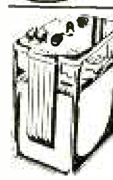
## ONE-QUART BOTTLE BATTERY ELECTROLYTE

Made by Willard, for above storage batteries. 1 quart sufficient for two 2-volt cells. Hermetically sealed. SPECIAL, per qt. bottle ............ **$1.45**

## 7-PRONG 2-VOLT RADIO VIBRATOR

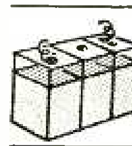
for Portable and Farm Sets Replacement for GE LB 530 ................. **$1.95**

## WILLARD 2-VOLT STORAGE BATTERY 20 Ampere-Hours



Exact replacement for GE portables for LB-500— BRAND NEW. Each **$2.69**

## WILLARD MIDGET 6-V STORAGE BATTERY



3 amp hour rating. Transparent plastic case. Brand new. 3⅝" x 1 13/16" x 2⅜" high. Uses standard electrolyte. Each .............. **$2.65**

## HEADPHONES—*All Brand New!*

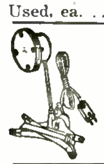
Individually packed, complete with phone plug.

HS-33 600 ohms, in lots of 3 ........ 3.95 each
HS-23 2000 ohms, in lots of 3 ...... 3.25 each
HS-30 With earplugs, LOTS OF 12 .. 1.65 each

## U. S. Army Field Phone Set EE-8

Leather case, with handset, generator, ringer, etc. Requires 2 flashlight cells. Wonderful value! Good Used, ea. ... **$14.95**

## W.E. BREAST MIKE



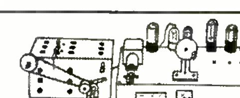
Single button carbon mike, with breastplate. Very sensitive, complete with 6-ft. cord and W.E. plug.

SPECIAL. New **$1.29**

## HANDSET

Cradle-type handset with butterfly switch, unbreakable black plastic, 4-ft 3 wire cable, BRAND NEW, individually packed, each ............ **$7.50**

## McElroy Automatic KEYER



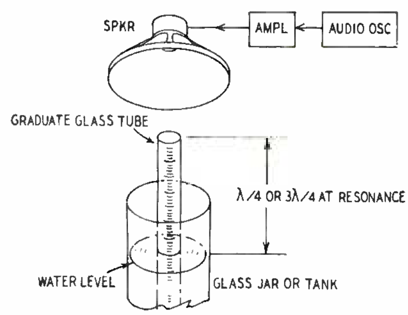
Suitable for keying transmitter, or for code practice. Has photocell and sensitive relay. Variable speed motor. 10V AC or DC. Complete with 2-117Z6 and 1-117L6 tubes, your cost .................... **$21.00**

## We Have Available CODE PRACTICE TAPE **$12.75**

which was used for code practice work by the Signal Corps—from slow to fast practice. 15 rolls on 16MM metal reels in heavy wooden slotted case, to be used with McElroy TG10 Keyers, Tone Keyers or any code practice.

## CALIBRATING OSCILLATORS

By using a simple experimental setup described in most elementary physics textbooks, you can accurately calibrate audio oscillators without oscilloscopes or other complex measuring equipment. The calibrating equipment consists of an audio amplifier and speaker having fairly good frequency response and an open-ended glass tube 1 to 1½ inch in diameter, calibrated in fractions of an inch, and somewhat longer than one-quarter wavelength at the lowest frequency to be checked.




This calibration method is based on the fact that the sound level increases when a musical note produced by a tuning fork or similar instrument is closely coupled to a column of air one-quarter or three-quarters wavelength long at the same frequency. The frequency of the note is equal to the velocity of sound (in air) in feet per second divided by its wavelength in feet.

One-quarter wavelength is found by lowering a calibrated glass tube in water as shown in the setup until the sound level reaches a peak.

The velocity of sound is 1,090 feet per second at 0° C and increases 2 feet per second for each degree of increase in temperature. To find the velocity of sound in air (V) at any temperature T above 0° C, use the formula: $V = 1{,}090 + (2 \times T)$.

With the oscillator and amplifier operating and the speaker close to the top of the tube, slide the tube in and out of the water until resonance is indicated by a sharp increase in sound level. Read the tube length in inches, multiply by 4 to find wavelength in inches, then divide by 12 to convert to wavelength (L) in feet.

Frequency in c.p.s. equals V/L, where V is velocity at room temperature and L is wavelength in feet. For example: If the room temperature is 20° C and there is 6 inches between the water level and the top of the tube at resonance, the corrected velocity is $1{,}090 + (2 \times 20)$ or 1,130 ft./sec., L is $6 \times 4/12$ or 2 feet, and F is 1,130/2 or 565 c.p.s.—*Dominic Angelo, W9KGC*

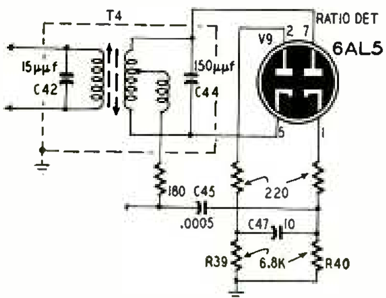
## SOLDERING KINK

Replacing resistors, capacitors, and other components in electronic devices is often made difficult by excess solder on the terminals of sockets, switches, and mounting lugs. To remove excess solder, try holding a piece of heavy bus bar on the terminal and flowing the solder onto it.—*O. C. Vidden*

—end—

### MOTOROLA TS-101 AND TS-119

Some complaints of sound interference in the picture are caused by pickup from the discriminator circuit. If careful lead dress does not cure the condition, check capacitor C44 across the secondary of the transformer. This unit, a 150-μμf, 500-volt ceramic tubular capacitor, should be connected so the outside plate goes to the low side of the coil. In strong signal areas, the simplest cure is to slightly detune the *primary* of the discriminator transformer. Do not do this in fringe areas because the gain is reduced.




In fringe-area installations, the condition should be remedied by inserting suppressor resistors in series with each diode of the 6AL5 ratio detector. The circuit changes are shown in the diagram. Remove all wiring from pins 1 and 2 of the 6AL5 (V9). Connect a 220-ohm resistor to each of these pins. The leads which were disconnected from pins 1 and 2 are then connected to the other ends of the resistors.—*Motorola TV Service Notes*

### NEW AUTO RADIOS

If new auto radios come in with sticking vibrators, check or replace the buffer capacitor and have the voltage regulator checked by a competent ignition mechanic before putting the set back in service.—*Brian Bailey*

### ADMIRAL 30A1 CHASSIS

Complaints of no raster when the sound section of the set is O.K. are often caused by failure of the horizontal-discharge section of the 6SN7-GT V403-B. If this tube is bad, check the 6BG6-G output tube. The latter may have been ruined by excessive plate dissipation due to lack of drive when the 6SN7-GT failed.—*Wilbur J. Hantz*

### SENTINEL TV SETS

Distorted or weak sound which shows up a week or 10 days after the set is placed in operation is caused by drift in the discriminator transformer in early production runs of models 419, 420, 423, 424, 425, and 428.

This is easily corrected by adjusting the secondary tuning slug located on top of the discriminator transformer shield can. Make this adjustment for minimum buzz and clearest sound. The correct position is between the two maximum-buzz peaks which will be noticed when the adjustment is turned right or left from minimum-buzz.

Discriminator transformers used in later models will be given an additional impregnation and baking process which will eliminate drift in this circuit.—*Sentinel Service Bulletin*

### CROSLEY TV TUNERS

An orange dot next to the oscillator-mixer tube socket indicates that the tuner was aligned at the factory for a 12AV7 tube in place of a 12AT7.

When it is necessary to replace the oscillator-mixer tube in tuners marked with the orange dot, always use a 12AV7 tube, otherwise realignment is necessary.—*Crosley Service Dept.*

### GENERAL ELECTRIC TV SETS

Lack of high and low voltage in the G-E 10C101, 10C102, 10T1, 10T4, 10T5, 10T6, 12C101, 12C102, 12C105, and 12T1 as indicated by lack of sound and raster is probably caused by an open circuit in the 4.6-ohm current limiting resistor in series with the selenium rectifiers in the low-voltage supply. Use a factory replacement (catalog number RRW-048).—*James Moudry*

### ZENITH 10S669 AND 10S690

These sets come in with extremely low volume. All components and tubes check O.K. Replace the 7G7/1232 r.f. amplifier tube before going further. Some of these tubes will check good even when they are too weak for these circuits.—*Lawrence Roeshot*

### HUM IN TV SETS

Intermittent hum and noise in TV receivers can often be traced to an intermittent short between heater and cathode in the local oscillator tube. Since this short does not always show up on a tube tester, the most reliable test is to substitute a new tube. Because noise and hum of this type seldom appear in the picture, the technician can waste lots of time looking in the a.f. circuits.—*Don Ebert*

### WESTINGHOUSE H-185

A severe a.c. hum which cannot be traced to bad filter capacitors in this three-way portable may be caused by the a.c. field around the selenium rectifier. The hum is picked up by the first audio grid.

Remove the red lead which runs between the B-plus terminal on the rectifier and the 180-ohm filter resistor and replace it with a shielded lead. Shield the rectifier with insulated tin foil.—*Vincent Petroccione*

### MORE GAIN IN RCA TV SETS

Additional sound and picture gain for weak-signal areas is made possible by minor changes in the circuits of the following models: 6T54, -64, -65, -71, -74, -75, -76, -84, -86, -87, and 9T57, -77, -79, -89.

Change the first and second picture i.f. cathode resistors (R104 and R108 in 12½-inch models or R103 and R107 in 16- and 19-inch models) from 120 to 82 ohms. This provides additional gain through these stages.

Move the point of sound take-off (connection C) on trap T103 up two turns on the coil. This provides more 21-mc signal for the sound i.f. amplifier.

Carefully realign the sound and picture i.f. stages after making the above changes.—*RCA Service Tips*

### RCA 8BX5, 8BX54, 8BX55

The position of the battery pack affects the loop inductance. The inductance increases and the sensitivity of the set decreases because of poor tracking when the battery is removed.

When a battery is temporarily unavailable, place a sheet of aluminum, 8½ inches long, 3⅝ inches wide, and .02 to .05 inch thick in the bottom of the cabinet. This will approximate the effect of the battery so proper performance is restored. Brass may be used as a substitute for the aluminum sheet. *Do not* use iron or steel because the performance of the set will be adversely affected. The sheet can be waxed to the inside of the case to hold it in place. Do not place wax, cement, or other material on loop windings.

Be sure that the battery—or sheet—and chassis are in the correct position before aligning the oscillator and oscillator circuits. Follow manufacturer's instructions when aligning the i.f.'s. Conventional stage-by-stage alignment procedure cannot be used because of neutralization in the first i.f. stage.—*RCA Service Data*

### AIR KING THREE-WAY PORTABLES

Distortion may be noticeable in the models 4012, 4016, 3912, and 3916 when operated on power lines, but not when in use on batteries. This may be caused by a weak 1A5-G output tube. Changing this tube will remedy the condition.—*Air King Engineering Dept.*

—end—

## RTMA OPPOSES LICENSING

Licensing or public regulation of any form of radio and television service technicians met with strong opposition by the Radio-Television Manufacturers Association. That group voted overwhelmingly in favor of taking action to provide an effective answer to the demand for regulation, particularly in the New York City area.

Definite plans have not yet been drawn up to eliminate the criticism of present servicing facilities, but the RTMA indicated that manufacturers, distributors, and technicians will be called upon to cooperate in a program to eliminate unethical service operators. A code of advertising and selling ethics was drawn up by the RTMA and is being submitted to the entire membership for comment.

## PICTURE TUBE FAILURE

Many set owners worry about their picture tube going bad and about the cost of replacement. This is particularly true of those who have not invested in a second year's service contract.

Yet picture tube failure is one of the least frequent causes for TV set repairs. One New Jersey service technician said that in over 400 sets serviced in the past few years, only about 15 required new picture tubes, and none of these were in sets he had sold in his own shop.

One prewar set was still using the same C-R tube.

## THE FUND GOES OVER $7,500.00

## HELP - FREDDIE-WALK FUND

Last month we had a visit from Herschel Thomason, Arkansas radio technician, whose three-year-old son Freddie Thomason was born both armless and legless.

Freddie's father reported that the boy is getting along splendidly and has taken on quite a bit of weight and enjoys his leg braces immensely, although he cannot as yet walk. He has only learned to balance himself and the only way he will ever be able to walk will be by twisting his body from side to side, which will give him a sort of walk—none too good—but sufficient to be able to get around by himself.

Every few months his parents have to come up north to the institution which is fitting these appliances onto Freddie and gives him walking lessons. It will take a long time before he will finally be enabled to even have a semblance of walking.

This month we are happy to report the following generous contributions:

$3.50 tendered by Miss Cecilia J. Goldpaugh for the Pupils of a One-Room School in Sawkill, N. Y.

$135.00 contributed by the Staff and Students of the Radio Electronic Television Schools, Detroit, Michigan through Eugene H. Wolfe.

Please do not stop with your efforts as all of us wish to help make Freddie a radioman when he finally grows up.

Please send your contributions from time to time—even the smallest donation will be greatly welcome.

*Make all checks, money orders, etc., payable to Herschel Thomason.* Please address all letters to:

Help-Freddie-Walk Fund
c/o RADIO-ELECTRONICS
25 West Broadway
New York 7, N. Y.

| | |
|---|---|
| Balance as of February 20, 1951 | $7,253.71 |
| Anonymous—Glendale, Calif. | $ 1.00 |
| Anonymous—Los Angeles, Calif. | 1.00 |
| Anonymous—Ridgefield Park, N.J. | 3.00 |
| Anonymous—Troy, N.Y. | 1.00 |
| Anonymous—Bedford, Ohio | 2.00 |
| Katie Baier—Baltimore, Md. | 1.00 |
| J. H. Barksdale—Charlottesville, Va. | 5.00 |
| Bertha Bishop—Baltimore, Md. | 1.00 |
| H. L. Bumbaugh—Los Angeles, Calif. | 5.00 |
| Patricia Casto—Scotia, N.Y. | 1.00 |
| Erna Cermak—Baltimore, Md. | 1.00 |
| James J. Cermak—Baltimore, Md. | 1.00 |
| James O. Cermak—Baltimore, Md. | 1.00 |
| William E. Cermak—Baltimore, Md. | 1.00 |
| J. T. Cookson—Puxico, Mo. | 1.00 |
| Margie Cruttenden—Baltimore, Md. | 1.00 |
| Hazel Davis—Baltimore, Md. | .25 |
| Mrs. V. E. Davison—Huron, S. Dak. | 5.00 |
| Mrs. C. P. Donnelly—New York, N.Y. | 2.00 |
| Elion Brothers—El Paso, Tex. | 5.00 |
| Paul Evans—Dayton, Ohio | 2.50 |
| Karl Fleck—Baltimore, Md. | 1.00 |

| | |
|---|---|
| From a Dorchester Freddie to Freddie —Dorchester, Mass. | 2.00 |
| Don Goetcheus, W2QH —Binghamton, N.Y. | 2.00 |
| Paul Guertin—Quebec, Canada | 3.00 |
| R. F. Harvey—San Diego, Calif. | 2.50 |
| Hassett's—Franklin, Va. | 2.00 |
| Madge Higdon—Baltimore, Md. | 1.00 |
| Frank Hollingshead—Garnett, Kansas | 5.00 |
| Miss Jeanne Jones—Indianapolis, Ind. | 2.00 |
| O. G. Keylor—Lancaster, Pa. | 3.00 |
| Sfc. Eugene E. Kodadek Washington, D.C. | 5.00 |
| Mr. and Mrs. Gene Lemons & Sons Cambria, Ill. | 2.00 |
| Edward Leward—Chicago, Ill. | 2.00 |
| H. Owen—Santa Marta, Col., S. A. | 2.00 |
| J. Owen—Santa Marta, Col., S. A. | 2.00 |
| Mrs. Isabel Owen—Santa Marta, Col., So. Amer. | 1.05 |
| Miss Isabel Owen—Santa Marta, Col., So. Amer. | 1.00 |
| Marie Peek—Baltimore, Md. | 1.00 |
| Walter Prybysz—Lockport, Ill. | 2.00 |
| Pupils of a One-Room School —Sawkill, N.Y. | 3.50 |
| Iva Rapp—Baltimore, Md. | 1.75 |
| Carrie Rellinghaus—Baltimore, Md. | 1.00 |
| O. E. Schellhose—Baltimore, Md. | 5.00 |
| Lawrence Sigmont—Weirton, W.Va. | 2.00 |
| Sgt. Paul H. Smith —c/o P.M., New York City | 10.00 |
| Staff and Students of the Radio Electronic Television Schools —Detroit, Mich. | 135.00 |
| Sunridge Radio T.V.—Brooklyn, N.Y. | 1.00 |
| Gray Trembly—Somerville, Mass. | 5.00 |
| T/Sgt. James E. Welch c/o P.M., New York, N.Y. | 1.00 |
| Mildred Wilson—Baltimore, Md. | 1.00 |
| George Wirsching—Baltimore, Md. | 1.00 |
| Wilbur Wright—Hamilton, Ohio | 2.00 |
| Total received to March 19, 1951 | $7,505.26 |

## Radio Thirty-Five Years Ago
### In Gernsback Publications

**HUGO GERNSBACK**
*Founder*

| | |
|---|---|
| Modern Electrics | 1908 |
| Electric Experimenter | 1913 |
| Radio News | 1919 |
| Science & Invention | 1920 |
| Television | 1927 |
| Radio-Craft | 1929 |
| Short-Wave Craft | 1930 |
| Television News | 1931 |
| Wireless Association of America | 1908 |

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

### MAY, 1917
### ELECTRICAL EXPERIMENTER

War and the Radio Amateur, by Hugo Gernsback
Wireless Telegraphy, by E. B. Pillsbury
San Diego—Largest Radio Station in U. S., by J. Bassett
An Exceptional Amateur Radio Station
Van Wireless Traces Messages
How the Audion Repeater Repeats
The Ionic Radio System and Theory of Ionic Tuning, by Otto E. Curtis
Receiving Marconi 300 K. W. Spark Stations with Oscillating Audion, by Samuel Curtis, Jr.
Distributed Capacity and its Effect, by Samuel Cohen
A Study of the Law of Response of the Silicon Detector
Auxiliary Relay Break for Coherers
Using "Auto" Spark Coil for Radio, by George F. Harrington
A Drum Type Antenna Switch, by Harold Davie

### Service Contract Exposed

The television service contract is just beginning to be dragged out into the light for remedy as the villain responsible for much of owners' difficulties and for most of the bad feeling between the set owner and the service technician. The surprising thing is that this has not been done before. Exposés and licensing bills both have gravely recited abuses due to the service contract, then gone on to recommend control, regulation, or greater attention to every other factor in servicing.

It began with the Associated Radio-Television Servicemen of New York City, who early this spring put on record a resolution which stated that since most of the customers' troubles were due to the contract method of servicing, pay-by-the-call servicing was to be recommended as a more reliable and less expensive method. The resolution was published in the daily press (and in RADIO-ELECTRONICS, April, page 94).

Next step was made by New York City Councilman Keegan, who has for nearly two years been attempting to put a licensing bill through the New York City Council. Faced at a public hearing with the fact that his proposed bill overlooked completely the dealer who writes service contracts but himself does no servicing, Keegan promised to amend the proposed bill to include all organizations writing service contracts. Keegan stressed that the great bulk of television service complaints originated with customers who had paid for a year's service in advance and had received inadequate or no service.

Now the New York Senate has swung into action, with the O'Connor Bill, No. 344, especially directed at service organizations who receive money under contract for television servicing. The full text of the proposed act follows:

> Section 1. The legislature hereby declares that it is a matter of grave concern, that a great number of the inhabitants of the state have been deprived of money paid to persons, firms or corporations for service contracts which have not been fulfilled. Greater number of such inhabitants are daily becoming the owners of television receivers, and as a result thereof a new business of servicing, maintaining and repairing said television receivers, including installation and servicing of antennae has come into being. Due to the method of operating said business numerous persons have paid in advance sums of money for service contracts and thereafter have failed to receive said service due to the financial failure of the service organizations resulting in great financial loss to said inhabitants of the state. The unscrupulous tactics of such service organization tends to harm ethical businessmen and organizations and to discredit the television industry generally, it is hereby declared a

matter of legislative determination that remedial measures are necessary.

§ 2. The penal law is hereby amended by inserting therein a new section, to be section thirteen hundred two-c, to read as follows:

§ *1302-c. Payments of money under contracts for servicing television receivers, apparatus and antennae. All payments of money received by any person, firm or corporation under contracts hereafter made by such person, firm or corporation as a consideration for the promise or agreement of such person, firm or corporation to install or service television receivers or any apparatus or equipment incidental thereto or connected therewith shall receive such money as a trust fund which must be deposited in a special account subject to withdrawal by such person, firm or corporation to the extent the withdrawal in any one month shall be equivalent of the proportion one month bears to the time of the entire contract. Payments made under any renewal of such contracts shall likewise be subject to the provisions of this section. Such person, firm or corporation may issue in place thereof a contract stating that a contract bond issued by an insurance company authorized to do business in this state and naming such company has been issued which guarantees the performance of such agreement.*

§ 3. This act shall take effect immediately.

(We quote the bill verbatim: its language is not due to typographical errors on our part.—*Editor*)

This does not indicate that the television contract is on the way out. Many television set owners who have had the good luck (and good sense) to tie up with a reliable service firm find it a comfortable blend of service and insurance and prefer it to pay-by-the-call servicing. Put on a reputable basis, and stripped of the "unlimited calls" feature which is now disappearing from most service contracts, it may become a stable and permanent factor of television servicing.

## New Slant on License

New slant on the television service licensing controversy was offered by the Associated Radio-Television Servicemen of New York City recently, in a proposal to license technicians rather than firms.

Introducing the proposal, ARTSNY president Max Leibowitz, pointed out that bills proposed up to the present provided for only one qualified technician to a service organization. This, he said, would not improve television servicing, but would have the opposite effect. A license that would attest that the man actually working on his receiver had passed a technical test and subscribed to a code of ethics would, however, assure the customer of qualified service, and would also partially protect the service industry from the bad reputation caused by the work of half-trained "technicians."

ARTSNY also proposed that a group of radio technicians be chosen to act as a consultative body to any licensing authority set up by the council.

### NEW SLATE FOR TEXAS GROUP

New 1951 officers of the Texas Electronic Technicians Association (TET) of Houston, Texas, are:

President—Frank J. Humpola (re-elected)
Vice-President—G. A. Brown
Secretary—Al Gaske
Treasurer—F. H. Lillard (re-elected)

The Houston association meets twice monthly, and since its beginning just a little over 18 months ago has increased its membership from the original 12 to a current 100.

### SERVICING RESPONSIBILITY

"Divided responsibility" is the cause of much television service trouble, according to Victor H. Nyborg, president of the Association of Better Business Bureaus. In an article in the *American Magazine* entitled "Quacks of the Electronic Age," Mr. Nyborg states that the division of responsibility among the dealer, the repairman, and the manufacturer for the performance of a piece of equipment exists in this field as the first instance of such in business history. And it has led in some instances to what is known as the "three-cornered brush-off" familiar to set owners and service technicians alike, in which neither the service technician, the dealer, nor the manufacturer assume responsibility sufficient to satisfy the owner of the inoperative receiver. When the problem is not one of an inoperative receiver, but of dealer's representations as to performance, the situation becomes even more complex, as the repairman knows and the article proves.

Mr. Nyborg rejects licensing as a complete solution of the problem, by pointing out that it has not kept out the unscrupulous minority in such an old profession as medicine. He suggests that the remedy may be self-government by means of repairmen's organizations with defined codes of ethics and procedures strong enough so that the crooked service technician would flout them only at his peril. The Pittsburg Radio Repair Men's Association is cited as an example, as well as combined groups in New York City, where dealers, the local service technicians' association, and the Better Business Bureau have co-operated to produce a fair practices code which is being used as a model in other cities.

### OHIO CONFERENCE

Subjects to be presented at the National Conference on Airborne Electronics will range from Antennas and Components to Radar and Airborne Television. This conference will be held on May 23, 24, and 25 at the Biltmore Hotel in Dayton, Ohio.

—end—

**W. L. Rothenberger,** formerly assistant general sales manager of the RCA Tube Department, was promoted to the post of manager of sales operations. He will co-ordinate the activities of the Renewal Sales and Equipment Sales Sections. **M. J. Carroll** and **H. F. Bersche** continue as respective managers of the Equipment and Renewal Sales Sections. **L. J. Battaglia** was appointed manager of the Renewal Sales Field Force, and **L. F. Holleran** manager of Sales Administration. **G. C. Brewster** and **M. R. Stoecker,** newly appointed managers of the Sales Planning Section and the Product Distribution Section, report to Mr. Holleran.

W. L. Rothenberger

**Lawrence Le Kashman,** former assistant to the advertising manager, was promoted to manager of the Advertising and Sales Promotion Section of the RCA Tube Department. He reports to **Julius Haber,** advertising and sales promotion director for all RCA Technical Products. Mr. Haber was also named acting manager of Advertising and Public Relations for the Tube Department.

L. Le Kashman

**Leonard F. Cramer,** vice-president and director of Allen B. Du Mont Laboratories, was named to head the company's newly formed Government Liaison Department. The new department will be responsible for defense mobilization planning and will work on armed forces contract negotiations.

Leonard F. Cramer

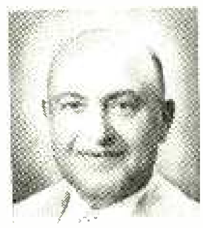
**Edwin B. Hinck,** active with Allen B. Du Mont Laboratories since 1943, was promoted to the post of sales manager of the Electronic Part Division He succeeds Major Harry Van Rensselaer, who was recalled to active duty with the Air Force. Mr. Hinck will be responsible for the sale of new products and components manufactured by the Electronic Parts Division.

Edwin B. Hinck

**Robert C. Tait** and **Fred R. Lack** were elected co-chairman of the Joint Electronics Industry Committee sponsored by the RTMA and the National Security Industrial Association. The committee was established to co-ordinate industry mobilization activities.

James B. Lindsay

**James B. Lindsay** was elected vice-president and director of THOMAS ELECTRONICS. He will direct the company's expanded production program in cathode-ray, miniature and subminiature television tubes. Mr. Lindsay has been active as a key electronic executive with several major companies.



Louis Gerard Pacent

**Louis Gerard Pacent**, president of the PACENT ENGINEERING CORP., was awarded the Marconi Memorial Medal of Achievement by the Veteran Wireless Operators Association at its 26th Anniversary Dinner. Mr. Pacent received this award for his pioneer work in radio and communications. Captain George F. Shecklen, USNR, executive vice-president of the Radiomarine Corp. of America, also received the award.

R. M. Butler

**R. M. Butler**, distributor contact man in Philadelphia for the INTERNATIONAL RESISTANCE CO., was promoted to the position of assistant sales manager of the Merchandise Division servicing electronic distributors. **J. F. Whitaker** succeeded Mr. Butler in the Philadelphia area.

**Arthur C. Stallman**, Ithaca, N. Y.; **Dahl W. Mack**, Scranton, Pa.; **W. D. Jenkins**, Richmond, Va.; **George Wedemeyer**, Ann Arbor, Mich.; **Hoyt C. Crabtree**, Dallas, Tex.; and **Lealis L. Hale**, Monroe, La., were named by the Industry Advisory Committees of the National Production Authority to serve on the Electronic Parts and Components Distributors Industry Advisory Committee as members of the National Electronic Parts and Components Distributors Association.

**Glen McDaniel**, first full-time paid president of the RTMA, was named chairman of the association's Policy Committee. Other members include: **Benjamin Abrams**, EMERSON; **Dr. W. R. G. Baker**; GENERAL ELECTRIC; **Paul Galvin**, MOTOROLA; **L. F. Hardy**, PHILCO; **Leslie F. Muter**, MUTER CO.; **A. D. Plamondon, Jr.**, INDIANA STEEL PRODUCTS; **Robert C. Sprague**, SPRAGUE ELECTRIC CO.; **Robert C. Tait**, STROMBERG-CARLSON; and **R. G. Zender**, LENZ ELECTRIC MFG. CO.

## Personnel Notes

. . . **Joseph T. Bozzelli**, formerly with Brach Manufacturing Co., joined HAYDU BROTHERS, Plainfield, N. J., as general sales manager.

. . . **R. O. Bullard** was appointed manager of manufacturing of the GENERAL

Electric Tube Divisions. Formerly a staff assistant of the Tube Divisions, he has been with General Electric for 20 years.

. . . **Harold J. Schulm :n**, active in television servicing activities in the New York City area since 1946, joined Allen B. Du Mont Laboratories as service director of the Teleset Service Control Department.

. . . **C. M. ("Buck") Lewis** was named manager of the Broadcast and Communications Sales Section of the RCA Engineering Products Department. He was formerly manager of Broadcast Field Sales for the Engineering Products Department.

. . . **Andrew F. Stanier** was elected president of Eureka Television and Tube Corp. He succeeds **William R. Holt** who resigned. Mr. Stanier will continue as chief engineer. **Frank X. Wells**, former chief maintenance supervisor, succeeds Mr. Holt as chief maintenance engineer. Mr. Holt will continue as chief engineering consultant as well as a member of the board of Eureka.

. . . **D. E. H. Schulz**, chairman of the Electrical Engineering Department at Armour Research Foundation of Illinois Institute of Technology, was elected president of the National Electronics Conference, Inc. **Dr. W. G. Dow** of the electrical engineering department at the University of Michigan was made chairman of the board.

. . . **Allen Henry**, advertising manager of Belmont Radio Corporation, manufacturer of Raytheon television sets, was appointed contracts administrator for the company. He will retain supervision of television advertising. The company also appointed **William Garstang**, Midwest regional sales manager for Belmont, as contracts co-ordinator, technical products.

. . . **Frank Freimann**, president of Magnavox Co., was elected a member of the RTMA Board of Directors by the Set Division Executive Committee to replace **Richard A. O'Connor**, chairman of the Board of Magnavox, who resigned.

. . . **Ray F. Crews** was appointed vice-president in charge of sales for the Fairchild Recording Equipment Corp.

. . . **F. J. Cooke** joined the Reeves Soundcraft Corp. as general manager of the Colorcraft and Magnetic Tape Divisions. He was formerly an engineering executive with Remington Rand Electronic Tube Laboratory.

. . . **L. W. Howard** of Triad Transformer Co. was elected as the West Coast Electronic Manufacturers Association representative to the Radio Industry Co-ordinating Committee and the 1951 Parts Distributors Show.

. . . **Jerome Tannenbaum** and **Bill Cameron** joined the Concord Radio Corp., Chicago, respectively as chief engineer of the Audio Division and store manager.

. . . **Harry D. Hanafus** was named purchasing agent for the newly formed Electronic Tube Division of the Westinghouse Electric Corp.

. . . **W. E. Darden** rejoined the Hammarlund Manufacturing Co. as general sales manager for the company. . . . **H. Leslie Hoffman**, president of the HOFFMAN RADIO CORP., was awarded a plaque by the San Francisco Academy of Television Arts and Sciences. The plaque was awarded for his company's contributions to the television industry and for his outstanding public service.

. . . **W. G. (Bill) Many** resigned as advertising and sales promotion manager of the CORNELL-DUBILIER CORP., to open his own public relations service.

. . . **Russell G. Eggo, B. L. Bethel, Charles E. Palmer, Lewis G. Woycke,** and **Charles L. Hubbard** were elected vice-presidents of JOHN MECK INDUSTRIES. **John S. Meck** was re-elected president and **G. F. Meck** treasurer.

. . . **Arthur L. Reese**, former West Coast regional manager of the Communications and Electronics Division of the Motorola Co., was named marketing manager of the Microwave and the Carrier and Control Sections of the company.

. . . **George E. Smith** was elected to the Board of Directors of the SIGHTMASTER CORP.

. . . **Henry Schneider**, formerly with STEWART-WARNER, joined the PENTRON CORP. as special assistant to the director of purchasing.

. . . **Robert Sebris**, a Swiss instrument and meter engineer, joined OAK RIDGE PRODUCTS engineering staff.

. . . **Henry Fogel** was named executive vice president of the newly reorganized MCMURDO SILVER CO., New York City. He was previously with Tele-Tone Radio Corp.

. . . **George A. Engelbert** was promoted from assistant section chief to section chief, technical publications of Bendix Radio Division of BENDIX AVIATION.

. . . **Joseph W. Fleming**, manager of the Technical Information Center for PHILIPS LABORATORIES, was killed in an automobile accident in Edgewater, N. J.

—end—

## PRE-1925 ELECTRIC LAMPS CAUSE TV INTERFERENCE

Ancient light bulbs can cause TVI, as mentioned in a Technote in the April RADIO-ELECTRONICS. Information from General Electric's Lamp Department reveals that bulbs of pre-1925 manufacture are the main offenders. These lamps have straight-wire filaments which radiate directly to the antenna circuit of the TV set. The interference appears as a horizontal pattern at one to three places on the screen.

Most of these lamps are probably located in hallways, attics, or basements, where they are used intermittently. Since frosted bulbs came into use about the same time as the coiled filament, usually the trouble is found to be caused by clear glass bulbs of older vintage.

One way of identifying this type of interference is by its intermittent character, as these lamps are turned on only occasionally.

## TV'S THE THING

*Dear Editor:*

I am a student at the Baltimore Technical Institute, which is the largest radio and television school in Maryland. I have completed radio and am now in TV. . . . In the last few months you have been printing a lot of valuable TV servicing information, such as the "Television Service Clinic" and a couple of others. The Service Clinic I think is very good and I hope you will continue it.

ALBERT BEHRENS

*Dundalk, Md.*

## MORE ON TUBE CARDS

*Dear Editor:*

I would like to make a suggestion to Mr. J. R. Woollard of Nashville, Tennessee, regarding his idea of tube data on cards.

RCA has a Triple Pindex in which Mr. Woollard will find the tube diagrams large enough and there is enough room for any further reference data to be added.

I would like to add that I appreciate reading your magazine, especially the important contribution by Mr. Buchsbaum ("TV Service Clinic"), which is a great help to all service technicians.

F. G. WITNEY

*Brooklyn, N. Y.*

(This method might be satisfactory. We still feel, however, that some manufacturer is missing a bet in not putting out a card-index type of tube data book, possibly with the base diagrams on the back of the cards to permit a clearer drawing. It could be kept perpetually up to date with supplements as new tubes are produced.—*Editor*)

## FM FOR AUTOS

*Dear Editor:*

Why doesn't the automobile industry manufacture and install frequency modulation radio receivers in their horseless chariots? Even when purchasing a Cadillac, one must buy an AM radio set.

CLYDE D. KIEBACH

*Washington, D.C.*


*Suggested by N. Blew, Sarasota, Florida*

My husband says he thinks it is a condenser . . ."

**MOST-OFTEN-NEEDED 1951 TELEVISION SERVICING INFORMATION, compiled by M. N. Beitman. Published by Supreme Publications, Chicago, Ill. 8½ x 10¾ inches, 192 pages. Price $3.00.**

The latest edition to be added to the Most-Often-Needed series is, as its title implies, a compilation of service data on this year's crop of TV receivers. It contains schematic diagrams, alignment instructions, drawings showing placement of parts, and set manufacturer's latest production changes.

The material is arranged to serve as a quick and easy guide for the busy repairman who is not interested in wading through a lot of theory and explanation when he has a broken down set on his bench to repair.

Because the sets built in the period covered by this book were built during parts shortages, production changes were frequent. These are covered by the book wherever possible.

The value of this book of up-to-date servicing data need not be stressed to the working television service technician. The active TV experimenter and constructor will also find much of the data and circuitry contained in the book useful when modernizing or revamping an older set.—*RFS*

**SUPER-REGENERATIVE RECEIVERS, by J. R. Whitehead. Published by Cambridge University Press, New York, N. Y. 5½ x 8½ inches, 169 pages. Price $4.75.**

Prior to the war little technical information was available on the design of superregenerative detectors. Judging from the published information, engineers knew comparatively little more than the rank amateur who was aware that they were tricky circuits which—with all their squeals and whistles—were, on occasion, capable of running rings around a superheterodyne designed to receive on the same frequencies.

The demand for simple, reliable v.h.f. radar receivers having high sensitivity and selectivity led to extended research on the superregenerative detector. As a result of this work, the author submits design data which makes possible the solution of such problems as: how to design for given selectivity, how signal-to-noise ratio compares with that of a superheterodyne, what is the optimum relationship between signal and quench frequencies for receiving different types of transmissions, how do various design factors affect gain and selectivity. The data which leads to the solution of these and other problems is substantiated by graphs, oscillographic patterns, and several practical diagrams.

The author uses higher mathematics to explain many of the phenomena and to develop design factors, but this does not make the book less useful from a practical standpoint. The author's clear, easy-to-read style and the many simplified design formulas make the work highly useful to students or engineers who may lack the background or inclination to wade through the more complex mathematical derivations and analyses.—*RFS*

—end—

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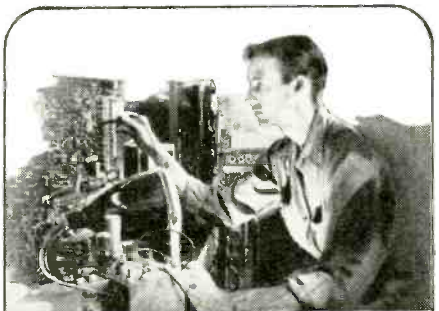

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### RADIO SCHOOL DIRECTORY (Page 127)



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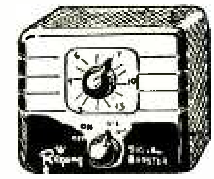

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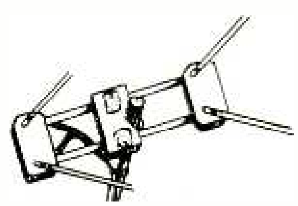

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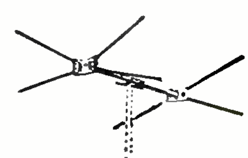

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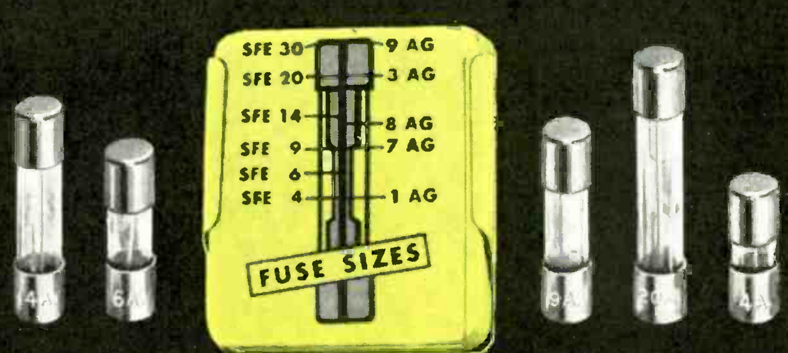


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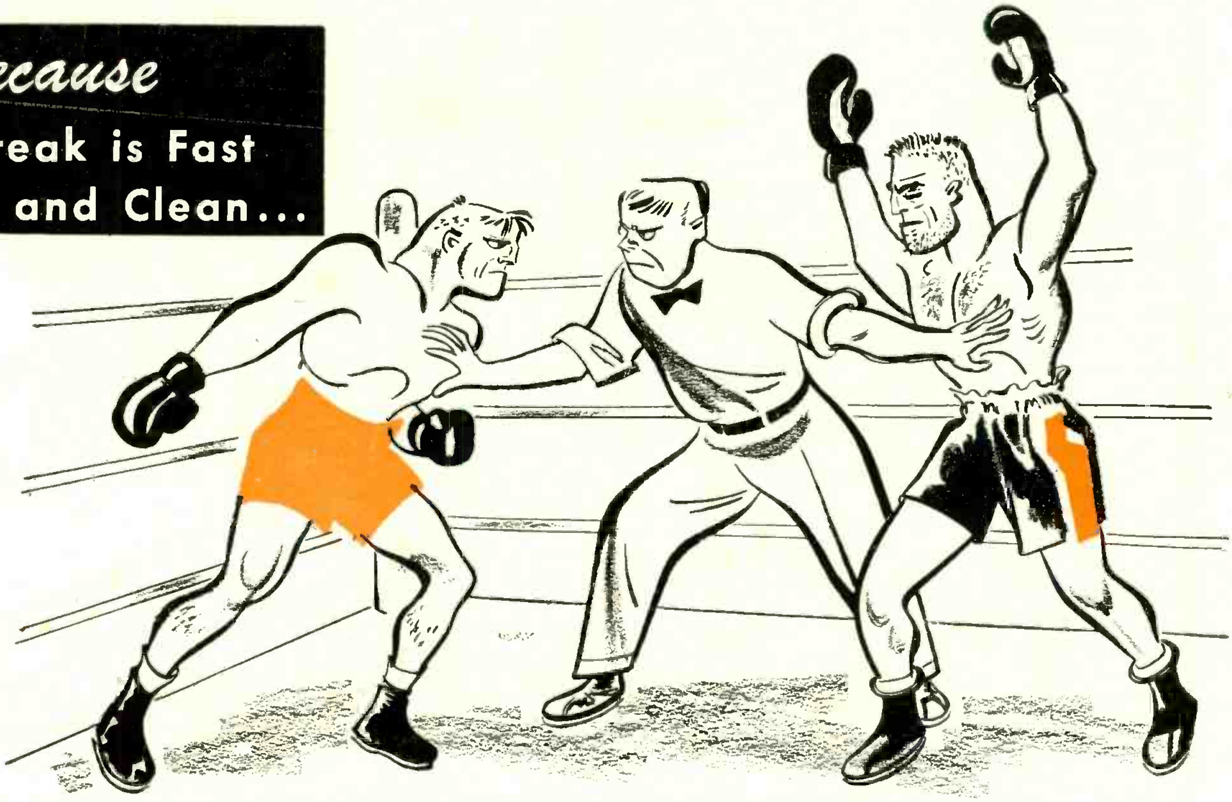

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