RADIO — ELECTRONICS

K

Exclusive
TELEVISION NEWS
Section

HUGO GERNSBACK, *Editor*

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RADIO CRAFT

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1949 IS T-V YEAR

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LATEST IN RADIO — ELECTRONICS — TELEVISION

If your Pictures look like this →

YOUR TELEVISION WILL BE IMPROVED WITH A WARD OUTDOOR AERIAL

to give you Pictures like this →

The modern miracle of pictures by air can be a most satisfying means of entertainment. But be satisfied only with a picture comparable to a class "A" motion picture—on every station in your area. *It is unnecessary to compromise!*

HERE'S WHY: Television waves are like light beams — solid objects reflect and refract them, making it impractical to pick up all stations from an indoor aerial. That is why you get double images on some stations.
In addition, indoor aerials have poor signal pickup making it difficult to get good pictures on all stations.

FURTHERMORE: Your indoor antenna may have a high noise level which increases the amount of interference as you advance the contrast control to bring up a weak picture. All of these technical difficulties are eliminated by a WARD outdoor aerial installed by a competent radio serviceman. In *every case*, a Ward outdoor antenna will improve reception over an indoor aerial. Also, Ward aerials are so well designed, they are attractive on a house. *It is unnecessary to compromise!*

WARD is the largest and oldest exclusive maker of television and auto radio aerials.

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Does the antenna on your automobile need repair? Replace it with WARDS'S 8-BALL — world's largest selling auto aerial.

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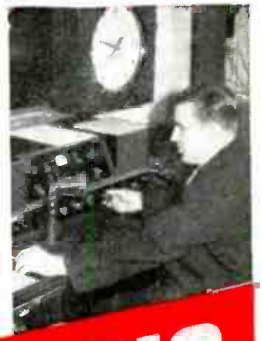
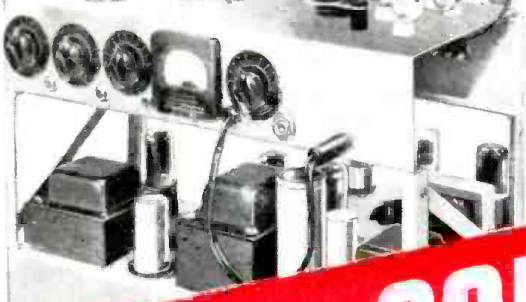
A Federal Communications Commission Commercial Operator's License puts you in line for a good job in Radio or Television Broadcasting, Police, Marine, Aviation, Two-way, Mobile or Micro-wave Relay Radio. Mail coupon below for book and catalog (both FREE) about my NEW Communications course.



YOU BUILD THIS TRANSMITTER

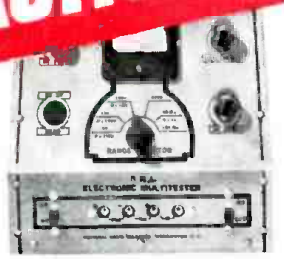
with parts I send. This low-power broadcasting transmitter shows you how to put a station "on the air." You perform procedures demanded of Broadcast Station Operators, conduct many experiments, make many practical tests.



LEARN COMMUNICATIONS by PRACTICING at Home in Spare Time

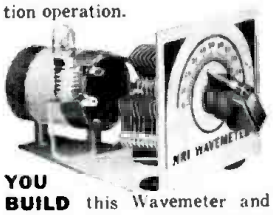
with MANY KITS of MODERN EQUIPMENT I SEND

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 SET UP code amplitude and frequency modulation circuits (put voice, music, etc., on "electrical signal" you produce). You introduce, correct defects, 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?

In 1945, there were 943 Broadcasting Stations. Today 2,694 are on the air! Result—THOUSANDS OF QUALIFIED MEN STEPPED INTO GOOD JOBS. Only 19 Television Stations were on the air in 1947. Today there are more than 50 and experts say there will be 150 in a few months. 1,000 within three years. That means thousands of well-paid jobs for trained Operators and Technicians. 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 books. Read outlines of 78 lesson texts written for you by leading Communications experts, edited 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 BRAND NEW course includes BOTH Theory and Practical Experience, with result-getting kits, in Radio-Television Communications. It's backed by N. R. I.—the world's oldest and largest home study Radio school.

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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 Parts. You conduct experiments and tests with modern Radio and other circuits you build. 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 catalog. Mail coupon.

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I TRAINED THESE MEN

"I am now Chief Engineer of Radio Station WORD, in charge of four engineers. Owe all I know about Radio to N. R. I."—C. J. BURDETTE, Spartanburg, S. C.

"I have been in several kinds of Radio work. I am now specializing in Marine Radio telephone installations and service."—MURRAY DICKSON, Paducah, Ky.

"Thanks for splendid Home Study Radio Course, a large factor in my getting present position as Senior Radio Operator of Station WRGP."—C. LISTER, Pensacola, Fla.

"When I enrolled, I had no idea of entering Commercial Radio. Now Operator, Police Radio Station WASP and Highway Station WKSJ."—G. DeRAMUS, Selma, Ala.

"Hold a Radio telegraph Second Class License. Now with Civil Service as P-4 Electrical Engineer."—OTIS L. WRIGHT, Albuquerque, N. M.

"Am now Chief Engineer at Radio Station WAGC. Still using my N. R. I. texts as swell references."—CHAS. W. STOKELEY, Chattanooga, Tenn.

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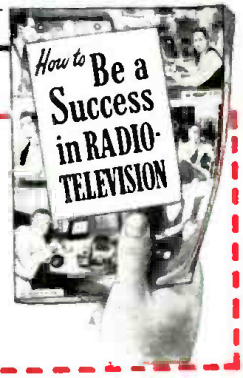

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Contents — November, 1949

ON THE COVER: Tex (Mrs. Rose Ann) Barbarite, television engineer, doing maintenance work on the equipment at RCA's Exhibition Hall, Radio City, New York, N. Y. Kodachrome by Avery Slack.

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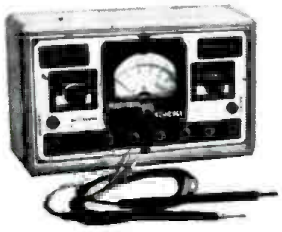
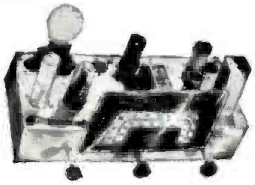


YOU RECEIVE THIS PROFESSIONAL MULTITESTER!

You will use this professional instrument to locate trouble or make delicate adjustments—at home—on service calls. You will be proud to own this valuable equipment. Complete with test leads.

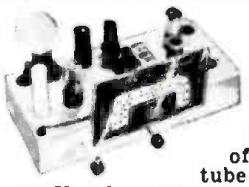
SIGNAL GENERATOR



You construct the Transitron Signal Generator shown here, demonstrating Transitron principles in both R.F. and A.F. stages. You study negative type oscillators at firsthand.

AUDIO OSCILLATOR:

An electronic device, which produces audio-frequency signals for modulating R.F. (radio frequency) carrier waves, testing A.F. (audio frequency) amplifiers, speakers, etc.



T.R.F. RECEIVER

You build several T.R.F. Receivers, one of which, a 4-tube set, is shown here. You learn construction, alignment, make receiver tests, and do trouble shooting.

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Broadcasting, Telecasting
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And scores of other good jobs in many related fields

YOU CONDUCT MANY EXPERIMENTS LIKE THESE!

Checking action of condensers
Experiments with AF and RF amplifiers
Experiments with resonance
Producing beat frequencies
Calibrating oscillators
Experiments with diode, grid-bias, grid-leak and infinite impedance detectors
Practical experience in receiver trouble shooting
Application of visual tester in checking parts and circuits
Experiments with audio oscillators
Advanced trouble-shooting
. . . and many, many others

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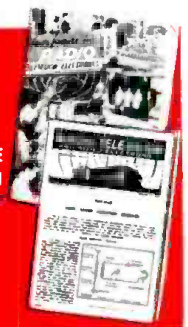

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Place these two new 1950 National Television receivers side by side with any other television receiver. Compare the large (12½") screen — compare the chassis — compare the picture quality — compare the cabinet styling. Because National Television is custom assembled — not mass-produced — there just *is* no comparison! Yet it costs no more.

Model TV-12W
Striking modern mahogany table model with 12½" tube and 2 six-inch oval speakers.
$269.95

Model TV-1225
A 12½" picture tube and a 10" speaker in a handsome mahogany console.
$299.95

● **Model TV-10W**
Genuine mahogany table model with 10" screen and 2 six-inch oval speakers.
$229.95

● **Model TV-7W**
Unbeatable TV dollar value. 7" screen with twin speakers. NC enlarging lens available, $16.95.
$129.95

● **Model TV-7M**
Metal cabinet version of TV-7W. Ideal as "second set" for playroom, den or bedroom.
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(1) Latest flyback high voltage supply gives clear, bright pictures even in fringe areas. (2) Automatic frequency control locks picture in place. (3) Exceptionally wide video band-width for beautiful clarity of detail. (4) Front-of-panel focus control. (5) Coil switching assures equivalent of separate, high-Q tuned circuits for each channel. (6) Automatic gain control. (7) 3-stage 37 mc IF minimizes picture interference caused by other radio services. (8) Double-tuned RF bandpass circuits improve selectivity and image ratio. (9) Automatic Station Selector and fine tuning control.

Prices Slightly Higher West of the Rockies

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★ CAMERAMEN

★ TECHNICIANS

★ INSTALLERS

Here's How CREI Home Study Training Prepares You for a Better Job in

TELEVISION

★ SERVICEMEN

Get *in* and get *ahead* in Television . . . the field that *Fortune* Magazine says is **"the most dynamic single element in the entire American economy!"** Within a few years, says the magazine, TV will be one of the *first ten* industries in the U.S.

New FCC frequency allocation plans call for 2,245 video stations in 1,400 communities. Since a television station requires many more technicians and engineers than the average AM station, you can readily see the great number of good jobs that are needed to be filled within the next year or two.

If you are now in radio, this is the time to prepare for your future in Television. CREI offers the very training you need to go after—*and get*—a good TV job. CREI courses can be studied in your spare time and can be fitted into the most crowded schedules. They are designed to give you a thorough grounding in basic principles (remember that all new electronic developments have their roots in past techniques) and take you step-by-step through the more advanced subjects of TV and its related fields.

Don't wait another day. Television won't wait for you. In all our 22 years of association with professional radiomen we know that the man who acts promptly is the man who succeeds. The facts about CREI, our courses, and what we can do for you, are described in our 32 page booklet. It's worth reading. *Send for it today.* **(Veterans: CREI training is available under the G.I. Bill. For most veterans, July 25, 1951 is the deadline—act now!)**

SAMPLE LESSON FREE!

Now, see for yourself, how interesting it is to study at home and improve your ability the CREI way.

"THE ORTHICON AND IMAGE ORTHICON"—this lesson describes the development of the small, 3-inch image orthicon tube; theory and operation of the orthicon; image orthicon; specific features.

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COLOR TELEVISION using all-electronic methods and utilizing only the present 6-mc channel was demonstrated to the FCC last month by RCA. Resulting from new and basic technical developments, the system permits color transmissions to be sent over existing, unmodified transmitters and to be received in black and white on present receivers. Receivers built for color reception or equipped with a color converter can receive programs either in color or in monochrome so that stations need broadcast in color only shows suited for it. The system is all-electronic, with no moving parts.

Dr. E. W. Engstrom, vice-president in charge of research at RCA Laboratories, who prepared the engineering statement for the FCC, said that there is no degradation in picture quality, whether images are received in color or monochrome, on special receivers or on standard ones. No receiver adjustments are required when stations switch from color to black-and-white or *vice versa*.

The new color system is based primarily on a time multiplexing system, by which three camera signals are successively sampled at high speed. Each signal carries picture information of one of the three primary colors. The signals are combined and passed to the transmitter after filtering, containing no components of higher frequency than 4 mc.

At the receiver the r.f., pix and sound i.f., second detector, and sound circuits are standard. The video signals are separated into their color components and fed to three cathode-ray tubes, one with red phosphor, one with green, and one with blue. The three images are projected on a screen in register so that in the final picture each color shows up in its correct value.

NEW INSTRUMENT called the *cholelithophone* locates gallstones inadvertently left in a patient's body after a removal operation. Some of the stones are as small as grains of sand; they are usually transparent to X-rays.

The instrument has a thin, flexible probe which the surgeon inserts in narrow ducts. When the probe tip encounters a stone, it acts like a phonograph needle. The tiny click is relayed to an amplifier and loudspeaker, which emits a distinctive "ping."

The inventors are Dr. E. A. Walker and E. G. Thurston of Pennsylvania State College and Dr. C. K. Kirby of the University of Pennsylvania Medical School.

BONDED TELEVISION SERVICE was launched last month in Boston, Mass., by the Federal Television Co., a service contractor, as its solution to the problem of contractor reliability. The bonded warranty is backed by the American Fidelity Co., a Vermont insurance organization. The company says its guarantee is unique in that the customer is assured of his year's service. Even if the contractor went out of business, the contract would still be performed by the insurance company.

TV SERVICE CONTRACTS may be made by independent service organizations (as well as by manufacturers and dealers) in New York State and may be substantially identical to those previously in effect—including renewal provisions—provided that new parts are not furnished without additional charge. This was (effectively) the ruling laid down in an interpretive bulletin issued last month by Alfred J. Bohlinger, Deputy Superintendent of the State Insurance Department, to clarify the department's position on the opinion given earlier by State Attorney-General Nathaniel Goldstein. An additional provision forbids "insuring" the set against damage from other than normal use, such as by fire; but standard service contracts have never covered such externally caused damage in any case. Goldstein's original interpretation of the law (see September issue of RADIO-ELECTRONICS, page 9) appeared to indicate that independent contractors could not operate at all.

TV RELAYS owned by private corporations and those operated by the Bell System should be interconnected, said the FCC last month in a proposed decision directing Bell to drop its policy against interconnection. The policy has heretofore prevented programs relayed for some distance by Du Mont or Philco relay systems from being carried further by Bell. While stating that television relaying will eventually be a business exclusively for common carriers, the Commission called the present refusal to tie up unjust and unreasonable because of Bell's lack of adequate facilities.

"PAY-BACK" TV SERVICE was announced last month by Sylvania Television as a new plan for reducing both set owners' contract cost and the number of nuisance service calls. Under Sylvania contracts, the buyer receives a book of coupons, each good for one service call. While the number of calls is not limited by the coupons, the owner receives a refund for each coupon he holds at the end of the year. Knowing that saved service calls mean saved money, owners will not request them without good reason and technicians will not waste time unnecessarily.

CITIZENS RADIO CORP., holder of the patents on the first transceiver to be approved by the FCC for use in the citizens band, was sold last month to Stewart-Warner Corp. Al Gross, inventor of the transceiver, will continue as chief engineer. Large-scale production is scheduled to begin soon; the firm has been flooded with orders.

THEATRE TELEVISION may require 60 channels, each 50 mc wide, for a complete and competitive nationwide theatre TV system, according to a statement made last month by the Society of Motion Picture Engineers. Picture quality will eventually have to rival motion pictures, say the engineers, and the 50-mc bandwidth may be essential to provide the extra definition.

SERVICE TECHNICIANS HOLD CONVENTION

Radio service history was made in the three-day convention and exhibition staged in Philadelphia on September 18, 19, and 20 by the Philadelphia Radio Service Men's Association (PRSMA). Held for the purpose of publicizing and promoting Pennsylvania's Preventive Maintenance Month in October, it was the first full-scale professional combined convention and show ever held by radio service technicians. More than 1,700 persons registered for the first evening of the convention, which began at 5 p.m. on the 18th and closed at 4 p.m. on the 20th. The evening of the 19th, attendance so greatly surpassed that of the first evening that it was necessary to turn several hundred people away. About 500 technicians were in constant attendance at the daytime sessions on Monday and Tuesday.

Fifty-two booths were occupied by companies whose products are interesting to the service technician and by radio magazines which deal with service problems. Exhibits ranged through the whole gamut of radio and television test equipment and accessories from antenna towers to technical books and service data.

Booths and technical sessions received almost equal attention from the attending service technicians. The latter included talks on the technician's technical and business problems and demonstrations of television servicing and trouble shooting, backed up by ample equipment. (Both the Dynamic Demonstrator operated by John Meagher of RCA and the oscilloscope and projection equipment used to assist the talk by Carl Quirk of Du Mont practically filled the stage.)

John Rider, Al Steinberg, and A. T. Alexander covered the general situation. Mr. Steinberg covered especially the relations among service technicians, distributors, and manufacturers. Mr. Alexander spoke on the problems of servicing and of service training from the manufacturers' viewpoint on a national scale.

Other papers covered television serving and maintenance from the antenna to the picture tube, with special attention to front ends, alignment, electronic antennas, multiple reception, and test equipment. The papers were exceptionally well received, and the hall was crowded during every one of the lectures and demonstrations.

The convention was presided over by Dave Krantz, president of PRSMA, who lost no opportunity to drive home the importance of the Preventive Maintenance Month campaign to the service technicians of Pennsylvania. Pointing out that the example of Harrisburg last winter proved that such a campaign could increase repair business as much as 25%, he urged that every set owner in the state be given an opportunity to have his set checked over to assure continued good performance and to avoid possible major repairs which may be necessary later.

Members of PRSMA cooperated to do the organizational, executive, and menial labor needed to keep the convention running smoothly, and it is to their efforts that the great success of the undertaking is due.

Above — Dave Krantz opens a session of the convention. Below — Service technicians visit the exhibitors' booths.

Radio Corp. of America, RCA-Victor Division, has placed on the market a new TV receiver to sell for $199.50. The set has a 61-square-inch screen and 22 tubes. The price is $70 lower than any previous RCA set and is the company's first below $200.

Zenith Radio Corp. reports estimated net consolidated profits for itself and its subsidiaries for the first three months ended July 31, 1949, of its current fiscal year amounting to $170,945 after federal income tax provision of $218,133, depreciation, excise taxes, reserve for contingencies, and a deduction of $251,376 representing amortization of good will incident to acquisition of a subsidiary.

Shipments for the quarter were down approximately 10% from the same quarter a year ago, due principally to the normal summertime seasonal decline and a two-week vacation shutdown.

Stewart-Warner Corp. sales for the first six months of 1949 were $27,875,957, a decline of 26.4% from 1948, JAMES S. KNOWLSON, chairman and president, revealed in a letter sent to stockholders. Sales in the first half of 1948 were $37,868,485.

Net profit for the six months ended June 30 was $796,564. Profit in the first half of 1948 was $1,874,601.

Motorola, Inc., for the six months period ended July 2, 1949, showed net earnings of $1,908,255, equal to $2.39 per share. This compares with earnings for the corresponding period last year of $1,650,039, equal to $2.06 per share.

The sales figure totaled $33,822,368, or nearly $7 million more than the corresponding figure for 1948, which was $26,918,540.

Planet Mfg. Corp., Bloomfield, N. J., has been organized to manufacture capacitors, according to PHILIP GREENSPAN, president. Other corporation officers are GEORGE F. JEPSON, vice president in charge of sales, IRVING A. GREENFIELD, treasurer and JOSEF UNGER, secretary, all formerly with Solar Mfg. Corp.

Admiral Corp. has increased its production capabilities to 15,000 receivers per week, vice president, J. B. HUARISSA stated recently. Increased expansion was made possible by the development at Admiral's Cortland Street plant in Chicago of the longest straight production line in the industry, and by installing facilities for the manufacture of 500 sets per day at the Harvard, Ill., plant.

Radio Parts and Electronic Equipment Shows, Inc., Chicago, through its president, JEROME J. KAHN, announces a distributors' advisory committee, made up of 10 of the industry's leading jobbers, to consult with the directors and management of the 1950 Distributors Show on ways and means of making the show of major interest and service to jobbers.

WILLIAM O. SCHONING, of Lukko Sales, Chicago, was named chairman and AARON LIPPMAN, of Aaron Lippman Co., Newark, vice chairman. The committee will consider the greatest interests of the greatest number of distributors in advising the educational program committee and other committees on features to be incorporated in the 1950 show, to be held at the Hotel Stevens, Chicago, the week of May 22.

Misleading television ads have gone too far, industry leaders stated last month. Especially bad is the practice of advertising screen sizes in square inches; for a 12½-inch tube, for example, six different manufacturers arrived at six different "square-inch" figures. Criticism was also directed at the practice of advertising little-known receiver models as "nationally famous."

BENJAMIN ABRAMS, president of Emerson Radio & Phonograph Corp., suggests that tube-face diameters be used instead of areas to make advertising less confusing to the public. Unless this plan is adopted, he believes the FCC or the Better Business Bureau may step in.

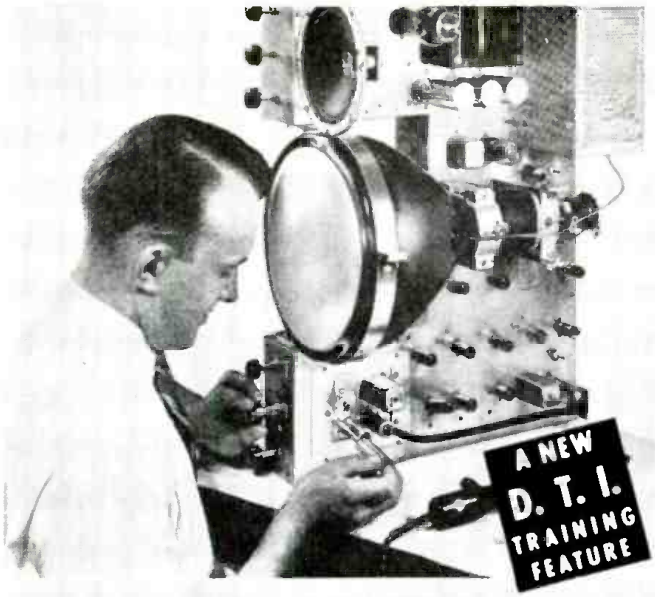
Mr. Abrams wrote to about 15 major producers requesting their views. Most approved of the plan, many indicating they would adopt it themselves. Large retailers, however, said they could not change unless everyone else did.

Sylvania Electric Products Corp. has entered the television receiver field with a line of sets priced between $199 and $450. Introducing the sets, E.E. LEWIS, president of **Colonial Radio Corp.,** the wholly owned subsidiary of Sylvania which makes the receivers, stated that a period of television price stabilization is beginning. Further TV price reductions could be made only through elimination of important components which would create a compromise with quality and performance, Mr. Lewis believes.

The new television sets feature built-in antennas, special sensitivity, one-hand tuning, intercarrier sound, and stabilized sweep oscillators.

Radio Corp. of America has signed a contract with Fabian Theaters, Inc., for installation of instantaneous projection television equipment in Fabian's Brooklyn Fox Theater. The equipment, costing $25,000 plus installation charges, is the first of its type to be ordered for a theater. S. H. Fabian, president of the theater chain, said the Fox would be the proving ground for theater television in this country.

John F. Rider, Publisher, Inc., announces that the forthcoming *Rider Television Manual Volume 3* will be published in a larger size than previous manuals. Page size will be approximately 12 x 15 inches, dimensions previously used only for special double-spread pages. The larger size will reduce the number of folds in giant-size pages, adding convenience and extending the life of the book.



NOW! Build and Keep Big Screen Top Quality Television Receiver at Home as You Prepare for a Profitable job in TELEVISION RADIO-ELECTRONICS

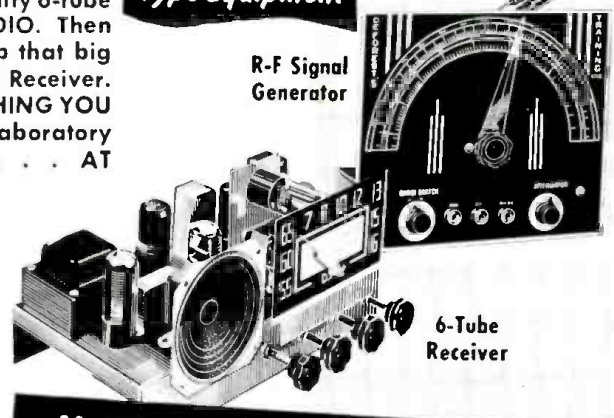
Choice of 10, 12½ or 16 inch picture tube

Now you can get this amazingly practical aid for learning Television at home, to help you get started toward FASCINATING WORK . . . GOOD MONEY . . . a THRILLING FUTURE—in a real job, or your own sales and service business. • When you complete our regular home training—described below—you can build and keep a top quality commercial-type Television Receiver. Standardized chassis is adaptable for a 10, 12½ or 16 inch direct view tube that gives big, bright, sharp, steady pictures. This is an optional training advantage—designed to provide the utmost in practical "learn-by-doing" home training in Television. Mail coupon for complete details. See why you owe it to your "Television Future" to enroll for DeForest's Training, Inc.

Mail Coupon NOW for FREE Information!

See how D. T. I.'s amazingly effective methods help start you toward a GOOD JOB or your OWN BUSINESS in one of America's most promising fields—including Television, F.M. Radio, Aviation, Train, and Taxi Radio, Broadcast Radio, Industrial Electronics. Get modern lessons . . . plus 16 shipments of Rodio-Electronic parts. Work over 300 experiments and projects—including building of (1) commercial-type OSCILLOSCOPE for practical T-V circuit training, (2) double-range R-F SIGNAL GENERATOR, (3) jewel-bearing MULTIMETER, (4) quality 6-tube SUPERHET RADIO. Then build and keep that big new Television Receiver. Here's EVERYTHING YOU NEED for real laboratory type training . . AT HOME!

You also build and keep this Professional Type Equipment

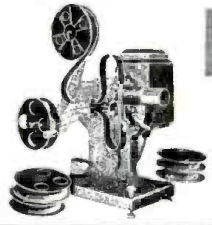


Modern Chicago Laboratories

* If you prefer, you can get ALL your preparation in our new, Chicago training laboratories . . . one of the finest of its kind. Ample instructors . . . modern equipment. Write for details!

Employment Service

* When you complete your training, our effective Employment Service helps you get started toward a real future in Television—Radio—Electronics.



You also use HOME MOVIES! a D. T. I. Exclusive!

D. T. I. alone includes the modern, visual training aid . . . MOVIES . . . to help you learn faster, easier at home. See electrons on the march and other fascinating "hidden action"—a remarkable home training advantage that speeds your progress.

DeFOREST'S TRAINING, INC.
CHICAGO 14, ILLINOIS
A DE VRY Institution

MAIL THIS COUPON NOW!

DeFOREST'S TRAINING, INC.
2533 North Ashland Avenue, Dept. RC-F 11
Chicago 14, Illinois

Without obligation, give me complete facts showing how I may make my start in Television-Radio-Electronics.

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

Street..... Apt.....

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

Simpson

INSTRUMENTS THAT STAY ACCURATE

Presents

the New! MODEL 303

VACUUM TUBE VOLT-OHMMETER

. . . A Worthy Companion of the 260

SPECIFICATIONS

DC Voltage
Ranges—1.2, 12, 60, 300, 1200 (30,000 with Accessory High Voltage Probe)
Input Resistance—10 megohms for all ranges
DC Probe—with one megohm isolating resistor
Polarity reversing switch

Ohms
Ranges—1000 (10 ohms center)
100,000 (1000 ohms center)
1 megohm (10,000 ohms center)
10 megohms (100,000 ohms center)
1000 megohms (10 megohms center)

AC Voltage
Ranges—1.2, 12, 60, 300, 1200
Impedance (with cable) approx. 200 mmf shunted by 275,000 ohms

AF Voltage
Ranges—1.2, 12, 60
Frequency Response—Flat to 100,000 cycles

Decibels
Ranges—−20 to +3, −10 to +23, +4 to +37, +18 to +51, +30 to +63
Zero Power Level—1 M. W., 600 ohms

Galvanometer
Zero center for FM discriminator alignment and other galvanometer applications

R. F. Voltage
(Signal tracing with Accessory High Frequency Crystal Probe)
Range—20 volts maximum
Frequency—Flat 20 KC to 100 M.C.
105-125 V. 60 cycles

Size *5¼"x7"x3⅛" (bakelite case). Weight: 4 lbs. Shipping Wt.: 6½ lbs.*

Dealer's Net Price *Model 303, including DCV Probe, ACV—Ohms probe and Ground Lead—$58.75; Accessory High Frequency Probe, $7.50 Accessory High Voltage Probe, $14.85*

Also available with roll top case, Model 303RT—$64.75

Smaller and Handier for Greater Portability

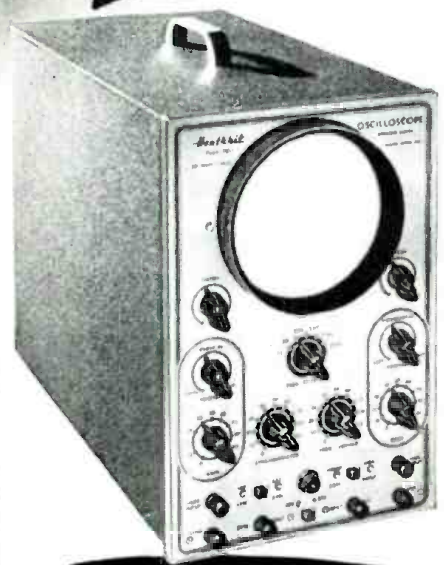
A worthy companion of the world-famous Model 260 is this brand new addition to the Simpson line—the Model 303!

Skilled Simpson engineers spent months of painstaking research in the laboratory to produce the Model 303, which is one of the most versatile instruments ever made for TV servicing. This ruggedly constructed instrument offers the maximum in portability because it is approximately 60% smaller than other vacuum tube volt-ohmmeters. However, no sacrifice has been made in readability. The 303 has a large 4½" meter, despite its handy compactness.

One of the many features of the 303 is its low current consumption. The AC voltage range is wider than on any other similar instrument—from 1.2 volts minimum to 1,200 maximum. Like all other instruments bearing the Simpson name, the Model 303 is an instrument of highest quality at an amazingly low price.

SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie Street, Chicago 44, Illinois
In Canada: Bach-Simpson, Ltd., London, Ontario

NEW 1950 Heathkits have all the Features



New 1950 Heathkit

PUSH-PULL EXTENDED RANGE 5" OSCILLOSCOPE KIT

Features

- The first truly television oscilloscope.
- Tremendous sensitivity .06 Volt RMS per inch deflection.
- Push-pull *vertical and horizontal* amplifiers.
- Useful frequency range to 2½ Megacycles.
- Extended sweep range 15 cycles to 70,000 cycles.
- New television type multivibrator sweep generator.
- New magnetic alloy shield included.
- Still the amazing price of $39.50.

$39.50

The new 1950 Push-Pull 5" Oscilloscope has features that seem impossible in a $39.50 oscilloscope. Think of it—push-pull vertical and horizontal amplifiers with tremendous sensitivity only six one hundredths of a volt required for full inch of deflection. The weak impulses of television can be boosted to full size on the five inch screen. Traces you couldn't see before. Amazing frequency range clear useful response at 2½ Megacycles made possible by improved push-pull amplifiers. Only Heathkit Oscilloscopes have the frequency range required for television. New type multi-vibrator sweep generator with more than twice the frequency range. 15 cycles to 70,000 cycles will actually synchronize with 250,000 cycle signal. Dual positioning controls will move trace over any section of the screen for observation of any part. New magnetic alloy CR tube shield protects the instrument from outside fields. All the same high quality parts, cased electrostatically shielded power transformer, aluminum cabinet, all tubes and parts. New instruction manual now has complete step by step pictorials for easiest assembly. Shipping Weight 30 lbs. Order now for this winter's use.

CONVERSION FOR OTHER MODEL HEATHKIT OSCILLOSCOPES

A conversion for all 03 and 04 scopes is available changing them to the new push-pull amplifiers (does not change the sweep generator). Complete kit includes new chassis, tubes and all parts. For a small investment, add the latest improvements to your present oscilloscope (Except C.R. Tube Shield). Shipping weight 10 lbs.
Order 05 Conversion Kit No. 315 ..... **$12.50**

THE NEW *Heathkit*

HANDITESTER KIT

MORE *Features* THAN EVER BEFORE

- Beautiful streamline Bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 Microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
- All the convenient ranges 10–30–300–1,000–5,000 Volts.
- Large quality 3" built-in meter.

$13.50

Note
HANDY OHMS ADJUST.

The instrument for all—the ranges you need—beauty you'll enjoy for years and you can assemble it in a matter of minutes—an instrument for everyone. The handiest quality voltohmeter of all. Small enough to put in your pocket yet a full 3" meter. Easy pictorial wiring diagrams eliminate all assembly problems. Uses only 1% precision ceramic divider resistors and wire wound shunts. Twelve different ranges. AC and DC ranges of 10–30–300–1,000–5,000 Volts. Ohms ranges of 0–3,000 ohms and 0–300,000 ohms. Milliampere ranges of 10MA and 100MA. Hearing aid type ohms adjust control fits conveniently under thumb for one hand adjustment. Banana type jacks for positive low resistance connections. Quality test leads included. The high quality Bradley instrument rectifier was especially chosen for linear scales on AC.
The modern case was styled by Harrah Engineering for this instrument. The 400 microampere meter movement comes already mounted in the case protected from dust during assembly. An ideal classroom assembly instrument useful for a lifetime. Perfect for radio service calls, electricians, garage mechanics, students, amateurs and beginners in radio. The only quality voltohmeter under $20.00. An hour of assembly saves you one-half the cost and quality parts give you a better instrument. Order today. Shipping weight 2 lbs.

EXPORT DEPT.
13 East 40th St.
NEW YORK CITY (16)
CABLE: ARLAB–N.Y.

The HEATH COMPANY
. . . BENTON HARBOR 20, MICHIGAN

Beauty · Quality · Economy

New Heathkit

IMPEDANCE BRIDGE KIT

A LABORATORY INSTRUMENT NOW WITHIN THE PRICE RANGE OF ALL

Only $69.50

Nothing ELSE TO BUY

Measures Inductance from 10 microhenries to 100 henries capacitance from .00001 MFD to 1000 MFD. Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1000.

Ideal for schools, laboratories, service shops, serious experimentors.

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimentors and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 micro-amp zero center galvanometer — ½ of 1% ceramic non-inductive decade resistors. Professional type binding posts with standard ¾" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of *Silver* Mica, accurate to ½ of 1% and with dissipation factors of less than 50 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

Internal 6 volt battery for resistance and hummer operation. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited. Shipping weight, approximately 15 lbs.

10,000V. H. V. TEST PROBE KIT

No. 310. Extends range of any 11 megohm VTVM to 3,000 and 10,000 Volt ranges. A necessity for television. Shipping Wt., 1 pound. $4.50

R. F. CRYSTAL TEST PROBE KIT

No. 309 Kit to assemble. R.F. probe extends VTVM range to 100 Mc. Complete with 1N34 crystal. Ship. Wt., 1 lb. **$6.50**

New Heathkit

TOOL KIT

Now a complete tool kit to assemble your Heathkit. Consists of Krauter diagonal cutters and pointed nose assembly pliers. Xcelite screwdriver, 60 Watt 110V. soldering iron and supply of solder. Shipping Wt., 2 lbs. Complete kit $5.95

New Heathkit

TELEVISION ALIGNMENT GENERATOR KIT

$39.50

Nothing ELSE TO BUY

Everything you want in a television alignment generator. A wide band sweep generator covering all FM and TV frequencies 0 - 110 and 165 to 220 Megacycles, a marker indicator covering 19 to 43 Megacycles. AM modulation for RF alignment — variable calibrated sweep width 0 - 30 Mc. — mechanical driven inductive sweep. Husky 110V. 60 cycle power transformer operated — step type output attenuator with 10,000 to 1 range — high output on all ranges — band switching for each range — vernier driven main calibrated dial with over 45 inches of calibration — vernier driven calibrated indicator marker tuning. Large grey crackle cabinet 16⅛" x 10⅝" x 7-3/16" Phase control for single trace adjustment. Uses four high frequency triodes plus 5Y3 rectifier — split stator tuning condensers for greater efficiency and accuracy at high frequencies — this Heathkit is complete and adequate for every alignment need and is supplied with every part — cabinet — calibrated panel — all coils and condensers wound, calibrated and adjusted. Tubes, transformer, test leads — every part with instruction manual for assembly and use. Actually three instruments in one — TV sweep generator — TV AM generator and TV marker indicator. Also covers FM band.

EXPORT DEPT.
13 East 40th St.
NEW YORK CITY (16)
CABLE: ARLAB—N.Y.

The HEATH COMPANY

. . . BENTON HARBOR 20, MICHIGAN

all in HEATHKITS . . .

Heathkit
TUBE CHECKER KIT

Features

1. Measures each element individually
2. Has gear driven roller chart
3. Has lever switching for speed
4. Complete range of filament voltages
5. Checks every tube element
6. Uses latest type lever switches
7. Uses beautiful shatterproof full view meter
8. Large size 11" x 14" x 4" complete
9. Checks new 9 pin piniatures

Check the features and you will realize that this Heathkit has all the features you want. Speed — simplicity — beauty — protection against absolescence. The most modern type of tester — measures each element — beautiful Bad-Good scale, high quality meter — the best of parts — rugged oversize 110V. 60 cycle power transformer — finest of Mallory switches — Centralab controls — quality wood cabinet — complete set of sockets for all type tubes including blank spare for future types — fast action gear driven roller chart uses brass gears to quickly locate and set up any type tube. Simplified switching cuts necessary time to minimum and saves valuable service time. Short and open element check. No matter what arrangement of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker today. See for yourself that Heath again saves you 2/3 and yet retains all the quality — this tube checker will pay for itself in a few weeks — better build it now.

Complete with detail instructions — all parts — cabinet — roller chart — ready to wire up and operate. Shipping Wt., 15 lbs.

Only $29.50

Nothing ELSE TO BUY

Heathkit
SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Nothing ELSE TO BUY

$34.50

Experimenters and servicemen working with a square wave for the first time invariably wonder why it was not introduced before. The characteristics of an amplifier can be determined in seconds compared to several hours of tedious plotting using older methods. Stage by stage, amplifier testing is as easy as signal tracing. The low distortion (less than 1%) and linear output (± one db.) make this Heathkit equal or superior to factory built equipment selling for three or four times its price. The circuit is the popular RC tuning circuit using a four gang variable condenser. Three ranges 20-200, 200-2,000, 2,000-20,000 cycles are provided by selector switch. Either sine or square waves instantly available at slide switch. All components are of highest quality, cased 110V. 60 cycle power transformer, Mallory F.P. filter condensers, 5 tubes, calibrated 2 color panel, grey crackle aluminum cabinet. The detailed instructions make assembly an interesting and instructive few hours. Shipping Wt., 13 lbs.

New Heathkit
BATTERY ELIMINATOR KIT

Nothing ELSE TO BUY

$22.50

Now a bench 6 Volt power supply kit for all auto radio testing. Supplies 5 - 7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. A well filtered rugged power supply uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter. 0 - 15 Volt meter indicates output. Output variable in eight steps. Excellent for demonstrating auto radios. Ideal for servicing — can be lowered to find sticky vibrators or stepped up to equivalent of generator overload — easily constructed in less than two hours. Complete in every respect. Shipping Wt., 18 lbs.

NEW Heathkit
SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

Nothing ELSE TO BUY

$19.50

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—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 assortment of switching ranges to match push pull or single output impedance. Also test microphones, pickups — PA systems — comes complete — cabinet — 110V. 60 cycle power transformer — tubes, test probe, all parts and detailed instructions for assembly and use. Shipping Wt., 8 lbs.

EXPORT DEPT.
13 East 40th St.
NEW YORK CITY (16)
CABLE: ARLAB—N.Y.

The HEATH COMPANY
. . . BENTON HARBOR 20, MICHIGAN

MORE QUALITY in 1950 Heathkits

The NEW 1950 Heathkit VACUUM TUBE VOLTMETER KIT

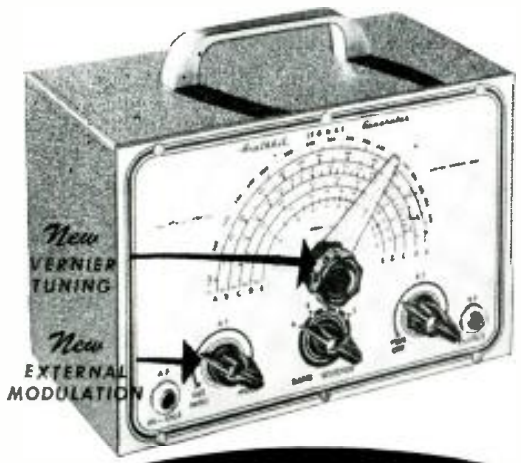
Features

- New 200 microampere meter.
- Uses 1% precision ceramic divider resistors.
- Burn-out proof meter circuit.
- 24 complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory probes (extra) extend ranges to 10,000 Volts and 100 Megacycles.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.

A new Model V-2 Heathkit VTVM with new 200 microampere meter four additional ranges—full scale linear ranges on both AC and DC of 0-3 V., 10 V., 30 V., 100 V., 300 V., and 1,000 V. Accessory probe listed elsewhere in ad extends voltage range to 3,000 and 10,000 volts D.C New model has greater sensitivity, stability and accuracy—still the highest quality features—shatterproof plastic full view meter face—automatic meter protection. push-pull electronic voltmeter circuit, linear scales—db scale—ohmmeter measures 1/10 ohm to 1 billion ohms with internal battery—isolated DC test prod for dynamic measurements—11 megohm input resistance on DC—AC uses electronic rectification with 6H6 tube. All these features and still the amazing price of only $24.50. Comes complete with cabinet—panel—three tubes—new Mallory switches—test prods and leads, 1% ceramic divider resistors and all other parts. Complete instruction manual for assembly and use. Better start your laboratory with this precision instrument. Shipping weight 8 lbs. *Model V-2* .....

$24.50

New 1950 VERNIER TUNING R.F. Heathkit SIGNAL GENERATOR KIT



$19.50

Features

- New 5 to 1 ratio vernier tuning for ease and accuracy.
- New external modulation switch—use it for fidelity testing.
- New precision coils for greater output.
- Cathode follower output for greatest stability.
- 400 cycle audio available for audio testing.
- Most modern type R.F. oscillator.
- Covers 150Kc. to 34Mc. on fundamentals and calibrated strong harmonics to 102 Mc.

The most popular signal generator kit has been vastly improved—the experience of thousands combined to give you the best. Check the features in this fine generator and consider the low price $19.50. A best buy for any shop, yet inexpensive enough for hobbyists. Everyone can have an accurate controlled source of R.F. signal voltage.

The new features double the value—think of being able to make fidelity checks on receivers by inserting a variable audio signal. Internal 400 cycle saw-tooth audio oscillator modulates R.F. signal and is available externally for audio testing. The new 5 to 1 ratio vernier drive gives hairline tuning for maximum accuracy in scale settings. The coils are already precision wound and calibrated. Uses turret type coil and switch assembly for ease of construction. The generator is 110 V. 60 cycle transformer operated and comes complete in every detail—cabinet—tubes—coils—beautiful two color calibrated panel and all small parts—new step-by-step pictorial diagrams and complete instruction manual make assembly a cinch even for novices. Why try to get along without a signal generator when you can have the best for less than a twenty dollar bill. Better order it now. Shipping weight 7 lbs. **$19.50**

CONVERSION KIT FOR G-1 GENERATORS

Conversion kit for G-1 generators for vernier tuning and external modulation includes new high band coil for greater output. Gives all the features of new G-5 listed above. Order G-5 Conversion Kit No. 316 ..... **$4.50**

EXPORT DEPT.
13 East 40th St.
NEW YORK CITY (16)
CABLE: ARLAB-N.Y.

The HEATH COMPANY
... BENTON HARBOR 20, MICHIGAN

Order YOUR HEATHKITS Now — Enjoy them for years...

Heathkit
ELECTRONIC SWITCH KIT

DOUBLES THE UTILITY OF ANY SCOPE

$34.50

Nothing ELSE TO BUY

An electronic switch used with any oscilloscope provides two separately controllable traces on the screen. Each trace is controlled independently and the position of the traces may be varied. The input and output traces of an amplifier may be observed one beside the other or one directly over the other illustrating perfectly any change occurring in the amplifier. Distortion — phase shift and other defects show up instantly, 110V. 60 cycle transformer operated. Uses 5 tubes (1 6X5, 2 6SN7's, 2 6SJ7's). Has individual gain controls, positioning control and coarse and fine sweeping rate controls. The cabinet and panel match all other Heathkits. Every part supplied including detailed instructions for assembly and use. Shipping Wt., 11 lbs.

New Heathkit
FM TUNER KIT

CABINET EXTRA

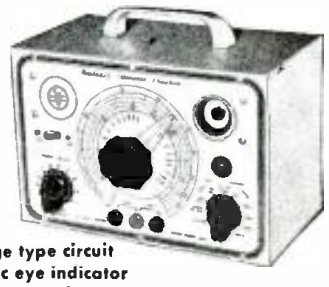
$14.75

A truly fine FM Tuner with the coils ready wound, all alignment completed — all that is necessary is wiring and it's ready to play — uses super regenerative circuit — 110V. 60 cycle transformer operated — two gang tuning condenser — slide rule calibrated dial — two tubes — complete instructions including pictorial enable even beginners to build successfully. Shipping Wt., 4 lbs.

Beautiful mahogany cabinet for FM Tuner (shown above) extra $3.75

Heathkit
CONDENSER CHECKER KIT

$19.50



Features

- Power factor scale
- Measures resistance
- Measures leakage
- Checks paper-mica-electrolytics
- Bridge type circuit
- Magic eye indicator
- 110 V. transformer operated
- All scales on panel

Checks all types of condensers, paper-mica-electrolytic-ceramic over a range of .00001 MFD to 1000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read without a college education. A leakage test and polarizing voltage for 20 to 500 volts provided. Measures power factor of electrolytics between 0% and 50%. 110V. 60 cycle transformer operated complete with rectifier and magic eye tubes, cabinet, calibrated panel, test leads and all other parts. Clear detailed instructions for assembly and use. Why guess at the quality and capacity of a condenser when you can know for less than a twenty dollar bill. Shipping Wt., 7 lbs.

Heathkit
3-TUBE ALL WAVE RADIO KIT

$8.75

CABINET EXTRA

An ideal way to learn radio. This kit is complete ready to assemble, with tubes and all other parts. Operates from 110V AC. Simple, clear detailed instructions make this a good radio training course. Covers regular broadcasts and short wave bands. Plug-in coils. Regenerative circuit. Operates loud speaker. Shipping Wt., 3 lbs.

HS30 Headphones per set $1.00
2½" Permanent Magnet Loudspeaker 1.95
Mahogany Cabinet 2.95

Heathkit
HIGH FIDELITY AMPLIFIER KIT

Nothing ELSE TO BUY

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To the Service Technician

. . . How many service technicians are there in the U.S.A.? . . .

By Hugo Gernsback

THIS particular article is addressed exclusively to the radio servicing trade. The reason: Ever since the inception of this magazine, in 1929, a large percentage of its reading matter has been addressed to the service technician. For over 21 years, as our old readers well remember, this policy has never changed.

From time to time we have made various surveys to ascertain the extent of service-technician readership of the magazine and have been able to draw certain conclusions from this. Yet, the editors in planning the magazine over a long-range term must have certain vital information as to its readers. *No one can give that information to us better than* YOU.

Several years ago we made a mail survey and we found that 53% of our readers were connected in one way or another with radio servicing.

With the advent of television, revolutionary changes have taken place within the servicing industry. To find out what the prevailing trends are, a new survey is urgently required.

The sensational advance of television during the past two years leaves no doubt whatsoever that the entire country will soon be blanketed completely with television stations.

Yet, speaking populationwise, 40% of the country does not have television as this is written. It is certain, however, that by 1953 nearly all of this country's inhabitants will be within range of a television transmitter.

Service technicians who have read RADIO-ELECTRONICS have no doubt observed that not all of our readers see eye to eye with us on our television policy. Those readers who are not now in an area served by television stations particularly criticize us for carrying television articles at all. The reason is that to them, for practical purposes, television articles are only of theoretical interest at present.

Yet, as we have pointed out editorially a number of times, even if you are in a locality not served by a television station, *now* is the time to learn all you can on the subject, because the moment a television transmitter begins functioning in your region *it will be too late* and time will be too short to get practical experience.

The editors keep all these points in mind in the formulation of their editorial policy, particularly from the long-range viewpoint. They also know that today there are service technicians who service only radios, but do not touch television. Some confine themselves to television receivers, while others do both.

To give you the magazine you want at the present time, when the whole servicing industry—due to the impact of television—is in a state of flux, it is of utmost importance to the editors to have certain information on radio servicing which only you can supply.

The editor therefore, urges you to do us a great service and fill out the short blank which you will find on page 52 and mail this back to us as quickly as possible. It will give us the information necessary to bring to you in the future the articles and information which you want and need most.

This is the first time in 21 years of publishing your magazine that the editor has asked for your cooperation in this manner.

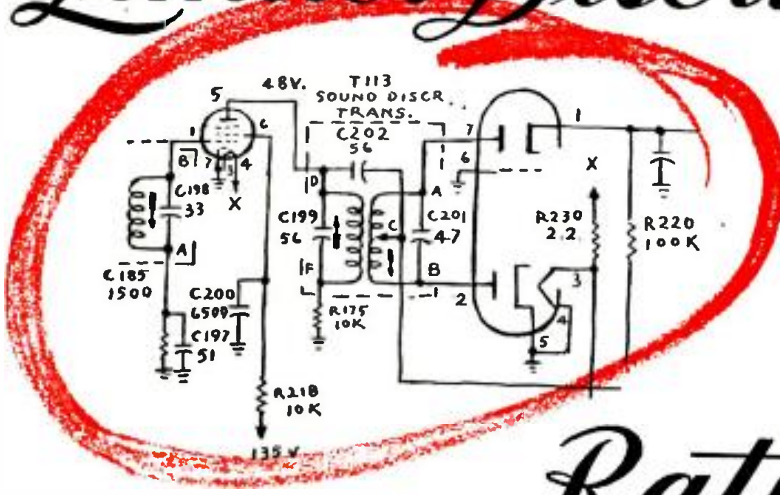
Won't you be good enough to comply with this simple request and return this short questionnaire as soon as possible?

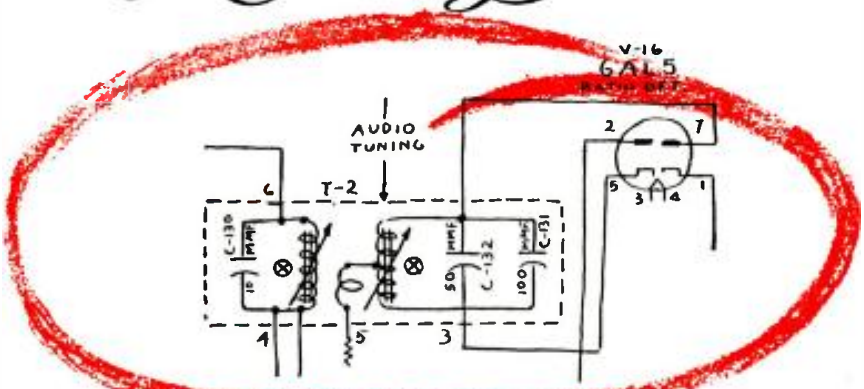
If you know others in the servicing industry, please tell them about this too. The information is vital and most important to them and to you, as well as to us.

For our part we will, as soon as the returns are complete, publish a comprehensive resumé of this questionnaire. This will appear probably in our March issue—sooner if feasible.

Thank you for your cooperation!

Limiter Discriminator versus Ratio Detector





By H. K. MILWARD and R. W. HALLOWS

IN Britain there is as yet no regular FM broadcasting, and there has been no propaganda blitz over the respective merits of the limiter-discriminator and ratio-detector systems as noise rejectors. An inquiry into this question can thus be undertaken with a completely impartial approach and with no background of "political" bias. That is why the Editor asked us some months ago to make a series of comparative tests and to report the results which we obtained. Standard components made by leading firms in the United States were sent us in England and these were used in circuits made up for the tests, which were conducted in one of the best equipped radio laboratories in the country

The ratio detector is simpler than the discriminator with its necessary limiter or limiters; it requires fewer components, and, although a little more difficult to adjust in the first place, it is likely to be considerably cheaper to produce than the other. It is therefore important to know how its inherent noise rejection —one of the great advantages of FM over AM—compares with that of the limiter-discriminator. The conclusions we reached as the result of measurements and a series of aural tests are:

1. Though the difference in noise rejection is not great, the discriminator with one limiter is a slightly better performer than the ratio detector;

2. The discriminator with two limiters is decidedly superior to the ratio detector;

3. The superiority of the discriminator is most marked when the noise level is high.

In the measurements made, peak values of both signal and noise were used. Actually, the annoyance effect of impulse noise is proportional to peak values only when the recurrence of pulses is slow. As the recurrence frequency increases, the annoyance level becomes proportional to r.m.s. values[1]. For comparison of the two circuits, however, it is immaterial whether peak or r.m.s. values are used so long as the same measure is used for both.

A block diagram of the complete test circuits is shown in Fig. 1. The r.f. and first i.f. stages were part of a receiver designed for FM. The i.f. and oscillator stages were modified to give an output at 10.7 mc. Two small coils of one turn each were wound on the output transformer of this i.f. stage and the output fed *via* two short co-axial leads to the test circuits. This insured that the test circuits were fed with similar signals so that comparative tests could be made simply by switching.

The noise generator was made up from a 6-volt vibrator, a car ignition

[1] BBC Research Department, Report G.036.

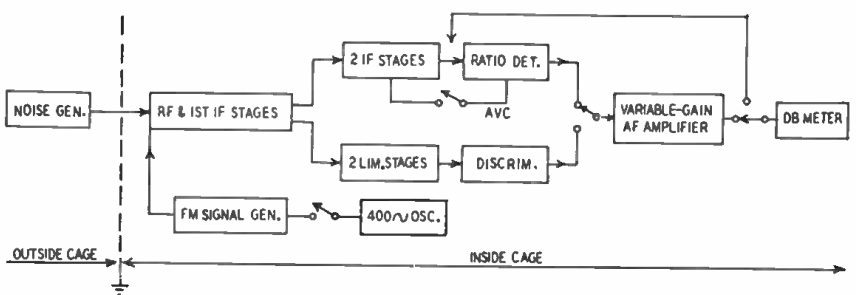


Fig. 1—Equipment used to compare ratio detector with limiter-discriminator.

coil, a spark plug, and a 6-volt storage battery. These were mounted in a double metal box as shown in Fig. 2. Originally it was intended to vary the noise signal by altering the coupling of

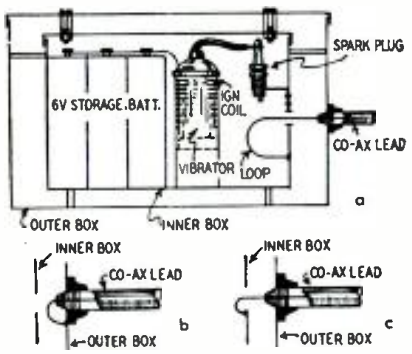


Fig. 2—Details of noise generator.

the coil feeding the receiver, but this was found unsatisfactory, for the noise signal stubbornly refused to be attenuated by more than a few db. The difficulty was overcome finally by feeding the first r.f. coil as shown in Fig. 3, and varying noise strength at its source. Three levels of noise were obtained by

1. Connecting the inner conductor of the co-axial to the outer box in a very small loop (Fig. 2-b).
2. Connecting it to the inner box in a small loop (Fig. 2-c).
3. Connecting as in Fig. 2-a with a large loop.

For the tests the noise generator was placed outside the shielded cage in which the rest of the work was done, and the co-axial led through the mesh of the cage.

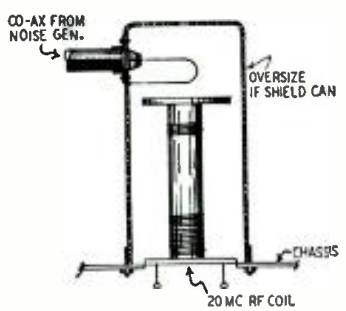


Fig. 3—Method of injecting the noise.

Some attenuation of noise level was obtained by leaving a long cable between the cage and the generator. The lowest level provided gave output signal-to-noise ratios of around 1 for signals which were just above threshold for limiter or a.v.c. action. The generator produced 50-70 noise pulses per second.

The signal generator was a simple FM oscillator which had been calibrated for the tests. The deviation it produced was not linear; but as the tests required only a signal to be compared with the noise, this was no disadvantage.

The circuits tested are shown in Figs. 4 and 5. (The schematics have been simplified by leaving out screen and suppressor connections.) They were lined up at 10.7 mc with a 160-kc bandwidth with the aid of an oscilloscope and sweep oscillator. Response curves for the two test circuits were made as similar as possible. The curves showed a response which was level to within 3 db 70 kc each side of 10.7 mc and was 6 db down at ± 80-kc deviation. The loss beyond these limits was about 0.4 db per kc.

When the i.f. stages were satisfactorily lined up, the demodulators were tackled. The discriminator gave the curve of Fig. 6-a without adjustment, and the ratio detector gave that in Fig. 6-b after adjustment of the tuning slugs in the transformer. The ratio detector was then adjusted for maximum AM rejection by injecting a 400-cycle signal into the suppressor grid of the first r.f. stage, which produced a signal which was amplitude-modulated. The presence of output containing a 400-cycle component was shown by the oscilloscope[2]. The circuit values were adjusted until this component was a minimum.

To assure complete impartiality, this comparative test of ratio and phase detectors was arranged in England, where regular FM broadcasting has not as yet been established.

The outputs of the two demodulators were connected *via* a changeover switch to the a.f. amplifier and meter. No de-emphasis circuit was used as it would not have affected the relative merits of the circuits. The a.f. amplifier was a simple, two-stage, negative feedback combination, with an input impedance of about 20,000 ohms. The gain was controlled by varying the feedback path in fixed steps of 4 db.

The output meter was a v.t.v.m. with two inputs, one for r.f. and one for a.f.; and the meter itself was calibrated in decibels (reference 1 milliwatt). The meter input impedance was approximately 6,000 ohms, and the amplifier output impedance was adjusted to match. Thus readings of relative signal strengths could be made directly. The scale readings for a.f. signals were checked and found to be accurate. For both a.f. and r.f. inputs the meter measured peak volts for anything above 30 cycles or 30 pulses per second.

After this preliminary work the main test readings were taken. First the output meter (r.f. input) was connected to the output of the two i.f. stages of the ratio-detector circuit, and the a.v.c. was switched off. The noise generator was switched on, a reading taken, and the generator switched off again. This gave the level of noise with no signal. The signal generator was then switched on (with 400-cycle FM deviation ± 22.5 kc, representing about 30% of maximum deviation) and readings were taken for each of several generator output control settings. This gave a set of signal-to-noise ratios for the r.f. side.

Following this the output meter was connected to the a.f. side and a.v.c. switched on for the ratio detector. Readings were then taken with the signal generator operating the whole time, its output being varied as required. For each previously charted output level, a.f. readings for both detector circuits were taken of noise output with modulation off and modulation output with noise off. These readings gave output signal-to-noise ratios for each circuit. The actual signal-to-noise improvement, a.f. ratio r.f. ratio, depends on a number of factors including percentage modulation (in the case about 30%), and also the accuracy of the output meter at radio frequencies. Thus the improvement ratio shown by these results is not necessarily accurate, but the comparative output figures are. The results are shown in Figs. 7-a and 7-b.

The ratio detector was then altered to the form shown in Fig. 8 and a further test made. The results (Fig.

[2] This procedure is described in full in "The Ratio Detector," by Seeley and Avins, *RCA Review*, June, 1947.

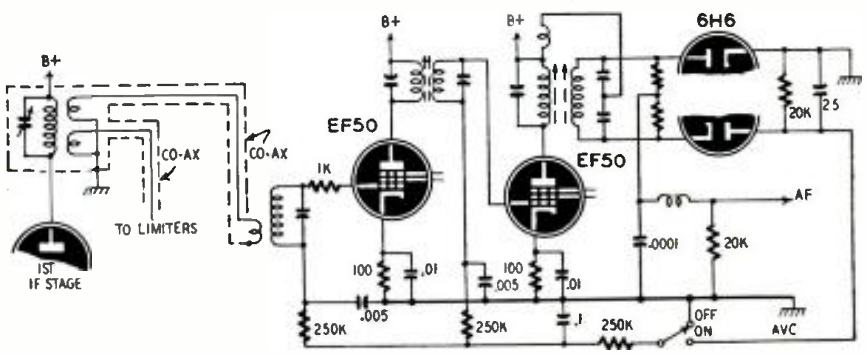


Fig. 4—Simplified circuit of the ratio detector used in the experiments.

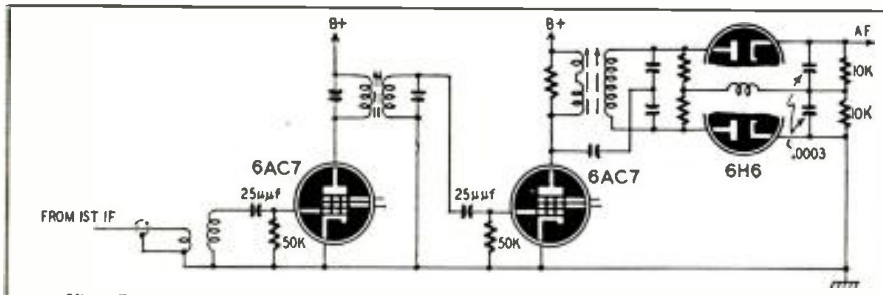
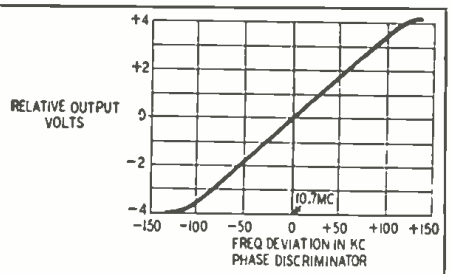
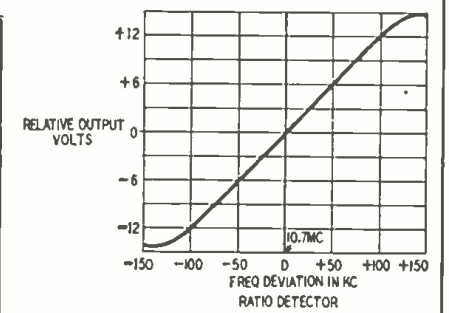


Fig. 5—The limiter-discriminator parallel of the circuit shown in Fig. 5.





Figs. 6-a, 6-b—Curves of phase discriminator and ratio detector, no noise.

7-a) are substantially the same as those for the original circuit. The results taken for two limiters with the discriminator and one limiter with the ratio detector are interesting in that they suggest a connection between noise rejection and AM rejection. This is not surprising, for a noise pulse effectively consists of two parts: that which affects only an FM system, and that which affects an AM system. There would be a certain minimum noise response from the most perfect FM system, and any practical system would be worse in proportion to its AM response.

Finally, the two circuits were tested aurally. The receiver was coupled to a short rod antenna and tuned to the BBC experimental FM transmissions. The noise generator was placed outside the building with a short length of wire protruding as an antenna. A variable attenuator was inserted in the output of the ratio-detector circuit and adjusted so that the output from a loudspeaker was the same for both circuits. Flicking the switch made it possible to compare noise levels.

In the tests four observers were asked to judge which circuit was least noisy. The ratio detector with a.v.c. and discriminator with one limiter were tried first. When the noise level was so high that all but loud passages were masked, the judgment averaged about 3 to 1 in favor of the discriminator, each observer listening to about 10 changeovers. When noise was low enough to be noticeable only during soft passages, the results were about even for the two circuits if the switching was done during loud signal passages and about 3 to 2 for the discriminator if done during the soft passages.

When the discriminator was used with two limiters, the ratio detector remaining as it was, the results were 100% for the discriminator on the loud noise test and about 7 to 1 on the low noise. These results confirmed the measurements generally, although the difference appeared to be more noticeable aurally than was to be expected from the actual figures.

During the tests both circuits stayed in adjustment and no difficulty was experienced in lining up and adjusting either. The ratio detector was somewhat more tedious to adjust, and the component values appeared to be a little more critical.

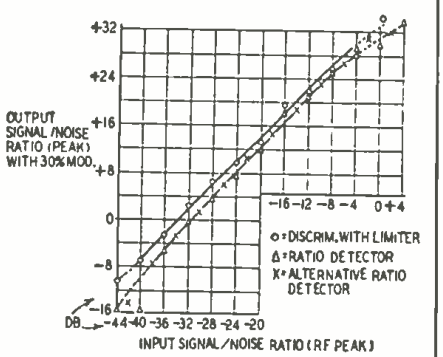


Fig. 7-a—Comparison of the two types.

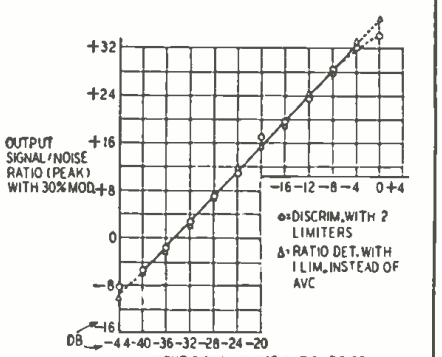


Fig. 7-b—Limiter helps ratio detector.

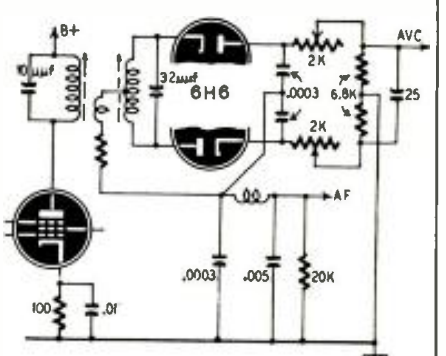


Fig. 8—An alternate ratio detector.

Thought, Memory, Produce New Brain Waves

IDENTIFICATION of a hitherto unknown brain wave, which seems to be associated with thought, is reported by a research team of the Institute for Applied Experimental Psychology, Tufts College, Medford, Mass. Readers familiar with electroencephalography will remember that previously recognized brain waves not only appear best when the mind is at rest, but are actually inhibited by thought processes.

Dips show drop in "thought output" as subject finishes reading line of type.

The four researchers, John L. Kennedy, Robert M. Gottsdanker, John C. Armstrong, and Florence Gray, have named the new manifestation "kappa waves." The figure shows how the waves appear when the subject reads. The irregular waves are produced as the reader scans each line of type, and the retrace results in the drops at S. The third and longer wave was recorded as the reader concentrated on a new paragraph. Similar graphs made while the subject was performing mental multiplications and other tasks requiring thought show a remarkable correlation of kappa bursts to periods of thought.

The kappa waves are detected by electrodes placed just back of the external canthi of the eyes (the corners of each eye where the upper and lower eyelids meet).

Later research, reported by the same workers to the recent meeting of the American Psychological Association at Denver, indicates that the kappa waves are particularly active when the brain is attempting to remember something. They reported that when a student was learning new material, kappa-wave activity was moderate. When the student was trying to recall imperfectly-learned material the kappa waves reached a maximum, and when reciting perfectly memorized matter they again sunk to a new low, the scientists reported.

Further research is being carried out on these waves, which appear to represent a new advance in brain study.

Lady Television Engineer

by TEX BARBARITE

The author repairs a camera

MAINTAINING an electronic exhibit like the Radio Corporation of America's Exhibition Hall in the heart of Radio City, New York, means a great deal more than replacing knobs and pilot lights removed by souvenir hunters. It includes turning a bushing on a lathe as well as answering the queries of John Q. Public on AM, FM, and television.

My engineering bent was formed in my early childhood. My hobby throughout my younger days, until I was enrolled in a girl's private school, followed radio lines. My three brothers and I constructed our own crystal sets. When crystal sets were outgrown, we graduated to vacuum-tube circuits. When I entered the girls school, I found myself very unhappy because the administration felt that science and mathematics were unnecessary subjects for a girl. Finishing secondary school, I decided to go to the Texas College of Mines in El Paso to study for a degree in mathematics. There I received a scholarship to study electrical engineering at Purdue University. At Purdue my interest was spurred by the the fact that the field of engineering, hitherto dominated by men, was being opened to women by the wartime shortage of men.

From school I went to RCA in Camden, N. J., and worked in the Television Terminal Equipment Design Laboratories. This division handled design for the microwave transmitter, distribution amplifiers, video amplifiers, synchronizing generators, image orthicon and iconoscope cameras, and all associated equipment.

Having little knowledge of television, I took advantage of courses the company offered in night school. In the laboratory we operated our own experimental transmitter, W3XEP, for which I got my commercial phone license. This provided all-around experience—students served as announcers, projectionists, cameramen, station engineers, and in other essential positions. At that time I was also teaching basic theory and code to Civil Air Patrol cadets. This background was the basis for my transfer to the RCA Exhibition Hall when it opened in New York in April, 1947.

The most important exhibit here is the television field camera mounted in a "See Yourself" display. This camera (see cover), used in conjunction with the field power supply, sync generator, and camera control, utilizes an image orthicon tube. Highly sensitive, it is most useful where low light levels are available. When the camera is in use, the cover can be removed and the viewfinder attached on top of the camera. A plug receptacle provides all the connections between the two units. The viewfinder is a monitor using a 5FP4A kinescope. The sides of the camera are hinged to give access to the unit for maintenance and servicing. Selection of any one of four lenses is made possible by a rotating turret controlled by a handle at the rear of the camera.

Orthicon Ingenious

I consider the image orthicon one of the most interesting and ingenious pieces of equipment I have ever worked with. By means of the lens system, the optical image is focused on the semi-transparent photocathode, which is at a high negative potential with respect to ground.

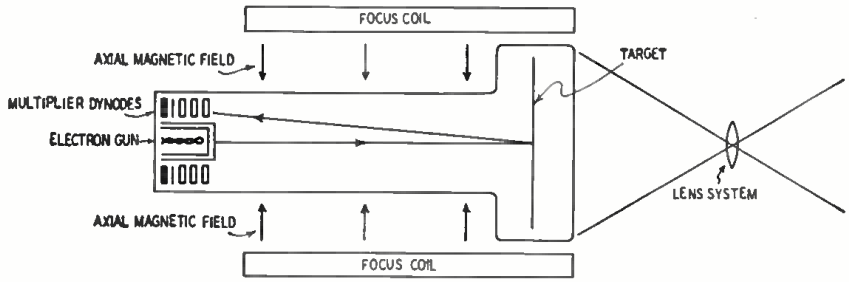
The radial electric field produced by the accelerator grid between photocathode and target, and the axial magnetic field produced by the focus coil around the tube, assures proper focusing of the photoelectrons on the target. If nonuniformity exists in either electric or magnetic field, the result is what is commonly known as S distortion.

As a well-focused beam of low-velocity electrons strikes the target (see drawing), enough electrons are deposited on the target to make it negative to the remaining electrons in the beam and repel them. The potential that any point on the target will reach is termed the "equilibrium potential." The beam is kept constant, and the electrons turned back are attracted to the rear end of the tube which is at the highest positive potential. The final function of the tube is to amplify the "picture information" in the returning electron beam. Several multiplier dynodes are used, each at a higher potential than the previous one. From the last dynode (there are five) the electrons are attracted toward the collector mesh (signal plate), connected to an external load resistor.

New Exhibit Projects

Projects in the making here in the Showroom include a monoscope camera and a master monitor, both to be installed in the control-room racks. The monoscope camera is a camera with the test pattern on the mosaic of the iconoscope. The pattern is composed of carbon deposited on an aluminum plate. The carbon and aluminum have different emission characteristics. Electrons

emitted by the scanning of the pattern are collected on the wall of the monoscope tube. This coating is at a positive potential with respect to the pattern, but is a.c.-coupled to ground. Therefore, the picture signal appears between plate and ground. The master monitor uses a 10-inch kinescope and a 5-inch oscilloscope and is adaptable to the supervision of composite picture signals at any stage of our transmission. A switching arrangement on the monitor allows it to be used as a control unit for the film camera chain. Both master monitor and monoscope must be wired for power and for our type of switching system, and adjusted for optimum operation.



A partial cross section of the image orthicon, showing path of the electrons.

Working as a maintenance engineer for the Promotion Department is not all repair work—not for a girl anyway. Once I was called on to don my best dress and attend a champagne cocktail party fashion show at the Ritz. I had to forego the champagne, however, as my job was to set up and operate a PA system for playing records. Another time I purchased and installed an inverter for Mrs. John McCormack, widow of the famous Irish tenor. I even entertained the mayor and his wife from my home town in Texas. It's all in a day's work.

Reaction of the public to a female technician is varied and amusing. I seldom talk to visitors; but, in the two years and more that I have been at the Exhibition Hall, just about every conceivable reaction has come to me. I'm not siding with my sex, but women, by far, are easier to talk to than men. The women know nothing about radio and don't pretend to, whereas too many men are out to "stump the experts." Men also seem reluctant to talk to women about a medium that used to be exclusively theirs.

Public pours out troubles

Many people come here to complain about the operation of their radios. The majority of these cases do not require a technician, but some instruction and a little public relations. A full recitation of the circumstances usually paints an entirely new picture. But service technicians do know of instances where Junior has dropped the new radio in the brook while the 90-day guarantee was still effective. Other set owners complain because the A-batteries of their portable receivers have gone dead before the end of the guarantee of the radio, or that the portables won't play in a steel-constructed building. Then there are our friends of the would-be-technician type who are at leisure and want to use all of ours picking up what they didn't learn in school.

Recently, I spent two weeks in Camden, N. J., at RCA's home office, learning the latest television circuits and techniques. Most important to me was the antenna information. Service and installation men will be glad to hear of the Woodward antenna which receives signals from only one direction at a time. Not an answer to any and all reception difficulties, it is most effective in cutting down co-channel interference when the receiver is located in a fringe area between two transmitters. Consisting of an array of four 8-foot dipoles in the form of a square, with the opposite members 8 feet apart, the antenna can be made to receive from one direction or the other by flipping a switch at the receiver. Interconnection of the dipoles through a diplexing network makes this one-way reception possible. Efficient reception on high bands is achieved by "shortening" the dipole with V's fastened to each leg.

Of special interest to the radio amateur is the TV interference suppressor recently developed by Captain John L. Reinartz of RCA's tube department in Harrison, N. J. This device, connected into the ham transmitter, traps harmonics before they can reach the antenna.

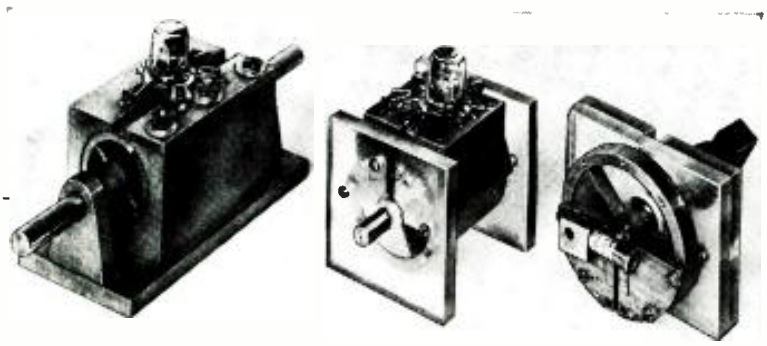
Hams are forever being blamed for many of the ills in television reception. I have seen at least one case where this was not true. In a small town just west of Philadelphia, there are only two amateurs in the entire area. Even though their logbooks showed they were off the air, they were blamed for a peculiar type of disturbance. The noise appeared in the form of a flash of maggots (similar to ignition noise). Just for a second it would disrupt the scene; occasionally it would travel downward in a bar effect. Service engineers from Philco, RCA, and Stromberg-Carlson traced the trouble to power lines and the power company remedied the difficulties.

My ambition—one that comes naturally to most radiomen and women—is to have my own well equipped shop. However, I am now involved in a project that has top priority; I am in the throes of building a shop in the basement of my home, not for radio, but for woodworking. It is my idea to gain some experience in the art of cabinet construction and finishing. I would like eventually to be able to design, construct, and finish custom cabinets for radios, television receivers, phonographs, and combinations. In the final analysis, I suppose that I have a different outlook on my ambition than a man would have. I prefer to make it a hobby rather than a money-making vocation.

CONVERTERS FOR THE ULTRA-HIGHS

Stanford Research Institute in Stanford, Calif., recently reassured the nation's present and future TV-viewers about the coming advent of u.h.f. picture transmission. The Institute's Department of Electrical Engineering has developed three new u.h.f.-to-v.h.f. converters which are both simple and inexpensive. With such a converter, a standard receiver will need no internal modifications to receive u.h.f. programs.

One of the laboratory models is fixed-tuned at 530 mc to pick up transmissions from an experimental station operated by John H. Poole, sponsor of the project. Another is variable from 475-675 mc, and a third tunes from 475-890 mc.



The tuners used are shown in the photo. At left is a cylinder oscillator. A modified "semibutterfly" oscillator is in the center, and a 475–890-mc crystal mixer at right. With the usual TV receiver, noise figure of the converters is about 11 db, sensitivity 200 μv. Oscillator radiation at the converter's antenna terminals is 56 mv. Image suppression is 42 db.

ndoor and Built-In Antennas Their Strong and Weak Points

The indoor TV antenna yields only a compromise performance

By IRA KAMEN

JOHN STUART MILL said, "In times of crisis we must avoid both ignorant change and ignorant opposition to change." This statement is wise counsel today both to those selling and installing television receivers and to landlords of multiple dwellings.

The urban television dealer has not been able to realize full sales possibilities because many building owners have refused to permit tenants to erect rooftop antennas. Often, to make his sale, the dealer has installed in apartments TV receivers with indoor antennas, the poor performance of which increased the tenant's resentment against his landlord.

The latter is often justified in refusing his permission, or, as shown in the photo, the roof becomes cluttered with a maze of disfiguring antenna rods, and the landlord becomes liable for public, personal, and property damage.

In addition, random installations of rooftop antennas may result in penalties for violation of local fire, building, and electrical ordinances. There are two main reasons why so many buildings have roofs like the one in the photograph: either the landlord did not want to offend tenants, or he used the permission as a way of persuading them to agree to a rent increase. Some landlords are neither cringing nor greedy, but allow the antennas so that tenants can enjoy television, feeling that the appearance of the roof—never exactly artistic in any case, with clotheslines, water towers, and so on—and the rather remote possibility of damage are subordinate to peaceful relations between landlord and tenant.

On all rooftops overloaded with antennas interference between television receivers may be so bad that on many evenings only two or three of a possible six or seven channels can be used by most tenants. All other channels show r.f. interference as pictured in Fig. 1. The Oscillator Interference Chart shows that when a television receiver is tuned to channel 2, 3, 7, 8 or 9, its oscillator radiates interference on either channel 5, 6, 11, 12, or 13.

The final solution

The permanent solution to the multiple-dwelling problem is a vacuum-tube-type master antenna system such as approved by the engineering committee of Television Broadcasters Association and conforming to RMA specifications. To date, two systems have been tested and approved, one made by RCA and the other by the Intra-Video

Fig. 1—Interference from another set.

Corp. of America. Both these systems suppress oscillator radiation enough to prevent its marring the pictures of other RMA standard receivers connected to the system. Any type of TV receiver may be connected to the system. Neither system is in common use.

Many a dealer is temporarily convinced (against his better judgment) that this or that indoor antenna is the answer, for he knows that a successful indoor antenna would mean greatly increased sales.

Installation companies guaranteeing in the original contract reception for stations not yet on the air should beware of the indoor antenna even though it may operate satisfactorily for channels now in use. Nearly every indoor installation is a costly, time-consuming experiment, and the set user is almost never fully satisfied. There are call-backs and a resultant financial loss every time a new station goes on the air.

There is no such thing as a high-gain indoor antenna. Even an adjustable unit barely approaches the performance of a simple outdoor dipole on the channel to which it is adjusted. Careful comparative tests should be made on all new "sensational" indoor antennas before embarking on a wholesale indoor-antenna program.

The indoor antenna is not practical as a final solution to the problem. TV signals do not pass readily through steel structures and are attenuated by the materials of which houses are built. Such antennas are always a nuisance, whether installed under a rug, in a closet, on a table or simply on top of the receiver.

Indoor antennas usable

There are, however, many locations where indoor antennas can provide a satisfactory *compromise* signal from most stations. The set owner must, however, overlook faults. There is a reduced signal-to-noise ratio and contrast will depend not only on the control, but

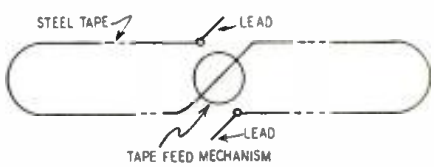


Fig. 2—Slide-Rule is a folded dipole.

on the positions of people and furniture in the room. With an "under-the-rug" antenna, every time someone walks across the room the contrast changes.

The signal quality varies, too, with the season. Window screens and foliage

The Tele-Tone has rotatable V antenna.

affect it during the summer, and during the winter, when the indoor antenna is picking up a reflected signal from a building or a mountain, ice formation on those surfaces may change picture quality and strength.

The only time, in fact, when an indoor antenna works excellently is when it is near a window from which it is possible to see the TV transmitting antenna.

Practical indoor antennas

For portable receivers, the indoor antenna is of course a must. The most practical is the rotating adjustable V which can be turned and the length of which can be adjusted. A typical one is used with the Tele-tone receiver in the photo. While the V antenna was originally a means of minimizing the space needed for a dipole, it definitely has an important advantage. Although TV transmitters send out horizontally polarized waves, reflections produce a signal which has a different angle of polarization from the original. By setting the V at the correct angle the two (direct and reflected) signals of different polarization can be combined in phase and the signal increased.

Many receivers with only average sensitivity may be installed with an indoor antenna yielding a weak signal, if a booster amplifier with a minimum gain of 20 db is connected between antenna and receiver. The booster should not oscillate and should pass the full 6-mc bandwidth required for good reception. Many boosters have such narrow bandwidths that they do not permit the TV receiver to "track" on picture and sound simultaneously. Many oscillate on some channels, mismatch the antenna input, and are unstable.

Another practical indoor antenna is the Radio Craftsmen slide-rule. The length of a folded dipole is adjusted like a steel measuring tape. While the length of this antenna is adjustable, it cannot offer a perfect 300-ohm match except at one adjustment (if at all) for the distance between elements cannot be varied. This distance should vary from 0.54 to 0.145 inch for optimum results from channels 2 to 13. This antenna's shape is not like that of a conventional folded dipole, either, as illustrated in Fig. 2.

Fig. 3 shows a typical under-the-rug antenna with high- and low-band folded dipoles made of ribbon line. Occasionally three or four of these must be installed and a switch provided at the receiver to select the one adjusted for the desired station. In other installations pairs of dipole rods are installed in different sections of an apartment and co-axial cables circuited to a co-ax switch at the receiver. While several indoor antennas and a switch may provide satisfactory reception, it is a rare customer who will accept and pay for such an installation.

It is conceded that a built-in TV indoor antenna (Fig. 4) would be a great stride toward full realization of customer acceptance of television. Capitalizing on this fact, several manufacturers have made judiciously worded claims to having solved this problem. However, as one of these manufacturers stated: "gold is where you find it." Indoor antennas—whether built-in or portable—will pick up television signals only if they are present in the vicinity of the indoor antenna, and the quality of the reception cannot be improved over the quality of the signals received.

Actual tests of built-in antennas indicate early enthusiastic customer reaction in some areas (Brooklyn, Queens, Kings, and Westchester County in New York) where strong TV signals from a majority of nearby TV stations have an unobstructed path to the indoor antenna from one general direction. As

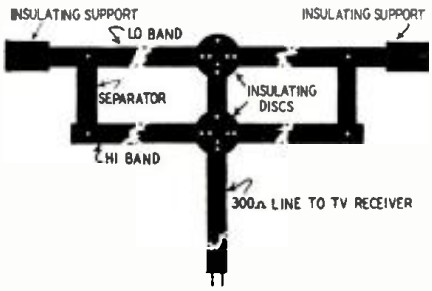


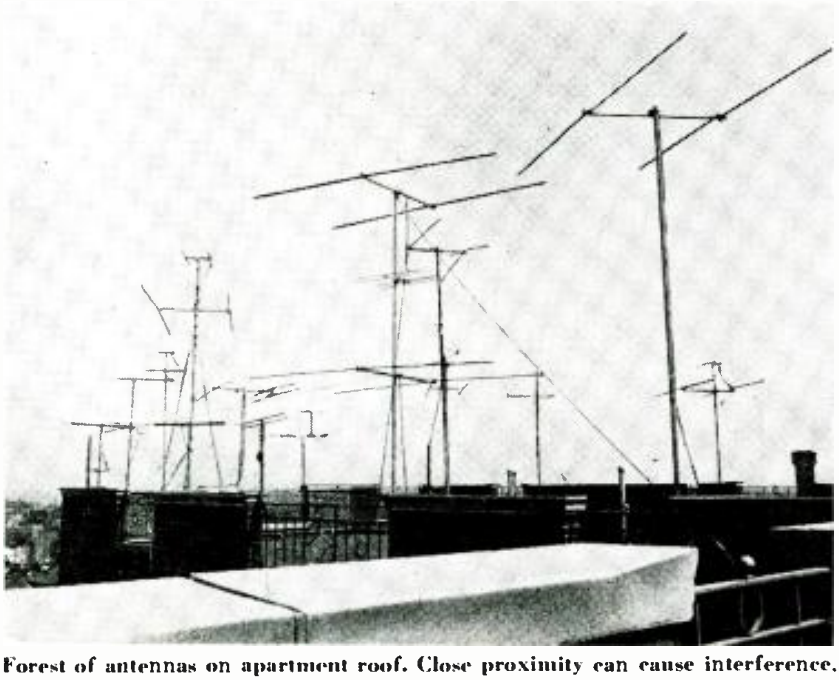
Fig. 3—Under-rug unit of ribbon line.

expected, in Manhattan, dealer and multiple-dwelling reception with built-in antennas has been generally poor. The following disadvantages have been noted by TV dealers:

On stations where signals are weak, the tuning adjustments become complex to the layman. The customer must keep his hands off the top of the cabinet as he tunes the antenna or else he affects the tuning. Metal trays or other large appurtenances cannot be placed on top of the cabinet by the customer.

In first-floor dealer establishments the built-in antenna will work on only one or two stations in one or two locations in the store, which reduces the flexibility of the dealer's sales operation. In many cases the dealer's serviceman must sell the customer on accepting the reception of the built-in antenna or rapidly install an outdoor antenna before the customer rejects the merchandise.

The service technician who has the responsibility of asking the "lady of the house" to relocate the TV receiver with built-in antenna in another section of the room or a different room where the TV receiver will pick up more channels, must have an outstanding sales personality. Many amusing situations have arisen where the receivers with built-in antennas work best in the middle of the living room, in front of a window, and in other loca-



Forest of antennas on apartment roof. Close proximity can cause interference.

tions which the customer usually rejects.

The idea of installing a TV antenna on the power line cord or as a permanent unit in the rear of a console TV set as though it were a built-in radio antenna is impractical. Several manufacturers have spent considerable money and time to prove it. Certainly for apartment-house installations, it is impossible except when the TV receiver is against a favorably placed wall or in front of a window.

The increasing number of TV stations will start the indoor antenna on

Fig. 1—Philco's built-in TV antenna.

the road out except for portable receivers and for those people willing to accept compromise reception.

OSCILLATOR INTERFERENCE CHART*

Receiver tuned to channel	Osc. freq. (mc)	Interference with channel
2 (54–60 mc)	81.25	5 (76–82 mc)
3 (60–66 mc)	87.25	6 (82–88 mc)
7 (174–180 mc)	201.25	11 (198–204 mc)
8 (180–186 mc)	207.25	12 (204–210 mc)
9 (186–192 mc)	213.25	13 (210–216 mc)

*For receivers with 21.25–27.5-mc i.f.

The plight of viewers living in multiple dwellings will be finally relieved when the landlord again faces a buyers' market and realizes that he must give his tenants television outlets just as he provides heating, plumbing, ventilation, and other fundamental services.

Many of our readers will not agree with Mr. Kamen on this controversial subject. For a different view, see Noll and Mandl in last month's issue (page 29)—*Editor.*

TELEOGLERS GET TELESQUAT

TV fans may be getting "telesquat" and "telecrane" spinal ailments, Dr. Martin R. Stone, president of the Chicago Chiropractic Society, said in an interview with a reporter of the *Chicago Daily News.*

Persons who perch themselves precariously on the edge of their spines by sitting in a slumped position are asking for trouble. They are doing the "telesquat."

"They sit on the bottom of their spine and not on their bottom like nature intended. The 'telesquat' can cause a low backache and other physical disturbances," he said.

Sitting in a forward bent position puts a strain on the vertebrae of the neck. This is what Dr. Stone calls "telecrane." This practice can cause severe neckache, headache, and eyestrain.

TV STATION LIST

WE receive occasional reports of television stations 1,000 or more miles away being received clearly on ordinary receivers. Reports of such television dx reception are both valuable and interesting because they indicate the extent of this undesirable long-distance propagation.

Beginning with the next issue, RADIO-ELECTRONICS will publish reports of long-distance TV reception. Readers are invited to notify us of their TV dx experiences in detail, giving the date, time, name, location, and distance of the station, quality of reception, type of receiver and antenna in use, as well as any other pertinent data.

To aid dx'ers, the following complete list of stations gives all necessary logging information.

City	Call	Channel
ALABAMA		
Birmingham	WAFM-TV	13
Birmingham	WBRC-TV	4
CALIFORNIA		
Los Angeles	KECA-TV	7
Los Angeles	KFI-TV	9
Los Angeles	KLAC-TV	13
Los Angeles	KNBH	4
Los Angeles	KTLA	5
Los Angeles	KTSL	2
Los Angeles	KTTV	11
San Diego	KFMB-TV	8
San Francisco	KGO-TV	7
San Francisco	KPIX	5
CONNECTICUT		
New Haven	WNHC-TV	6
DELAWARE		
Wilmington	WDEL-TV	7
DISTRICT OF COLUMBIA		
Washington	WMAL-TV	7
Washington	WNBW	4
Washington	WOIC	9
Washington	WTTG	5
FLORIDA		
Miami	WTVJ	4
GEORGIA		
Atlanta	WAGA-TV	5
Atlanta	WSB-TV	8
ILLINOIS		
Chicago	WBKB	4
Chicago	WENR-TV	7
Chicago	WGN-TV	9
Chicago	WNBQ	5
INDIANA		
Indianapolis	WFBM-TV	6
KENTUCKY		
Louisville	WAVE-TV	5
LOUISIANA		
New Orleans	WDSU-TV	6
MARYLAND		
Baltimore	WAAM	13
Baltimore	WMAR-TV	2
Baltimore	WBAL-TV	11
MASSACHUSETTS		
Boston	WBZ-TV	4
Boston	WNAC-TV	7
MICHIGAN		
Detroit	WJBK-TV	2
Detroit	WWJ-TV	4
Detroit	WXYZ-TV	7
Grand Rapids	WLAV-TV	7
MINNESOTA		
Minneapolis	KSTP-TV	5
Minneapolis	WTCN-TV	4
MISSOURI		
St. Louis	KSD-TV	5
NEBRASKA		
Omaha	KMTV	3
Omaha	WOW-TV	6
NEW JERSEY		
Newark	WATV	13
NEW MEXICO		
Albuquerque	KOB-TV	4
NEW YORK		
Buffalo	WBEN-TV	4
New York City	WABD	5
New York City	WCBS-TV	2
New York City	WJZ-TV	7
New York City	WNBT	4
New York City	WOR-TV	9
New York City	WPIX	11
Rochester	WHAM-TV	6
Schenectady	WRGB	4
Syracuse	WHEN	8
NORTH CAROLINA		
Charlotte	WBTV	3
OHIO		
Cincinnati	WCPO-TV	6
Cincinnati	WKRC-TV	11
Cincinnati	WLWT	4
Cleveland	WEWS	5
Cleveland	WNBK	4
Columbus	WLWC	3
Columbus	WTVN	6
Dayton	WHIO-TV	13
Dayton	WLWD	5
Toledo	WSPD-TV	13
OKLAHOMA		
Oklahoma City	WKY-TV	4
PENNSYLVANIA		
Erie	WICU	12
Lancaster	WGAL-TV	4
Philadelphia	WCAU-TV	10
Philadelphia	WFIL-TV	6
Philadelphia	WPTZ	3
Pittsburgh	WDTV	3
RHODE ISLAND		
Providence	WJAR-TV	11
TENNESSEE		
Memphis	WMCT	4
TEXAS		
Fort Worth	WBAP-TV	5
Houston	KLEE-TV	3
UTAH		
Salt Lake City	KDYL-TV	4
Salt Lake City	KSL-TV	5
VIRGINIA		
Richmond	WTVR	6
WASHINGTON		
Seattle	KRSC-TV	5
WISCONSIN		
Milwaukee	WTMJ-TV	3

Television Channel Frequencies

Channel Number	Frequency (mc)
2	54-60
3	60-66
4	66-72
5	76-82
6	82-88
7	174-180
8	180-186
9	186-192
10	192-198
11	198-204
12	204-210
13	210-216

The following stations, not on the air when the above list was made up, are expected to open on the dates indicated below.

City	Call	Channel	Probable starting date
Kansas City, Mo.	WDAF-TV	4	10/16/49
Greensboro, N. C.	WFMY-TV	2	9/22/49
Columbus, Ohio	WBNS-TV	10	10/1/49
Johnstown, Pa.	WJAC-TV	13	9/15/49
Dallas, Tex.	KBTV	8	9/17/49
Jacksonville, Fla.	WMBR-TV	4	10/16/49

TV CUSTOM INSTALLATIONS

By DAVID T. ARMSTRONG

The author explains techniques of successful custom-built television installations

THERE is a great deal of custom building to be done in all sections of the country, but few people know where or to whom to go to get the information they need. The service technician who wants his share of this business should go in for subtle, suggestive selling using high-class, direct-mail techniques to reach those people who have the means to finance, and the interest in TV to desire, a custom installation.

The author's recommendation that custom building be an adjunct to a service business is made for two reasons: first, not enough of it is likely to come your way to warrant going into it full time at the start; and, second—at the beginning anyway—you can hardly handle more than one job a month satisfactorily. The rewards are enticing enough to make one good custom installation per month sufficiently profitable to keep you going. Take it easy and build your business slowly, surely, and successfully.

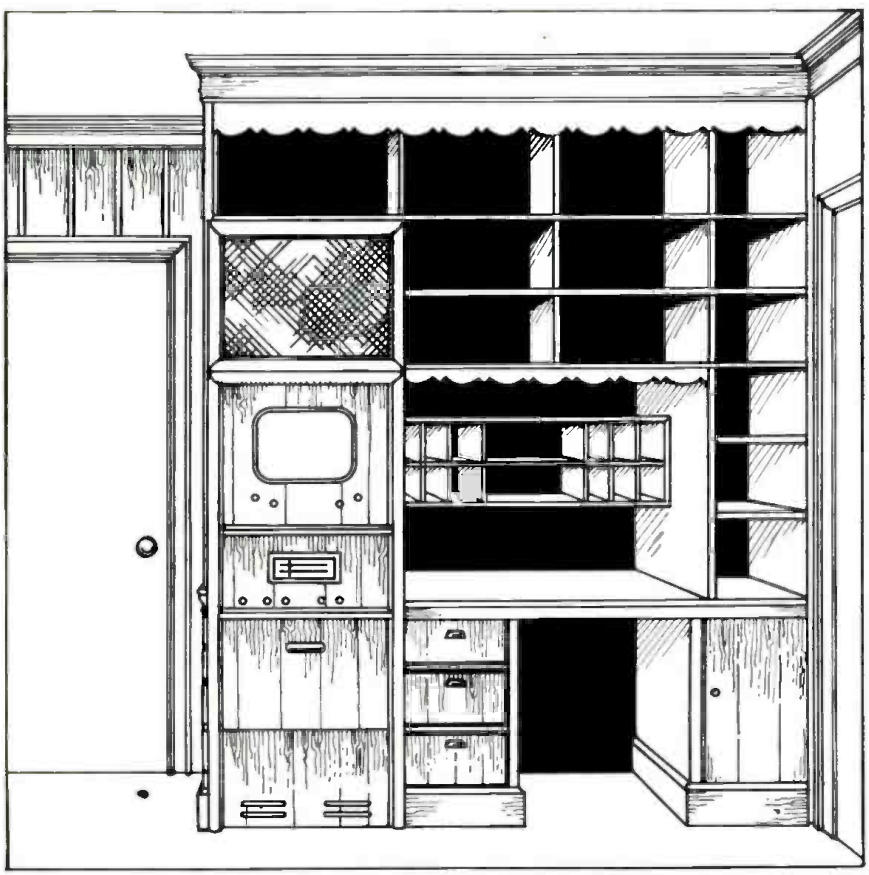


Fig. 1—Drawings like this one help to sell the installation to your prospect.

Last month we had an over-all view of custom installations. In this issue we are going to follow a single installation step-by-step to give you some idea of the problems you are likely to meet.

The drawing of Fig. 1 sold this job. The room was small, 8 x 10, and was used as a den. There was a door on the extreme right and one on the extreme left. The door on the left led to the basement; the stairwell was behind the TV installation. That meant leaving that wall alone but it did solve the ventilation problem nicely.

As you can see from the sketch, the TV installation is relatively simple, but the cabinet work is extensive and expensive. During the first call on Mr. Prospect, he decided where the TV would be and what he would like done with the remainder of the blank wall. He indicated he wanted a desk with some pigeonholes for letters and some drawers on either side of the desk, plus some shelving for books.

To be a good salesman, you must swallow your own preferences. Personally, I think the pigeonholes for letters and knick-knacks a little corny, but that was one of the most appealing features of the sketch for Mr. Prospect. We gave him drawers on the left side

and a cabinet on the right. In making the drawing we made an additional sketch of three drawers for the right side similar to the three on the left and pinned them over the storage cabinet shown. The monotony of the design at once convinced the family that it was better as we had it originally.

Here is another point. The depth of the shelves for books is 20 inches, making it possible to use the back part of the shelves for dead storage of infrequently used books and the front part for the currently consulted ones. However, the possibilities of such shelving are infinite. We asked if he had much liquor storage space, suggesting we make false partitions just behind a row of books and put in removable panels behind which liquor could be stored. But he wasn't much of a drinking man, and that was out. A little safe could be put back there and few people would suspect it. Other possibilities will occur to fertile minds; have the courage to use them.

Drawings are important

It is hard to overemphasize the selling effect of good drawings. Fig. 1 required about one hour to complete. Of course it was done by an expert draftsman. Drafting is a profitable skill for those who intend to make some money in this game. It is perhaps the chief stumbling block to many. There are so many separate and different little skills needed to sell and install TV that many little men give up. Perhaps it's just as well; the industry calls for men who can and will take the time to learn what they need to know.

The choice of a wood finish is important. This room was plaster and paint, but we sold the idea of a knotty pine finish *for the entire room including the doors.* Here the cabinetmaker got more work out of the job than we did; but since he was working for us, the major portion of the profit on the job was ours.

We used to hire a cabinetmaker by the job, but we have since found it profitable to have one permanently on our staff. He is paid a base sum per week whether he works or not and a higher flat rate during the time he is actually working for us. He has his own shop and makes his services, skills, and tools available to us at all times. Sometimes he is busy on a private job of his own and we have to wait a week for his services, but that is not a serious problem. People who are quality-minded and who pay quality prices realize you can't hurry a good craftsman. That is part of why it requires a month to do a job.

Construction procedure

The series of sketches in Figs. 2 and 3 break Fig. 1 down into dimensional detail. Let's consider first the front elevation and the cross-section views of the front elevation. The basic dimensions shown are absolutely essential for installing the parts—chassis, power supply, speaker, and picture tube. The audio amplifier as the heaviest component belongs at the bottom of the assembly, resting on the floor for best support. The record player is just above the amplifier, built on a trolley arrangement so that it may be slid out for operation. This means that the cabling must be of very flexible wire that will not break.

Note the thimble through the wall at the back of the audio amplifier. This amplifier generates a large amount of heat and so does the power supply. You will recall that the wall behind the TV location was a stairwell, making it convenient to cut through for a ventilation hole. The stairwell side of the thimble is covered with a perforated metal grill.

Ventilation is necessary

Ventilation of TV custom installation is extremely important, so much so that RCA will not approve or permit an installation until the specifications show that proper venting is provided. They usually figure that a 40° C or a 72° F rise above ambient temperature is the maximum for safe receiver operation. Assuming that 70° F is the normal room temperature, an additional 72° rise would bring the temperature to 142°, the temperature of domestic hot water, which is more than most hands care to stand. Actual tests have shown that, with proper ventilation, operating temperatures are usually around 90° to 100°.

Note another thimble cut into the wall behind the picture tube and the 4-inch open spaces along the rear wall to permit hot air to flow easily out of the upper thimble. In other types of installations some provision is made

Photo courtesy Allan Du Mont Labs., Inc.

A receiver like this is easy to install and finish to the customer's specifications.

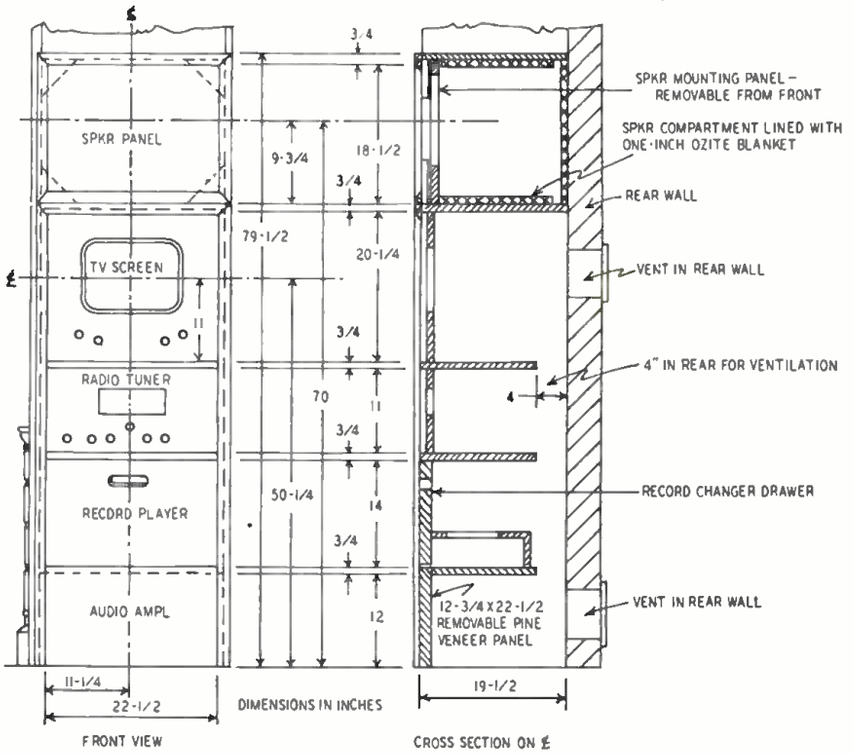


Fig. 2—A front-panel view and cross-section of the installation in Fig. 1.

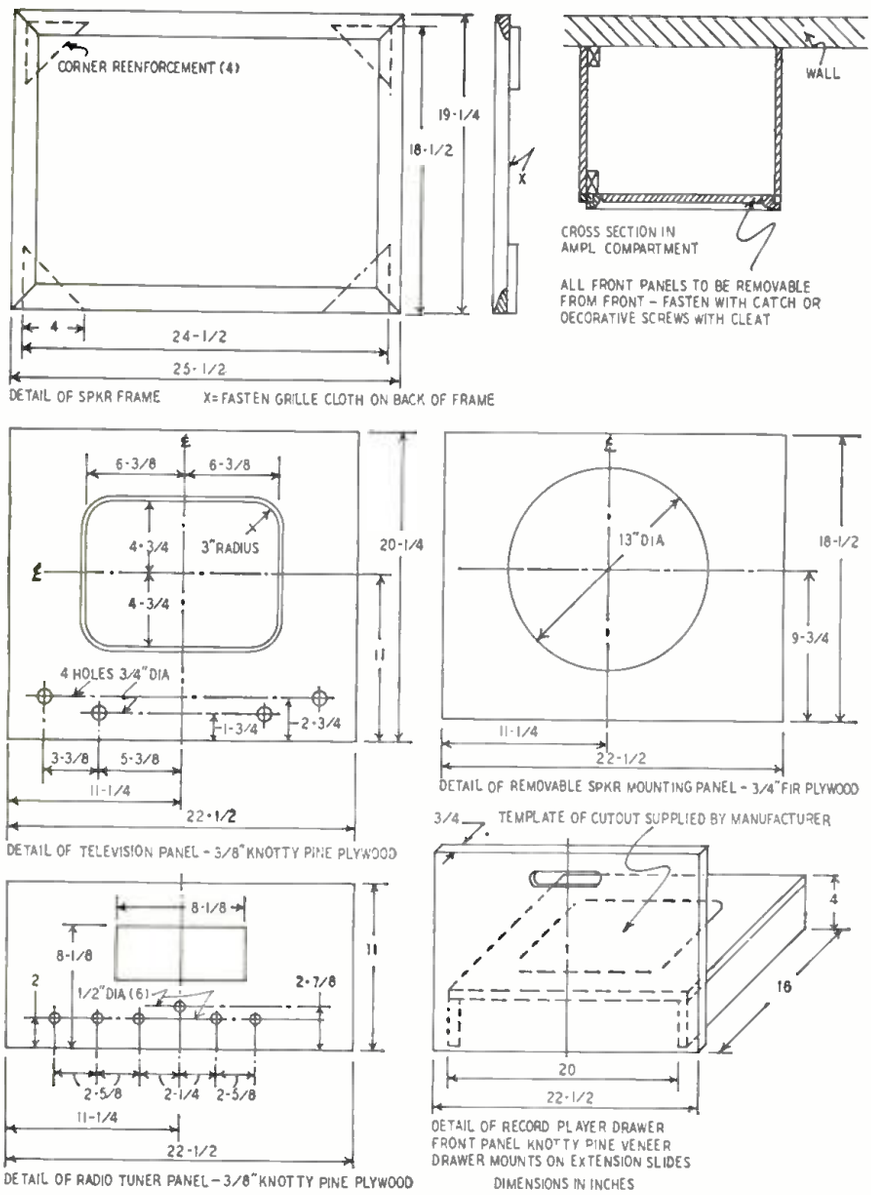


Fig. 3—Details of the panels on the individual compartments. The over-all dimensions and the positions of the holes will vary with different chassis sizes.

for openings in the paneling at the base of the unit; the grill work around the speaker provides the upper opening. So great is the chimney effect that a thin paper streamer held against the upper opening will blow out like a flag. When that happens, you are getting a good draft and you will have no trouble with overheating. The minimum opening area permissible for ventilation of the entire unit is 64 square inches.

The importance of dissipating heat from the TV installation and chassis is seldom understood. The capacitors and resistors in the front end of a tuner are heat-sensitive, and the stability of the oscillator depends to some extent on dissipating the heat generated in the oscillator and mixer sections.

Installations are flexible

Many variations are possible with the removable panels for the audio amplifier, record player, and speaker. The panels for the tuner, picture tube, amplifier, and speaker are removed only for servicing; they may be held in place with decorative screws, or just pushed into place and held there with spring-loaded catches. The record player front panel may be a slide which fits into a niche on the right or left side or at the bottom of the reproducer; or it may be the front of a drawer in which the reproducer is located, sliding out on ball-bearing runners. What is done depends on the desires of the prospect and the skill and experience of the cabinetmaker. Spring-loaded catches are wonderful because they make a little mystery of removing the panels, but they require a degree of precision to install that not every cabinetmaker possesses.

The enlarged views of the tuner and the television screen panels indicate the hole layout for the cabinetmaker. The holes are large enough for the control knobs and shafts and permit some tolerance in case they do not line up precisely with the shafts on the chassis.

The reinforcing corners in the speaker assembly are necessary to prevent the panel from sagging under the weight of the speaker. They are wooden pieces, and all cabinetmakers know how to install them. Cover the sides and back of the speaker compartment with a 1-inch Ozite blanket for sound deadening. Try covering the bottom and top and let the customer decide which sound he finds most pleasing.

The details of the record player in Fig. 3 will vary with the player selected. RCA will supply the installer with a template for the component used. Here the front panel is securely fixed to the record player drawer, and the handle is the slot cut into it near the top.

The installation discussed is only one of many possible types using equipment made by any of a number of manufacturers. It shows the kind of planning needed, the precision and care with which you must work, and the type of selling job involved.

Many custom installations use projection viewing systems. A typical one is made by General Electric. Fig. 4 shows how the optical system works, and, roughly, how the components must be placed. Obviously it requires a somewhat different layout from the direct-view installation.

One of the easiest installation jobs is the Du Mont unit shown in the photograph. It is shipped in the plywood case just as you see it, ready to work. All you have to do is make a place for it and finish off the front with paneling. While the installation is simplified, it takes a good bit of space and lacks the distinctiveness of an individually planned job for a specific location.

While I have no special preference for any one manufacturer, I have received much help and advice from the Consumer Custom Products Department of RCA in New York. If you make an RCA installation, you will have to have them OK your plans anyway before they will sell you the equipment.

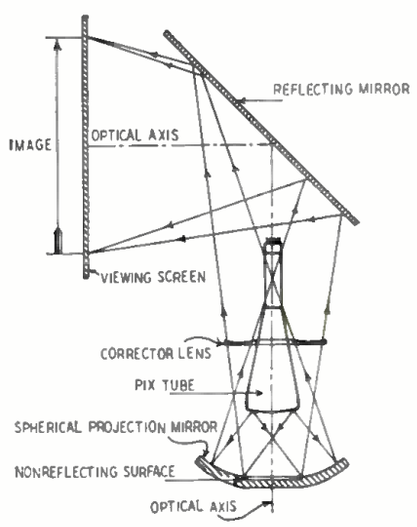
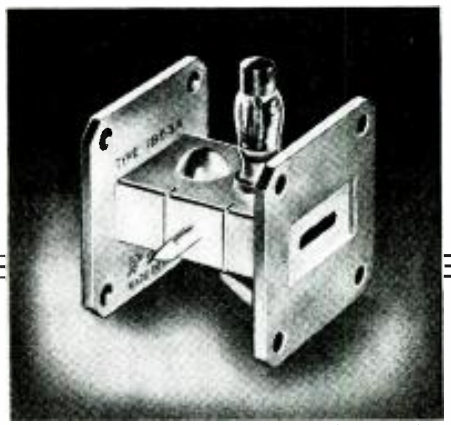


Fig. 4—A typical TV projection system.

MICROWAVES

Part VII—Action of below-cutoff attenuators, and of TR and anti-TR switches

By C. W. PALMER



Courtesy Sylvania Electric Products Inc.
A TR assembly for waveguide insertion

WE discussed waveguide attenuators in a general way in an earlier part of this series and showed how a resistance strip could be inserted into a waveguide to introduce an adjustable amount of attenuation.

Another type of attenuator used extensively in microwave work is called the "waveguide-below-cutoff" attenuator or sometimes simply the *cutoff* attenuator.

A wave propagates through a waveguide with very little loss, provided the diameter or width of the guide is greater than the cutoff point. If these dimensions are below cutoff, then there is no longer any real wave propagation; instead the magnetic and static fields of the r.f. waves are attenuated very rapidly down the length of the guide.

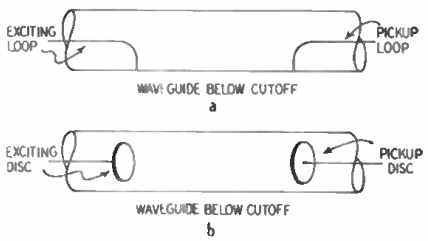


Fig. 1—Couplings are loops or discs.

If the guide diameter is made small compared to the free-space wavelength, the attenuation is independent of frequency over a very wide range. The modes generally used for such attenuators are the $TE_{1,1}$ and the $TM_{0,1}$. The methods of exciting waveguides in these two modes are shown in Fig. 1. Here a co-axial line is terminated in either a coupling loop or disc and the reduced power is picked up in another co-axial line. The distance between the exciting and pickup loops controls the amount of attenuation. Since the relationship is linear, a scale on the movable loop or disc can be calibrated directly in decibels. Attenuators of this type usually have an insertion loss of about 10 to 20 db at the position of maximum coupling and more as the coupling is reduced.

When co-axial line is coupled into a cutoff attenuator with loops, a serious mismatch to the line results, a co-axial line terminating in a loop being practically short-circuited. Three methods of reducing the bad effects of such mismatch may be used. The most common is to pad the input and output ends of the cutoff attenuator with lengths of high-loss co-axial cable. These add about 10 db of attenuation, and their resistance damps out the effects of reflection from the mismatched co-axial line termination.

Another way is to use resistor discs, little circles of graphite or carbon, made to fit the co-axial cable, with a hole in the center to contact the inner wire. The resistance of these discs should be equal to the characteristic impedance of the line so that the line is terminated correctly.

A third method is to make the loops of a resistance material and adjust the resistance of the loop to equal the characteristic impedance of the line.

Cutoff attenuators are also made to work in waveguide at the higher frequencies where co-axial line is not desirable because of high losses. Fig. 2 shows how this is done. A rectangular or circular guide is joined to the small "below-cutoff" section with a pickup probe near the termination of the large guide. This probe ends in a fixed loop for exciting the small guide. A second (movable) loop used as the pickup point ends in a probe extending into another section of large guide to continue the waveguide circuit.

The space between exciting and pickup loops is adjusted by one of several mechanical methods, the simplest of which consists of two telescoping metal tubes, each of which contains a loop and is terminated in the co-axial lines or waveguides. A rack-and-gear drive controls the amount of telescoping and, consequently, the spacing between loops, which varies the attenuation.

TR and ATR units

In radar and microwave communication systems in which the same antenna is used for both transmitting and receiving, it is necessary to use a fast-operating transmit-receive switch to prevent transmitter power from reaching the sensitive crystals and vacuum tubes of the receiver and also to prevent the received signal from being absorbed in the transmitter.

A transmit-receive (TR) box is an electronic switch which operates in a fraction of a microsecond. It must provide an excellent short-circuit for the receiver, since even a small part of the transmitter power would burn out a silicon or germanium crystal.

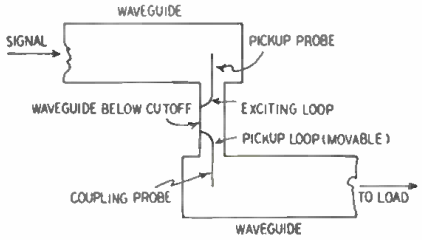


Fig. 2—Attenuator between waveguides.

Some form of gas discharge device is generally used for this purpose. Note Fig. 3. Here the transmitter power builds up a voltage across the gap, which then arcs over so that most of the transmitter power goes out to the antenna. This simple scheme could be employed in either a co-axial line or a

waveguide, but unfortunately it doesn't offer enough protection to the receiver.

The simplest way to improve it is to insert a voltage step-up transformer before the gap and a step-down transformer after it. And this is just what is done, in the form of a *resonant cavity* in which the gap is placed.

This resonant cavity may take the form of a cylindrical box with perfectly conducting walls and with two posts in the axis of the cylinder, separated by a gap, as shown in Fig. 4. In the lowest mode that will function in such a cylinder, the electrical field is parallel to the axis of the cylinder and increases toward the center. The magnetic field

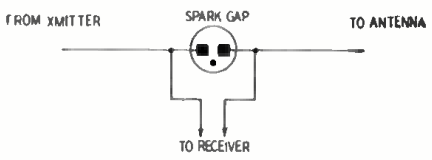


Fig. 3—The principle of the TR switch.

lines are circles perpendicular to the axis of the cylinder and currents tend to flow radially and up and down the center posts, as shown in the cross-section drawing.

Energy may be fed into and out of such a cavity either through windows in the cylinder walls or by coupling loops inserted into the cavity. The step-up ratio of the transformer is controlled by the size of the coupling windows or loops, the ratio increasing as the window or loop size is decreased.

When weak microwave currents pass through the waveguide or co-axial cable, the TR tube permits power to pass through. But if a strong wave—such as would be set up by applying power to the magnetron transmitter of Fig. 5—passes down the guide, the tube breaks down and becomes a short circuit. The shorting of the TR gap applies a "solid wall" at the junction of the T side arm of the waveguide, and sets up a strong standing wave in the side arm which prevents the transmitted signal from reaching the receiver.

In receiving, the magnetron is not fired, and since most magnetrons have a considerable change in impedance between hot and cold conditions, it is possible to tune the waveguide to provide a matched impedance condition when the magnetron is fired, thus introducing a gross mismatch when the magnetron is not fired. This sets up a standing wave in the line between the TR tube and the magnetron so that most of the received power goes through the cold TR box to the receiver.

Some magnetrons, particularly those on 3 cm and shorter wavelengths, do not change impedance enough to prevent an excessive loss of received signal. In these instances, an *anti-TR box* is used.

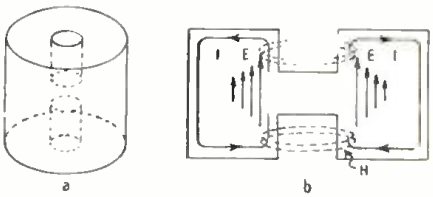


Fig. 4—Voltage is highest across gap.

The anti-TR box is very similar to the TR box except that it has only one coupling window instead of two. It is placed in a T side arm between the TR and the magnetron. On transmit, it fires just as the TR box does and reflects a solid wall at the junction of the T side arm, thus allowing maximum power to reach the antenna.

On receive, however, being situated a quarter-wavelength from the TR box and tuned in length so that when it is not fired it reflects signals coming from the direction of the antenna, it thus prevents loss of signal in the magnetron. If the distance from the anti-TR to the TR is correctly chosen, a maximum received signal will pass through the unfired TR to the receiver.

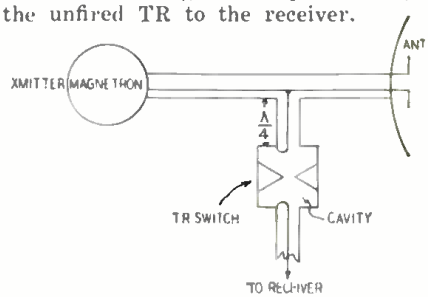


Fig. 5—TR switch in antenna circuit.

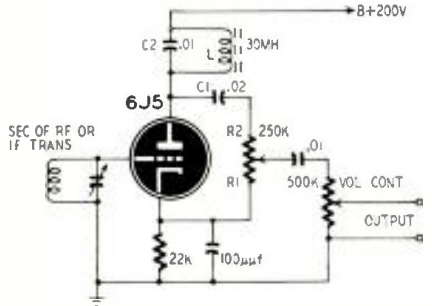
A TR switch may not fire in the first few cycles of the transmit signal and the high-voltage pulse may damage the receiver. To prevent this a "keep-alive" electrode is often built into the TR tube. An auxiliary electrode or gap near the main gap of the TR tube, it is connected to a source of voltage sufficient to keep a small arc always fired in the TR to supply the necessary ions to cause the main gap to fire on the first pulse from the transmitter. This causes a small loss of received signal, but prevents damage to the delicate receiver parts and is thus a worth-while compromise.

The use of TR and anti-TR switches in a microwave communication system permits duplex operation. Transmitter power can be applied momentarily to the antenna when it is desired to talk, but reception is possible at all times that the transmitter is not active. It also permits a single antenna and reflector system to be used for transmit and receive. This reduces cost and allows focusing on point-to-point transmissions to be simplified greatly. An even more important advantage is in radar, where the rotating antenna makes it extremely convenient to use one antenna for transmission and reception.

A DETECTOR-FILTER CIRCUIT

Heterodynes, caused by beating between adjacent-channel signals, are often annoying to users of high-fidelity receivers and tuners. A heterodyne filter is combined with an infinite-impedance detector in a circuit described in *Electronic Engineering* (London).

A parallel-resonant circuit L-C2 is inserted in series with the detector plate and B-plus in the circuit shown. The cathode bypass capacitor being small, the cathode voltage will follow the modulation envelope. Audio output is taken



from a bridge composed of the internal resistance of the tube, C1, R1, and R2. At frequencies above and below the resonant frequency of L-C2, the plate-circuit impedance is low and most of the audio voltage is developed in the cathode circuit. If R1 and R2 are equal and the reactance of C1 is low, the output voltage will be half that developed in the cathode circuit. If the impedance of the tuned circuit is equal to the cathode resistance at resonance, the audio voltage will be divided equally between the plate and cathode circuits. Since these voltages are 180 degrees out of phase—as in a kangaroo phase inverter—the audio voltage will be zero at the junction of R1 and R2.

R1 and R2 may be replaced by a potentiometer to permit balancing the system for best performance. The cathode capacitor is chosen to have a reactance much smaller than the cathode resistor at the lowest signal frequency—usually 550 kc—and much larger than the resistor at the resonant frequency of L-C2 (approximately 9,000 cycles). C1 is selected for a reactance equal to the resistance of R1 plus R2 at the lowest audio frequency to be passed by the audio system. If its reactance is too high, bass boost will be introduced. Feedback will occur at low frequencies if the reactance is too low. L is a 30-mh shielded r.f. choke. One with a powdered-iron core is preferable. C2 should be a high-quality mica unit. L-C2 may be replaced with a commercial heterodyne filter if it is considered desirable.

If the receiver has a separate detector, the filter may be incorporated in an a.f. amplifier stage. In such cases, the cathode bypass capacitor is omitted and the cathode resistor adjusted for normal amplifier operation.

How to Become a Ham

PART II:—

Learning the Code

By GEORGE SHUART

Have a friend send the code while you copy it down.

THE International Morse code was the first and—for a time—the only way of conveying intelligence by radio. More important to the would-be amateur, the Federal Communications Commission requires you to be able to send and receive it at a rate of 13 words per minute before you can get a license. That being the case, the thing to do is to get to work and learn it.

The code is used to transmit intelligence in exactly the same way as the spoken word. In speech, sound is varied to form words; in code, the duration and spacing of a single type of sound is varied. In either case the effect is the same. It is the complete sound that gets the idea across, not the individual variations. For example, should a person say "fishing rod," you would visualize a fishing rod, not think of the letters that make up the words, nor of the words themselves. So it is with code—one does not listen to the component parts of letters, but visualizes complete letters or words.

If I were walking down the street and heard a voice behind me say, "Shuart!" my head would turn almost instantly whether I wanted it to or not. Having been called Shuart for a number of years, I know that when somebody says "Shuart" he usually means me. I don't have to think about it. I answer to the name just as quickly and unthinkingly as my leg jumps when the doctor hits my knee with his little rubber hammer.

A good code man operates on the same basis. When he hears a long and a short sound, his hand writes "N" automatically. He doesn't think about it—he hasn't time. The long-short sound combination is directly associated in his mind with the letter N. No mental pictures of printed dots and dashes come between the sound and the letter.

There's a lesson here for you. It's so important that it is almost all you need to know:

The only good way to learn code is by ear.

Never look at any of the tables that show dots and dashes (or even dits and dahs) next to the letters they represent. From the very start of your training learn by having someone send letters to you and then tell you what each one is. That isn't practical if you can find no one to help you. But it is worth while to move heaven and earth to find someone who will sit down and send the letters to you—even if just until you can recognize the 26 letters and 10 numerals. The rest you can do yourself.

If you can get help

You'll need a code-practice oscillator or buzzer, which can be built following instructions in any of the articles listed at the end of this story.

Don't look at any tables showing the code in print—not even at the one given in this article. Sit down at a table with a good supply of paper and pencils. Let your "instructor" send you the letter A. The first few times, he should tell you what it is. Then let him send it over and over again, perhaps 30 times. *And each time he sends it, write it down.* Then do the same with the letter B. Next, try it with alternate A's and B's until you can copy them straight in any order, identifying each correctly. *Each letter should be sent at a good clip*, with long enough spaces between them for you to identify and write them down.

Now try C. Then D. Then A, B, C, and D. And so on through the alphabet and numbers. After a while you will not have to think so long for certain letters, and you'll know you are learning. This whole procedure may take a number of sessions, each of which should be stopped when you feel your mind is getting cluttered and is no longer alert.

As soon as you have learned a few letters, have your instructor send complete words, short ones, of course, with long pauses between them so that you can write down the word immediately after it has been sent. Thus you'll avoid the pitfall of attempting to write down each letter as sent. The beginner will, of necessity, be copying slowly. Try to remain at least two letters behind the sender. Do your early copying at a very slow rate of speed . . . stop if you find that you are hurrying. Don't strain at the pencil; that will get you nothing. Each letter should be formed carefully and slowly. It will then be more legible, and you will find it less difficult to copy *behind* the sender.

A great many code students believe that fast writing allows greater time for concentration on what is being sent. That is wrong! Write slowly and keep yourself relaxed. If a letter is missed or improperly formed, go right ahead to the next as though nothing had happened. If you stop for one letter, you will lose a dozen before you get going again.

If you have no help

If there is no one to help you, use the table printed with this article. Notice that there are no dots and dashes, only *dits* and *dahs*. A dit (short sound or dot) in print looks very much like a dah (long sound or dash) so your future progress is not so likely to be impeded by a mental picture.

Don't learn the code by eye. Put the table before you and rest your hand on the key. To learn the letter A, just let your hand follow the instructions to push once briefly (di) and once long (dah). The space between the two should be only as long as necessary to get the key up and down again. The di-dahs, remember, are just instructions for your hand, not things for your mind to learn. Make the sounds indicated with the key and oscillator and immediately pause and write each letter down. After you've made the sounds for A and B many times, mix them up—and write down each one. Then go on to C. Next, mix up A, B, and C. And so on through the list.

To send correctly, hold the key lightly, palm parallel with the operating desk, and with the elbow and the forearm muscle resting on the desk in a direct line with the key. Bounce the wrist. When the wrist is lifted, the key will go up. As the wrist is lowered,

the key will go down with it. Rapid bouncing makes the dots, while slow bouncing will make the dashes. Be proud of your "fist." Good sending is immediately recognized. You'll receive many more replies to your calls if your signals are easily understood. If your characters are slurred and your sending wobbly, the other fellow will pass you by and go to someone else who is easy to read.

Working up speed

Once you've learned the bare letters and numerals by either of the two methods above, your real training begins. It is simple; it is also tedious. Progress will be slow for a while, then suddenly speed up.

The procedure can be given in two words: Copy code! Have a friend send it to you or listen to it on your receiver. Commercial stations send fast but well. Amateurs may send fast or slowly, well or badly; but whatever you listen to, you will learn code as long as you put down on paper every letter you can recognize.

Peculiarly, you will make just as fast progress (though with less sop to your ego) listening to 25-words-a-minute press as to 15-word sending from a friend. You may catch only one letter a minute at the start, but soon you'll get more.

Above all, never copy for practice anything you can get "solid" (completely). It should always be faster than you can really copy.

There are many fine code-teaching machines on the market. Those who have to learn alone should certainly have one. Investigate the various types to find the one most suited to your needs and pocketbook. Phonograph records—sold by most radio mail-order houses—are especially useful to the lone student. In any event a practice outfit will he needed. This can be built or purchased.

Just one final tip: don't get discouraged. You may get on beautifully for a few weeks, then be unable to improve at all. But if you keep up your practice, you will eventually forge ahead. You may hit another snag a little later. Again, don't quit, for you will eventually break the tieup. Boosting code speed is a very peculiar process, but anyone at all can do it. *Nobody gets anywhere without constant practice.* Be assured that no matter how discouraging matters seem, more practice will pay off handsomely.

Many people who are interested in radio have never learned the code, simply because they believe it to be a fantastically difficult undertaking. That is not so! Learning the code is not hard, if you give yourself a chance. Just follow these four simple rules:

1. Relax! Take it easy!
2. Proceed s-l-o-w-l-y.
3. Do *not* set a deadline.
4. Take it in small doses.

With the help of these four rules and the simple information contained in this chapter, you may find learning the code one of your most worth-while experiences.

TABLE OF CODE SOUNDS

A. di *dah*
B. *dah* di di dit
C. dah di *dah* dit
D. *dah* di dit
E. dit
F. di di *dah* dit
G. dah *dah* dit
H. di di di *dit*
I. di *dit*
J. di *dah* dah dah
K. *dah* di dah
L. di *dah* di dit
M. *dah* dah
N. *dah* dit
O. *dah* dah dah
P. di dah *dah* dit
Q. *dah* dah di *dah*
R. di *dah* dit
S. *di* di di
T. dah
U. di di *dah*
V. di di di *dah*
W. di *dah* dah
X. *dah* di di *dah*
Y. dah di *dah* dah
Z. dah *dah* di dit
1. di *dah* dah dah dah
2. di di *dah* dah dah
3. di di di *dah* dah
4. di di di di *dah*
5. di di di di *dit*
6. *dah* di di di dit
7. dah *dah* di di dit
8. dah dah *dah* di dit
9. dah dah dah *dah* dit
Ø. dah dah dah dah dah

SPECIAL CHARACTERS

$\overline{AR}$. End of item.
R. Received and understood.
$\overline{K}$. Go ahead. Transmit.
$\overline{DN}$. Slant bar.
$\overline{SK}$. End of contact.
$\overline{IMI}$. Query. Repeat.
$\overline{AS}$. Wait a minute.
String of dits. Error.
$\overline{BT}$. Break.
$\overline{AAA}$. Period.

Notes
"Dit" indicates a short sound (dot). "Di" is the same but omitting "t" indicates that the next sound comes immediately.
Only listening to others can give an idea of correct spacing, but the italicized sounds may be very slightly accented mentally to give each character a rhythmic individuality. Each dah should actually be the same length, as should each di or dit.

Line through zero (Ø) distinguishes it from letter O.
In special characters, a line over two or three letters indicates they are sent as one character without spacing.
Instructions for building code-practice oscillators were given in the following issues of this magazine, 1949: Feb., p. 86; 1948: Mar., p. 63, Apr., p. 44, May, p. 80, Sep., p. 82, Oct. p. 84. Any of these oscillators should be satisfactory.

CODE-PRACTICE STATIONS

One of the best ways to increase your code speed is to copy government and commercial radiotelegraph transmissions with the aid of your receiver. The table below lists stations of Mackay Radio, Radiomarine Corp. of America, and the U. S. Coast Guard which transmit useful material for practice at reasonably low speeds.

Stations whose calls begin with N are Coast Guard. They broadcast weather and marine information. WSL, KFS, and DZM send press, while the others transmit weather.

Other good sources of practice material are ARRL information and code-practice transmissions (write ARRL or see *QST* for schedules) and miscellaneous commercial and government code stations you may run across. Foreign countries, notably England, broadcast traffic and press in a number of languages.

Note that you will require a special receiver for frequencies below 550 kc. This can be constructed by the listener, or he can use surplus beacon receivers, some of which receive over a range extending from 200 to 500 kc.

Time (GMT)	Freq. (kc)	Call sign	Station Location
0018	408	KSE	Torrance, Calif.
0418	8,452.5		
1618	16,990		
2018			
0330	127	NMR	San Juan, P. R.
1530	4,795		
0350	425	NMF	Boston, Mass.
1550			
0400	425	NMC	San Francisco, Calif.
1600			
0418	5,555	WSL	Amagansett, N. Y.
	11,115		
0420	425	NMA	Miami, Fla.
1620			
0420	480	NMY	New York, N. Y.
1620			
0430	425	NMQ	Long Beach, Calif.
1630			
0450	410	NMN	Norfolk, Va.
1650			
0500	126	KPH	Bolinas, Calif.
1700	436		
	8,440		
	11,160		
	22,325		
0500	425	NMW	Seattle, Wash.
1700			
0520	425	NMG	New Orleans, La.
1720			
0530	410	NMJ	Ketchikan, Alaska
1730			
0550	464	NMV	Jacksonville Beach, Fla.
1750			
0605	6,270	KFS	Palo Alto, Calif.
	12,550		
0900	425	NMO	Honolulu, T. H.
2100			
1700	8,670	DZM	Manila, P. I.
1748	418	WPA	Port Arthur, Tex.
	8,435		

HINTS ON COMMAND SET RIGS

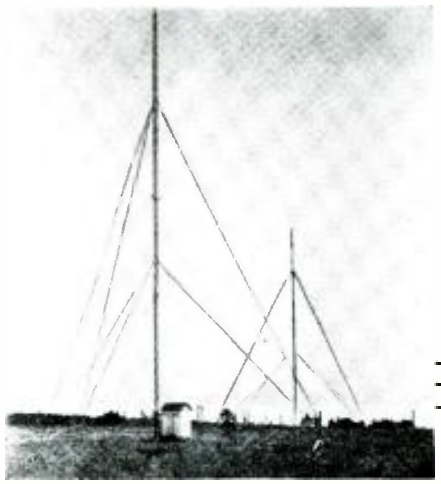
A number of amateurs are using the transmitters from the SCR-274-N and ARC-5 command sets. At W2PWG, we have found a few interesting points that we have not yet seen.

If you modulate the plates of the 1625's, remove the .01-μf plate bypass (C66) and replace it with a .002- or .005-μf 2,500-volt mica capacitor. This prevents most of the audio from being bypassed to ground.

The PA stage must be retracked. Tune to the high end of the band and adjust the PA padder C67 for minimum plate current. It should not vary more than 6 ma as the rig is tuned to the low end. If it does, adjust the slug for minimum dip. Return to the high end and check the variation in current. Continue the adjustments at high and low ends until current is within 6 ma.

CASE OF THE ELUSIVE BLIP

The problem that nearly stymied a broadcast station



Looking east, west tower in foreground.

By JAMES W. ESSEX

SETTING up a directional broadcast installation sometimes proves to be a greater problem than obtaining the necessary permission to operate a broadcast station. True, the difficulties of obtaining a license are tremendous and require a great deal of preparation and planning, but the problem of getting two towers to work as they were designed is often minimized to such a degree that a faulty pattern can hold up an anticipated opening for a long time.

Take this station as an example. CKBW is located in Bridgewater, Nova Scotia. Power was planned at 1000 watts and a license obtained to work on 1000 kc. The site was chosen, land purchased, equipment ordered, final assembly of studios and transmitter completed, and all items checked and rechecked for proper adjustment. Finally came the opening day.

Using a two-tower antenna system operating with a 90-degree phase difference between the two towers, a null area was to be had west of the line of towers—the towers running due east and west. This was laid down in the brief submitted to the licensing authority, on which basis the license had been granted. This station was not to contribute any interference on the 1000-k.c. channel in a westerly direction after sundown. It would operate non-directional by day and directional by night.

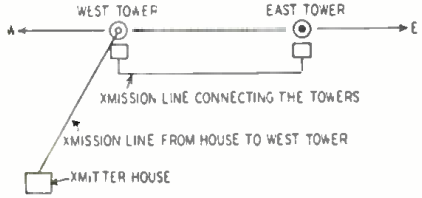


Fig. 1—Placement of towers and house.

Because the site chosen for the installation was such that the transmitter house could not be set directly in line with the towers, it was built in the position shown in Fig. 1. This was to contribute dire complications to the system in due course.

Having set up the phasing units at the base of each tower to obtain the 90-degree displacement, we were now prepared to make our first check on the resulting radiated field.

Using a loop receiver with an output circuit driving a meter calibrated in microvolts per meter, we made a trip by automobile, completely circling the two towers, stopping at each 9 degrees where such radials intersected an accessible road at a distance greater than one mile. Points appear in Fig. 2.

Our first complete run having been made, all readings obtained in microvolts per meter were evaluated into ratios, resulting in a set of numerical values. These figures plotted on a polar graph gave us a directional pattern similar to that shown in Fig. 3.

The distortion that appeared was a clear indication of trouble, the forerunner of disappointment and delay.

Because of the strict adherence to Department of Transport (Canadian equivalent of the FCC) regulations, the distortion or "blip" clearly indicated in the null area could not be accepted. A long struggle was begun to rid the pattern of it. The date for going on the air was promptly shelved, and the battle of wits began.

Tackling the problem on the basis that incorrect phasing between towers was causing the distortion, we shifted the phase slightly above and below the mean of 90 degrees. With each shift in phase, a trip by car was taken, running through the area where the null was supposed to appear, west of the towers. At the conclusion of each run, as described previously, the values obtained were plotted.

Soon gasoline consumption reached large proportions and the transmitter room was becoming a litter of graph paper—each run failing to bring us any closer to the desired result. The blip was determined to remain.

From the end of November to the middle of December, work carried on, though with increasing difficulty as snow began to fall. With the roads becoming difficult to negotiate by car, we abandoned the auto for a jeep. This carried us well into the null area by resorting to the farmers' fields; and with the aid of skis when any walking had to be done, our mobility was complete. It happened that the district experienced a record snowfall this particular season, and we felt that even the elements were against us. The colder it got, the warmer our tempers became.

We persevered. When phase shifting did not bring the desired result, it was suggested that some reflecting object might be adding a third signal to the array, producing the blip in the null area. This became the basis of a favorite joke. A large sign on the wall of the transmitter house stated: "All wearers of watchchains, etc., must cease wearing same forthwith. They are blamed for reradiating the signal that causes our Blip."

The reflecting-object theory was gone into thoroughly, even to the point of having the telegraph company temporarily remove copper wires which traversed the tower array directly back of the east tower. This, however, did not remove the distortion in the pattern, and the search continued.

With the approach of milder weather spirits were lightened somewhat and a final effort was made to solve the riddle.

(*Continued on bottom, page 36*)

Sideband Suppression

By I. QUEEN

Single-sideband systems provide a very effective method of reducing interference. Since the desired signal occupies only half the usual frequency band, there is less chance of picking up spurious radiation, heterodyne whistles, and general noise. With conventional double-sideband transmission the same improvement can still be had by chopping off one of the sidebands at the receiver.

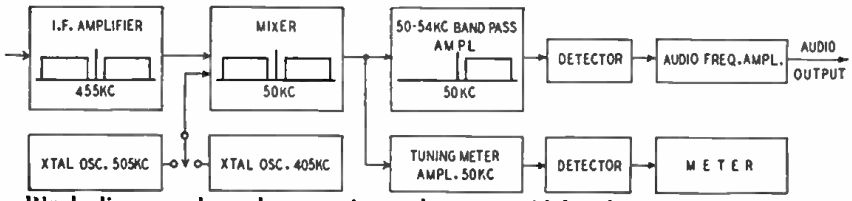
Patent No. 2,364,863, utilizing this principle of interference elimination, was issued to James L. A. McLaughlin about four years ago. Although more complicated than systems which rely on crystal filters, Wien bridges, or highly selective circuits, the results are more effective. This is because an entire sideband is eliminated rather than just a small portion (notch or rejection slot). In addition, operation is easier because there is no need for critical retuning or phasing for each new set of conditions.

To illustrate how single-sideband selection works, assume a conventional receiver i.f. of 455 kc and a bandwidth of 8 kc. Then the total range is 451-459 kc. Before suppressing a sideband, this i.f. is converted to a lower value by beating it with a crystal-controlled oscillator.

For maximum noise reduction it should be possible to suppress either sideband at will, to determine which gives better results. Therefore two oscillators are provided, one operating at 405 kc and the other at 505 kc. Either one may be switched into the circuit. No matter which one is used, the second i.f. (carrier) will still be 50 kc and the range will be from 46-54 kc. The second i.f. amplifier has a passband from 50-54 kc, so it transmits only the carrier and one sideband.

There is an important fact to note. When the 405-kc oscillator beats against 451-459 kc, it produces a range from 46-54 kc; therefore the lower sideband will be suppressed. When the 505-kc oscillator is used, the i.f. channel extends from 54-46 kc and the *upper* sideband is lost.

A portion of the mixer output is also connected to a sharply tuned 50-kc amplifier and detector. This controls a resonance meter for indicating correct re-receiver tuning.



Block diagram shows how receiver selects one sideband, suppresses other.

CASE OF THE ELUSIVE BLIP (*Continued from page 35*)

A complete re-examination of all past investigations and experiments was made, and one fact made itself apparent. This was that the transmission line from the west tower to the transmitter house was running almost at right angles to the point at which the blip occurred in the null.

The angle of the transmission line to the west tower was determined with a magnetic compass, figures being carefully recorded and compared with our previous findings as to the position of the blip. Knowing the type of transmission line in use (an open-wire system) we decided that a standing wave existed on this line, which, radiating, was causing the distortion in the null.

Armed with these facts, we investigated the tuning and phasing unit in the west tower. The search disclosed an inductance not properly shielded, which contributed a mismatch in the line when on directional transmission and formed a standing wave.

This was remedied by having the coil shorted out by a relay when not in use (it was not used when the system was directional). The parasitic inductance effect of this coil, detuning the circuit and causing the line mismatch, was eliminated, leaving the line properly loaded and eliminating any chance of a standing wave.

Our efforts were rewarded at last. Another run through the null area proved that the troublesome blip had been eliminated.

And so we stood by and listened, huddled about the monitor speaker in the transmitter house, to the first crisp words from the speaker, "This is CKBW in Bridgewater."

Another station was on the air!

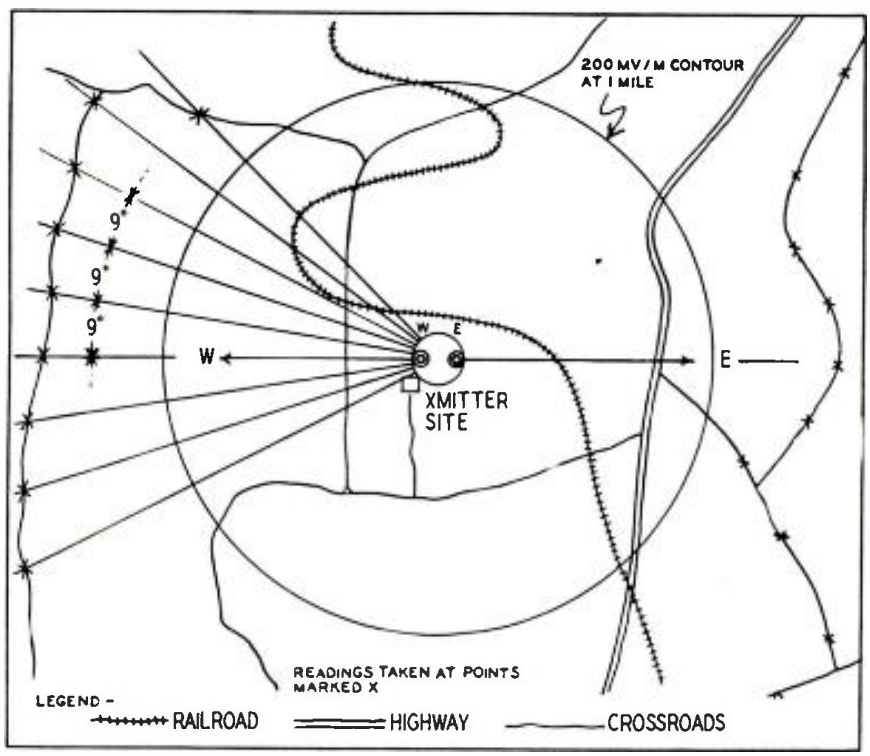


Fig. 2—Intensity readings were taken at 9-degree intervals around antenna.

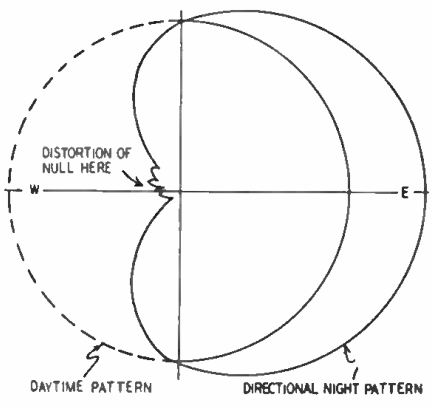


Fig. 3—The start of all the trouble.

Tracer Uses Tube As Probe

A small, convenient unit good for bench use or outside jobs

By ALVA R. WILSON and W. KENNETH WILSON

Fig. 1—Tracer is valuable shop help.

SIGNAL TRACERS are standard equipment for rapid trouble shooting. The signal tracer shown in Fig. 1 is even more useful than the average one because of its many applications. It has a 3-inch PM speaker (eliminating headphones), a volume control, and a meter which gives a relative reading of incoming signal strength. Unlike the speaker, the meter indicates signals of all frequencies, including unmodulated r.f. It enables the tracer to be used for checking a receiver's oscillator, for hunting down stray oscillations, and even for transmitter trouble shooting. When not otherwise in use, this signal tracer can be used as a local broadcast receiver.

The unique design of the probe, whose simplicity is shown in Figs. 2 and 3, gives both high input resistance and high amplification. Start with a 6K7, a 6F5, or almost any other metal tube which has a grid cap on top. Cut a piece of ¼-inch copper tubing about ⅞ inch long. Solder it directly to the grid cap (Fig. 3). Now take a piece of No. 10 copper wire approximately 1½ inches long, file one end to a point (place it in your drill chuck and hold a file against it), then wrap the other end with a 1-inch strip of waxed paper, allowing the paper to overhang the end of the wire slightly to insulate it completely from the copper tubing on the grid. When enough paper has been added for a tight fit, force the wrapped end of the wire into the copper tubing, and you have the input capacitor. The grid resistor is even more simple. Using a knife, scrape the paint from the edge of the metal tube cover where it is crimped over the piece of bakelite holding the grid connection. Now take a pencil and mark all over the bakelite, covering the entire surface between the grid and the shield. Rub the pencil lead in well with your finger, repeat the process once or twice, and you have formed the grid leak. (Note: This might work better in the authors' state of New Mexico than in higher-humidity areas.—*Editor*)

For convenience in changing tubes the probe tube is simply plugged into an eight-pronged female cable connector (or an S-type tube socket with a shield over the soldering lugs) to which the lead-in cable is connected. The lead-in cable should contain a shielded plate lead, a ground wire (or the shield can be used for this since it must also be grounded), and one filament lead.

The values shown in the meter bridge circuit should be closely followed. A 1-ma meter is preferred for sensitivity. Before use, the meter is adjusted to zero (while the probe tip is grounded) with the 2,500-ohm potentiometer. Thereafter, any input signal picked up by the probe will be indicated by the meter. If the signal contains audio components, they can be heard from the speaker.

The audio stage consists of a volume control, a 6V6 (or any other good output tube), and a 3-inch PM speaker.

The box was built of hard-pressed Masonite and is held together by small finish nails driven into predrilled 1/16-inch holes. If desired, the joints may be further strengthened by applying model airplane cement to the edges before nailing.

In Fig. 1 the lower control is the meter-zero, and the upper control operates both the off-on switch and the volume. An off-on indicator light may be mounted on the front panel.

For broadcast reception a replacement-type antenna coil is used.

In receiver trouble shooting, the ground clip on the probe is fastened to the receiver chassis. An input signal (such as a local station or an oscillator signal) can then be traced right from the antenna coil through each stage to wherever it stops.

Once you have started using this signal tracer, you will find a number of applications for it in addition to the ones already mentioned, and you will soon agree that it is a most useful piece of trouble-shooting equipment.

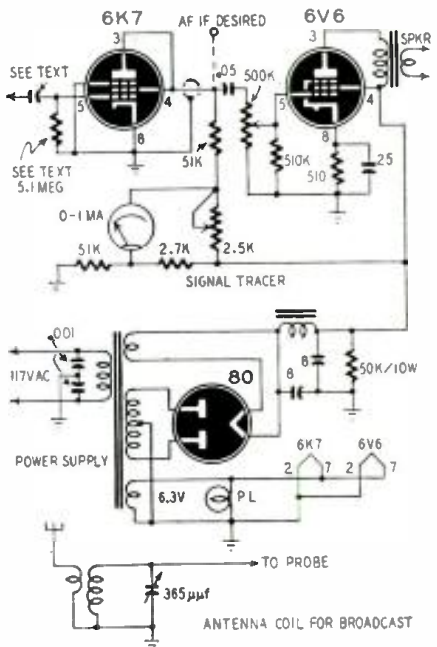


Fig. 2—Complete construction diagram.

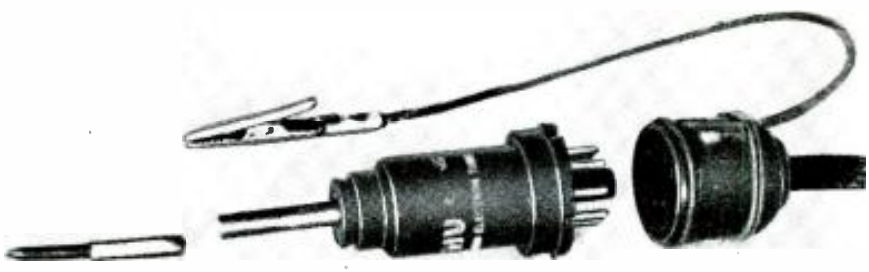


Fig. 3—Tubing is soldered to grid cap and a wire tip is slipped into tubing.

Operator sets dividers to exact width of pulse as she clicks camera shutter.

Radio test instruments check camera shutters and flash synchronizer

Cameras Are Tested With Simple Setup

By FRED C. GABRIEL

A USEFUL experiment for the radio man who is also an amateur photographer is the accurate determination of a camera's shutter speeds. The method described consumes no film or other materials; hence it can be repeated as often as desired at no cost. Expensive, conventional shutter-testing apparatus is far beyond the reach of most amateurs, and the number of professional photo laboratories supplying this service is small. An extension of the method makes it possible to check the operation of photoflash synchronizers, a boon to the indoor photo enthusiast.

The electronic equipment required includes an oscilloscope (the inexpensive variety works nicely), a calibrated audio oscillator, and a photoelectric cell.

The shutter speed of a camera is the elapsed time between the opening and closing of the shutter. This time may vary considerably from the value marked on the camera and many pictures may be missed before the cause shows itself. Our method is to record the opening and closing of the shutter as marks on the oscilloscope screen. The space between the "open" and "close" markers can then be filled with sine waves of known frequency, and the time interval determined by counting them.

Here is the step-by-step procedure:

1. After allowing a warmup period for all instruments, set the audio generator to a frequency high enough to permit about five cycles to be included in the shutter interval to be measured. For example, a shutter speed of 1/100 second would include five cycles of 500-cycle audio.

2. Connect the audio generator to the scope's vertical input, and also to the external sync terminal. Be sure that the sync selector on the scope is at the EXTERNAL position, and then adjust the sweep frequency to display about 10 sine waves. Use the SYNC AMPLITUDE control to lock the pattern. Remove the signal from the scope vertical input, *but leave the sync lead connected throughout the test.* This will insure against sweep oscillator frequency drift. If the sweep oscillator is not synchronized to the a.f. oscillator, all subsequent measurements will be useless.

3. Hook a photoelectric cell to the vertical input terminals of the oscilloscope. Arrange a light source to shine on the photo cell (we use a 25-watt bulb in a table lamp; place the camera between light and cell. Adjust the camera to its widest aperture and click the shutter a few times. A bit of experimenting with the camera position should result in ample vertical deflection of the scope trace. The vertical gain control on the scope will probably have to be near its maximum setting. Our setup gave usable deflection from a type 921 photocell (chosen because one was at hand) with a single vertical amplifier stage in the oscilloscope. A brighter light source will increase the amplitude of the trace. Incidentally, we experienced virtually no hum from the a.c.-operated light source.

The instantaneous pattern obtained is a more or less square wave, depending on the shutter speed being meas-

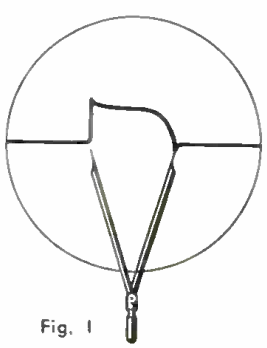


Fig. 1

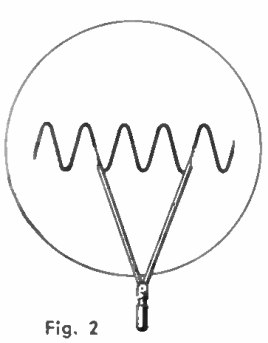


Fig. 2

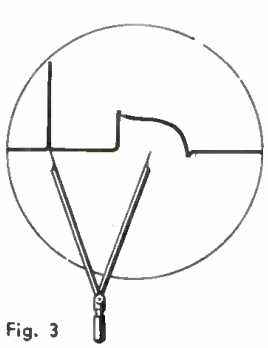


Fig. 3

ured and on the low-frequency response of the scope amplifier. In any case, the opening and closing points are clearly defined. Since the pattern is of short duration, it is necessary to click the shutter several times to be sure that all of the shutter interval is included on the scope face. Set a pair of draftsman's dividers to the width of the trace between the opening and closing markers (Fig. 1). The shutter may be operated as often as necessary to set the dividers accurately.

4. Switch the scope vertical input back to the a.f. oscillator. The stationary pattern of step 2 should be obtained immediately. Apply the dividers to the screen, and count the number of sine waves between the points, as in Fig. 2. The number of sine waves divided by the oscillator frequency gives the shutter speed in some fractional part of a second.

Checking the synchronizer

The photoflash synchronizer should close the battery circuit to the flash bulb at a predetermined interval before the shutter opening. If the synchronizer has been properly set, the open period of the shutter will coincide

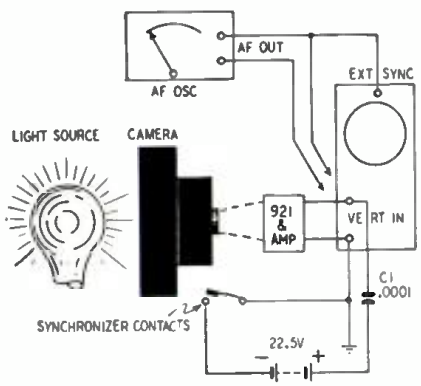


Fig. 4—A setup for synchronizer tests.

with the peak of light output from the bulb. The desired interval between closing the circuit and opening the shutter may be read from the "light output vs. time" graphs distributed by bulb manufacturers.

In our test we will display a marker from the flash synchronizer side by side with the shutter pulse described above. The audio oscillator can then be used to measure the time interval between the flash marker and the midpoint of the shutter pulse (Fig. 3). The flash marker must be readily distinguishable from the shutter markers, and it must not interfere with them. The synchronizer circuit remains closed after it has acted, but the vertical amplifiers must be allowed to recover in time to transmit the shutter pulse which follows. The synchronizer pulse is differentiated sharply by capacitor C1 (Fig. 4) and the input resistance of the 'scope. A 22½-volt battery in series with the synchronizer provides a large pip easily distinguished from the shutter markers.

Machinist's dividers are used to compare shutter opening with audio sine waves.

The required audio frequency can be determined by experiment. The time interval to measure is that between the synchronizer pip and the mid-point of the shutter pulse. The synchronizer should be adjusted until this interval corresponds to the ignition time of the flashbulb. The ignition time may be found in flashbulb data tables, or be obtained direct from the manufacturer.

Since one side of many synchronizer circuits is grounded to the synchronizer body, this side must be connected to the ground terminal on the 'scope input to avoid 60-cycle body pickup whenever the camera and synchronizer are handled. Note that the settings of the oscillator frequency and oscilloscope sweep, sync, and horizontal gain must not be disturbed during a test. Short unshielded leads may be used for all connections.

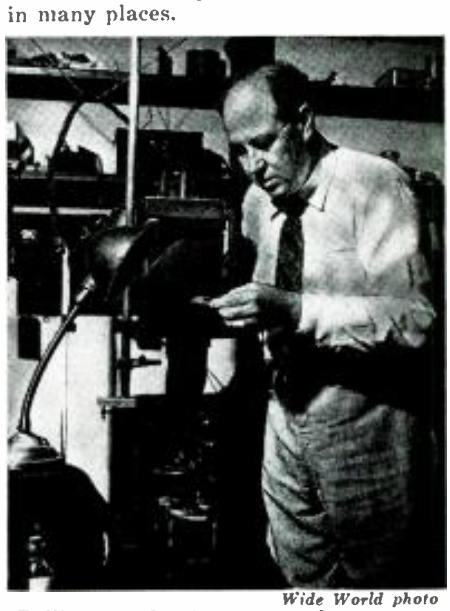
PHOTOTUBE ANALYZER FOR LIVING CELLS

The makeup of a single living cell may be analyzed in much greater detail than ever before possible with the aid of a new electronic instrument developed after seven years of work by members of the Columbia University Zoology Department under the direction of Prof. Arthur W. Pollister. The device, known as a microspectrophotometer, uses a phototube to measure the light absorbed by the various components of the cell.

All living cells consist mainly of two ingredients, proteins and nucleic acids. There are two types of the latter, which are the principal components of the chromosomes that determine heredity.

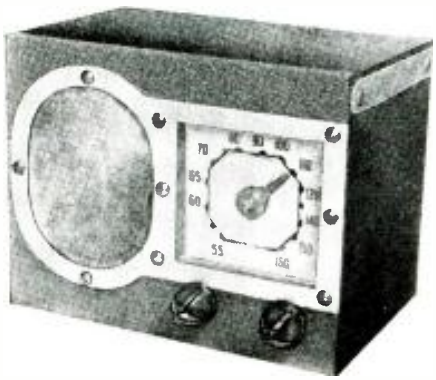
Each type of nucleic acid absorbs light of a different wavelength, the amount of light absorbed indicating the quantity of acid present. The phototube, together with a sensitive current-measuring circuit, indicates how much light is absorbed. From this information scientists can evaluate with very good accuracy the composition of any cell they study.

The instrument has already revealed many significant facts about living cells. According to Prof. Pollister (see photo) the technique has opened an entirely new field of quantitative chemistry. The device has been simplified so that anyone familiar with a microscope can use it. Research centers are being established at hospitals and laboratories in many places.

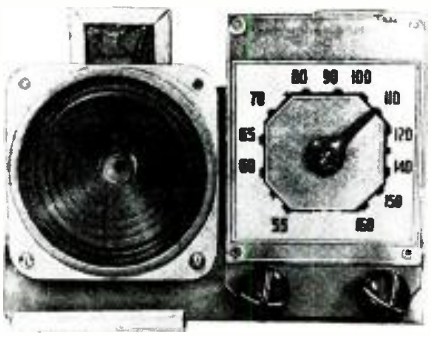


Wide World photo

Pollister and microspectrophotometer.



Complete receiver (left) is shown in its cabinet. Photo below emphasizes the set's small size—it's not much longer than a couple of standard-size cigarettes.



Commercial slug tuner makes construction of a small receiver easy for the experimenter

Miniature-Tube Receiver Has Permeability Tuner

By JOHN E. HAZELRIGG

MANY home-construction enthusiasts who would like to build a small broadcast receiver with the new miniature tubes are reluctant to do so because of the difficulty of working in small spaces. To have a set that is miniature throughout, midget coils and capacitors are also required; but they cannot be expected to give as dependable service as standard-size units.

By using a compact permeability-tuning unit, I was able to build a set comparable in dimensions to the very small manufactured sets now so popular. Miniature tubes are used, but all other parts except the speaker are standard size. The cabinet is 7¾ x 5 x 6 inches, and the actual chassis dimensions 7 x 4 x 1¼ inches.

Miniature tubes require very little chassis space; and because their socket terminals are more closely grouped than those of octal tubes, there is more room under the chassis. Thus, larger and better resistors and capacitors can be used.

The permeability-tuning unit I used is manufactured by the Aeromotive Equipment Corporation of Kansas City, Missouri. This unit—their Model 320—takes up only 1¼ inches of chassis space, a considerable economy compared to the two-gang tuning capacitor. The space saved permits mounting standard intermediate-frequency transformers. The Model 320 is complete with a dial and pointer, antenna and oscillator coils, tuning shaft, and a hole for the volume control shaft. The unit is factory-aligned to track perfectly with a 460-kc intermediate-frequency system. To complete the unit it is necessary only to purchase a 9-180-μμf trimmer for the antenna section and a 700-800-μμf trimmer for the oscillator section. Since building this set, I have noted a number of other permeability tuners on the market.

I used good-quality, 456-kc i.f. transformers and found that the tuning unit can be made to track just as well as it does at 460. (No harm in tuning the i.f.'s to 460, if you have a signal generator or can get your service technician to do the job.—*Editor*)

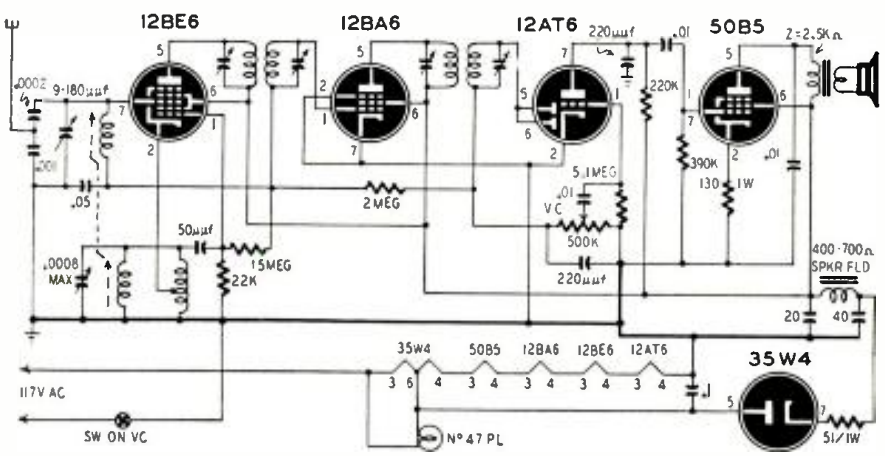
The easily mounted tuning unit is held to the chassis by the nuts on the drive-shaft and volume-control bushings. Complete drilling and mounting instructions being furnished, it is not necessary to repeat them here.

The speaker and dial extend the whole width of the chassis, dial and speaker each being 3½ inches wide. Minimum height of the set is 5 inches, because of the dial; if the output transformer is mounted on the speaker, recess the speaker into the chassis to keep its height down to that of the dial.

The constructor can get a good idea of the relative position of the components from the back-panel photograph. The chassis will have to be cut away for the tuning unit and—in most cases—the speaker. Place your components on a piece of paper and project a layout to suit your individual needs. Do not, however, change the relative positions of parts because this layout provides the shortest possible leads.

The two tuning slugs and coils also show up well in the back-panel photo; the larger coil is the oscillator, and the smaller one the r.f. section. The oscillator section has two coils. One of them is tapped for the converter tube cathode and is mounted underneath the chassis close to that tube.

Except for the tuning unit, the cir-



The two tuning coils are parts of the commercial slug tuner the author used.

Push-Pull Crystal Receiver

By RUFUS P. TURNER

BOTH the sensitivity and selectivity of a crystal radio may be improved greatly by using a two-crystal push-pull detector circuit and by tuning the antenna coil as well as both halves of the secondary. The circuit is shown in the diagram. This arrangement has pronounced advantages over a simple detector and one-coil tuning. Louder signals, longer-distance reception, and sharper tuning are obtained with the new hookup, which is only slightly more complicated than the usual simple crystal sets.

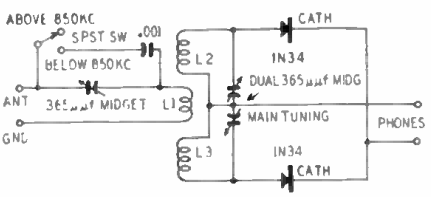
Two 1N34 germanium crystal diodes are used. The primary coil L1 is wound between the two halves L2 and L3 of the secondary coil. The main tuning capacitor is a dual 365-$\mu\mu$f unit. The primary coil is tuned separately by means of a single-section, 365-$\mu\mu$f variable capacitor. For all frequencies lower than 850 kc, a fixed .001-μf capacitor is connected in parallel with the primary trimmer by closing the switch.

The coil is wound in three sections with No. 32 enameled wire on a 1-inch-diameter polystyrene or bakelite tube 4 inches long, the turns of each coil being close-wound. L2 and 3 have 137 turns and L1 has 43. The inner ends of L2 and L3 are connected together and to the rotors of the main tuning capacitor. Space coils $\frac{1}{8}$ inch apart.

The components are mounted on a wooden board $8\frac{1}{2}$ inches long, $5\frac{1}{2}$ inches wide, and $\frac{3}{4}$ inch thick. All parts except the crystals are screwed to the board. The crystals are connected with their own pigtail leads directly between the stator lugs of the tuning capacitor and one of the headphone tip jacks. The crystal polarity indicated in the schematic must be observed carefully.

Operation of the receiver is very simple. Connect an antenna and a good ground to the antenna and ground terminals. The best antenna is a long wire, high in the air and out of doors. Use the nearest cold-water pipe for a ground. Tune in your station by adjusting the main tuning capacitor, then adjust the primary trimmer for maximum volume. If the frequency of your desired station is 850 kc or higher, leave the switch open. If it is lower than 850 kc, close the switch. The entire broadcast band can thus be covered.

This receiver has amazing headphone output, even when receiving low-powered broadcasters. When a long, outside antenna and a good ground are used, high-powered local broadcast stations will operate a high-impedance magnetic loudspeaker (but not a permanent-magnet dynamic). The double tuning scheme allows separation of strong local stations. In tests using the same antenna, this receiver has brought in distant stations not even heard with the best ordinary crystal set. The d.c. output of the set (taken across the headphone tip jacks with headphones disconnected) is 2.5 ma when picking up a 250-watt broadcast station 5 miles away!



The full-wave detector uses two 1N34's.

The builder may consider using a 1N35 duo-diode unit in place of the two 1N34's. The 1N35 consists of a pair of mounted germanium diodes which have been matched for use in full-wave detectors and in FM detectors and discriminators.

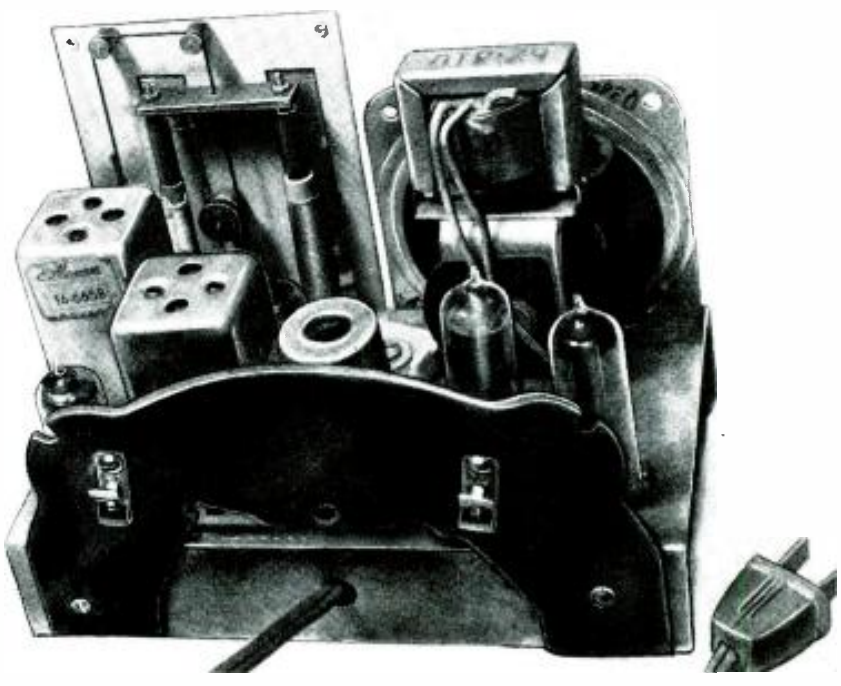
▶ MINIATURE TUBE RECEIVER (*Continued from page 40*)

cuit is quite standard. The chassis is a simple U-shaped piece of 16-gauge sheet iron and is quite rugged. One-hole mounting sockets with retainer ring were used for convenience.

Two strands of No. 20 bare, tinned, hookup wire were twisted together and anchored at each end to widely separated points on the chassis near the tubes. All ground connections were soldered to this lead. This simplifies construction, but does place the a.c. line voltage on the chassis. There should be no danger, however, if the chassis is placed in an insulating cabinet and a fiber panel used to cover the back. Be sure to drill holes in the panel for ventilation.

After the set reaches full operating temperature it is exceptionally stable, due to the high capacitance-inductance ratio in the oscillator section. There is a slight drift during warm-up unless a temperature compensating capacitor is used, but this refinement is hardly worth the additional cost.

There was some difficulty in peaking the i.f. coils because of regeneration in the i.f. system, but it disappeared entirely when the 12AT6 tube was shielded.



Rear view of the permeability-tuned receiver. Tuner is in upper left corner.

Design of Class-B Drivers

The design of a transformer-coupled class-B driver is simplified by this author's approach

By W. H. ANDERSON, VE3AAZ

OPERATORS of amateur phone stations are often confronted with the problem of selecting a suitable driver and driver transformer for class-B audio amplifiers or modulators. The most common solution is to select, from a catalog or manufacturer's literature, a transformer designed for use with the particular combination of driver and modulator tubes being used. This method is not practical when:

1. The tubes are operated under conditions other than those specified by the transformer manufacturer;

2. The driver-modulator tube combination is not listed;

3. Driver-to-line and line-to-grid transformers are to be used.

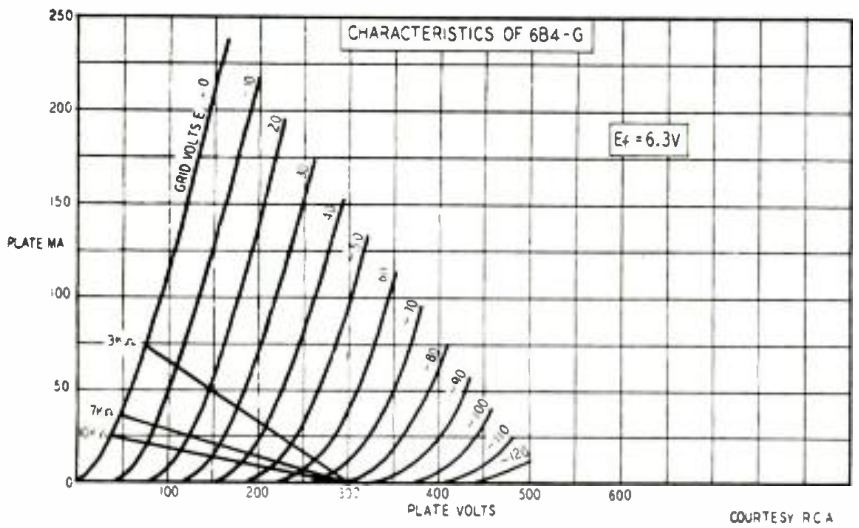


Fig. 1—Curves for this and other receiving tubes are in your tube manual.

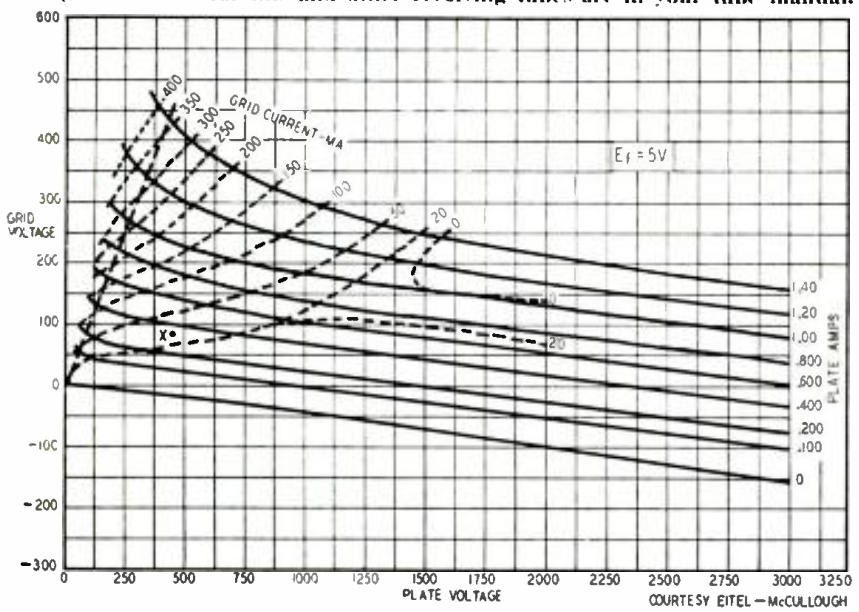


Fig. 2—Constant-current characteristics of the Eimac 75TH transmitting triode.

Consider a typical case where push-pull 6B4-G's are used as drivers for a class-B 75TH amplifier or modulator. Tube data shows that the 6B4-G's will deliver 15 watts of power when the effective load impedance (plate-to-plate) is 3,000 ohms, the plate voltage is 300, and 68 volts of grid bias is supplied from a fixed source. The 75TH's require 3 watts of grid drive when operated with 90 volts of grid bias and 2,000 volts on the plates. The peak grid-to-grid driving voltage is 350. Since there is a difference in the power in the primary and secondary of the driver transformer, transformer ratios cannot be calculated by comparing the primary and secondary voltages.

The grid circuit of a class-B stage presents a constantly varying load to the plate circuit of the driver stage. During one excitation cycle, the impedance of the grid circuit varies from a very low value to almost infinity and causes distortion which is intolerable in some instances. Distortion from this source is minimized by reducing the source impedance as much as possible. The driver transformer determines the impedance ratio between the driver plates and class-B grids; therefore, the greater its step-down ratio, the smaller will be the source impedance as seen by the grids.

We have found at VE3AAZ that distortion is minimized when the driver is designed to deliver just enough power to drive the class-B stage when its (the driver's) grids are fully excited—driven to zero volts by the speech amplifier. This condition is met by raising the driver plate-to-plate load impedance far above its normal value. This provides for a higher than normal step-down ratio between the driver plates and class-B grids. Increasing the driver load impedance decreases the voltage developed across the secondary load. It is important to remember that, while the voltage ratio varies directly as the turns ratio, the impedance ratio varies as the square of the turns ratio. Thus when a transformer is selected to deliver just enough voltage to drive the

class-B grids, the source impedance (driver plate resistance) will be lowest —a requirement for good regulation.

The 75TH's require 3 watts of grid drive. Since in this case—as in most others—the grid driving power is stated as an r.m.s. value, peak driving power will be twice as great or 6 watts. This power is delivered to first one grid, then the other, and is provided by one-half the voltage developed across the entire secondary. Knowing the grid power and voltage, the grid impedance can be calculated by Ohm's law. Since the peak grid-to-grid voltage is 350, each half of the secondary winding will develop 175 volts and the grid impedance (E^2/W) is $175^2/6$ or 5,104 ohms.

The next step is to draw trial load lines on the characteristic curves of a 6B4-G as shown in Fig. 1. One end of each load line is the point where the plate-voltage line intersects the zero-current line and the other end is on the Ec (grid voltage) = 0 curve. The resistance of a load line is determined by subtracting the minimum plate voltage from the maximum plate voltage and dividing the result by the maximum current. Refer to the 3,000-ohm load line on Fig. 1. Note that maximum plate voltage is 300 and minimum 75. As the voltage swings from 300 to 75, the plate current changes from zero to 75 ma so the resistance of the load line is 300—75/.075 = 3,000 ohms.

Peak power output from a given load resistance is determined from the familiar I^2R relationship, where I is the plate current at the point at which the load line intercepts the Ec = 0 grid bias curve. The 75TH grids require 6 watts peak power for full output. However, since the power loss in the driver transformer may run to 20%, the driver must be designed for approximately 7.5 watts peak output. Since the 7,000-ohm load line intercepts the Ec = 0 curve at 32 ma, the power output is $(.032)^2$ x 7,000 or 7.18 watts.

The load resistance for a single tube being 7,000 ohms, the plate-to-plate load will be four times 7,000 or 28,000 ohms for a push-pull stage. The grid impedance is 5,104 ohms, so the transformer turns ratio (primary to one-half secondary) is

$$\frac{\sqrt{28,000}}{5,104} = 2.3 \text{ to } 1.$$

If the speech amplifier-driver combination is located at a point remote from the class-B stage, a plate-to-line and line-to-grid transformer combination will be required. Disregarding the power loss in the second transformer, the over-all turns ratio should remain the same. Assuming a 500-ohm transmission line, the plate-to-line transformer will have a turns ratio of 7 to 1 and the line-to-grid transformer will have a ratio of 2.3 to 7 between the primary and one half of the secondary.

Calculating driver requirements

Manufacturers do not always list grid-drive requirements, and this must be calculated from available data. Consider the class-B operating data for the 75TH:

D.c. plate voltage	2,000
Max. signal d.c. plate current	225 ma
D.c. grid voltage (negative)	90
A.f. grid voltage	350

Each tube is carrying 112.5 ma or one-half the total plate current; however since the stage is operating class B, the peak instantaneous plate current will be three times as high or approximately 336 ma. The peak instantaneous grid voltage will be one-half the a.f. grid voltage minus the d.c. bias or 350/2—90 = 85 volts.

The crest operating point X (Fig. 2) is the intercept of the peak grid voltage and the peak plate current values. This point shows the peak grid current to be 35 ma. Knowing that this grid current is produced by the voltage across half the driver transformer secondary, we can compute driving power as the product of 175 volts and .035 ampere (35 ma) or 6.1 watts. Similarly, we compute the grid impedance as 175/.035 = 5,000 ohms. Note that these values agree with those used in previous calculations, but the grid-drive factor does not take into account the power loss in the driver transformer.

Cathode-followers as drivers

Occasionally, a push-pull cathode-follower stage (Fig. 3) is used as a driver for a class-B amplifier. This arrangement does a good job because of the high degree of degenerative feedback due to coupling between the input and output circuits. The major disadvantage of this circuit is that the input signal must equal the sum of the bias and desired output voltages.

Load impedance calculations generally consist of finding a combination of plate voltage and a reasonably low load impedance that will provide the required output. The stability or voltage regulation of a cathode-follower is such that the load impedance has little effect on the output voltage.

The excellent voltage regulation of a cathode-follower can be seen when its performance is compared to that of a conventional plate-loaded amplifier operating with identical loads and plate and bias voltages. If the regulation of an amplifier is perfect, the output voltage will vary in direct proportion to the input voltage.

Take two amplifiers using triode-connected 6L6's, one connected as a conventional plate-loaded amplifier and the other as a cathode-follower. Consider what happens in each when the signal voltage is halved and the reflected plate load changes from 2,000 to

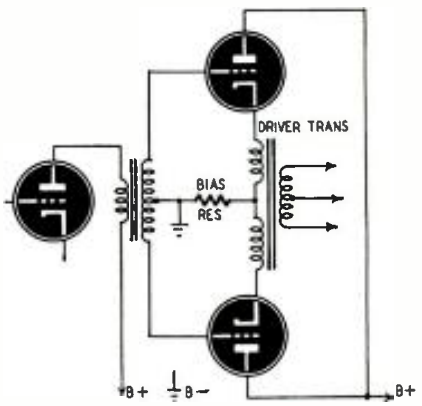


Fig. 3—A cathode-coupled driver stage.

5,000 ohms (8,000 to 20,000 ohms plate-to-plate), as it might when the class-B stage stops drawing grid current. The change in circuit performance is shown in Fig. 4 (characteristic curves for triode-connected 6L6's with 2,000- and 5,000-ohm load lines drawn in) and in the table below.

Drive (volts)	Reflected load (ohms)	Output (volts)	Point (Fig. 3)
Cathode-loaded amplifier			
20	2,000	130	A
10	5,000	115	B
Plate-loaded amplifier			
150 (20+130)	2,000	130	A
75	5,000	72	C

That the cathode-follower provides better voltage regulation is evident when we realize that the output voltage should have dropped to 65 (one-half its initial value) in both cases when the drive voltage was halved.

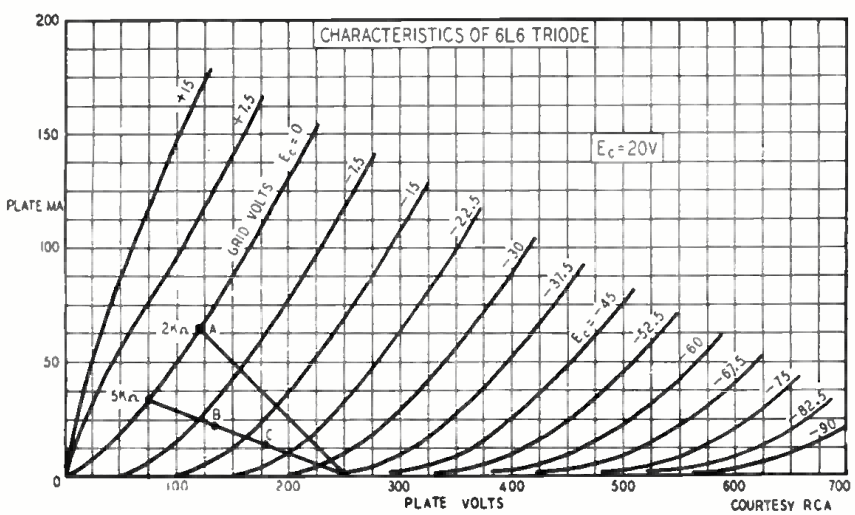
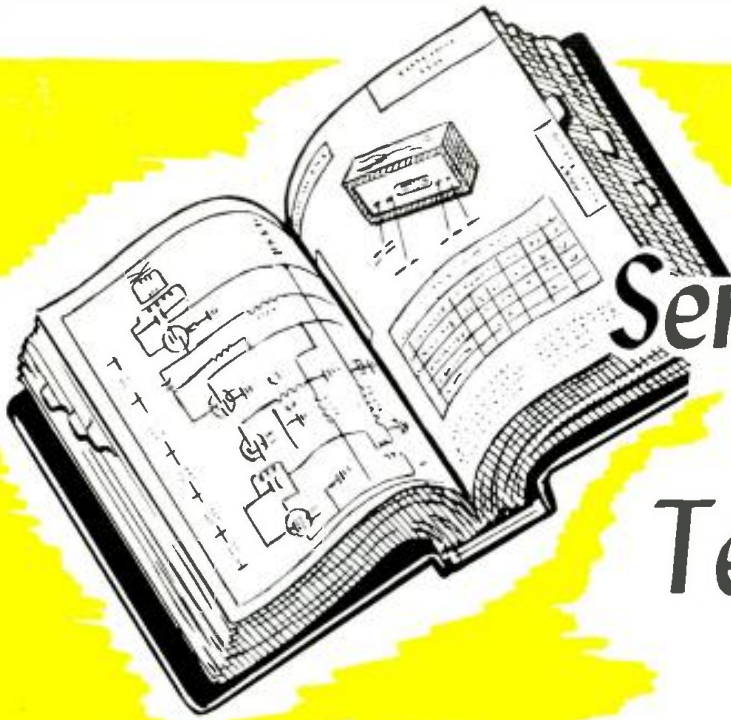


Fig. 4—Load lines compare performance of plate- and cathode-loaded amplifiers.



Service Data Technicians and Money

By JOHN T. FRYE

A LIE, some wag has said, is a last resort with men, but with women it is a form of first-aid. This masculine reluctance to a mischievous expedient is commendable; but when a radio technician insists upon applying the same attitude toward the use of radio service data, he is being short-sighted, money-wasting, and just plain stupid. Nevertheless, the sad truth is that there are many who turn to their shelves of service data for help only after they have exhausted every other possibility in their attempt to repair a receiver.

This is really puzzling. Any modern shop is certain to have a complete set of service information on hand. It can be quickly demonstrated to even the most stubbornly doubtful that radios can be serviced much more quickly, pleasantly, and efficiently through the use of such data. Every radio shop owner knows that minutes shaved off the time needed to repair a set is just like money in the bank. In spite of all this, there are far too many shops in which the books do not have that well-thumbed look that radio service manuals should have.

Possibly there are a few rare cases where the technician is one of those boys who bull-headedly waste hours searching a catalog for an item before looking it up in the index, merely because he likes doing things the hard way; but these, surely, are in the minority. It seems likely that the rest do not get the maximum benefit from their libraries simply because they have not formed the habit of using them properly.

Many, when they started servicing, felt that they could not afford to buy service manuals; the servicing procedure established necessarily excluded their use. Later, when they were able to obtain service data and did so, their servicing routine had become so firmly set that they could not—or at least did not—change it to take full advantage of the great help offered by their books.

The publishers of modern radio service data spend thousands of dollars trying to make their products of the utmost assistance in servicing *every* set that comes into the shop. The material is intended to be used all of the time, and is crammed with information calculated to be useful to the novice and the old-timer alike, but the only way in which any service technician can extract the full amount of benefit from it is to build his service procedure around its continuous use.

When to use data

The time to slide a manual from the shelf is the minute you decide which set you are going to tackle next. First, take a quick glance at the description of the receiver and at the diagram or picture in the book that shows the tube layout. You may be able to locate a similar diagram in the set, but at any rate it is much more comfortable to study the picture laid out on the bench instead of standing on your head trying to read an upside-down sketch pasted in the darkest, most cobwebbed corner of the cabinet.

This preliminary survey can tell you a lot. It will reveal whether you are working with an a.c.-d.c. set, a transformer job, or one of those electronic mules that employ a high-voltage series-filament winding on an autotransformer. It will show whether you should expect superheterodyne selectivity or are dealing with a t.r.f. receiver—something that cannot be told with a casual glance in this day of four-tube "supers," subchassis-mounted i.f. transformers, and padded oscillator tracking circuits. It will also reveal whether the tubes are where they should be; and if you tell an old-timer you have never wasted time working on a set in which the customer had switched a couple of tubes, you will make him question either your veracity or the amount of time you have been in the service game!

If your preliminary examination shows that surgery is indicated and that the chassis must be removed from the cabinet, take another look at your data. See if instructions for chassis removal are given. Some manuals give detailed information on this subject wherever it is needed—and believe me, it is needed often in opening up some of these ultra-modern creations with hidden chassis bolts, concealed hinges, and trick cabinet designs. Without such "open sesame" instructions, you can waste half an hour fumbling around the outside of one of these sleek-looking,

seamless armchair models like a monkey trying to get into a plastic coconut.

When the set has been extracted from the cabinet and is resting on the bench in front of you, your service data stands ready to lend a hand, no matter what method of trouble-shooting you prefer. If you use a signal-tracer, the diagram will tell you exactly where to touch your probe, and the stage gain of each section is plainly indicated. Any deviation from the normal can be detected at once, and the exact point at which this deviation begins can be pinned down.

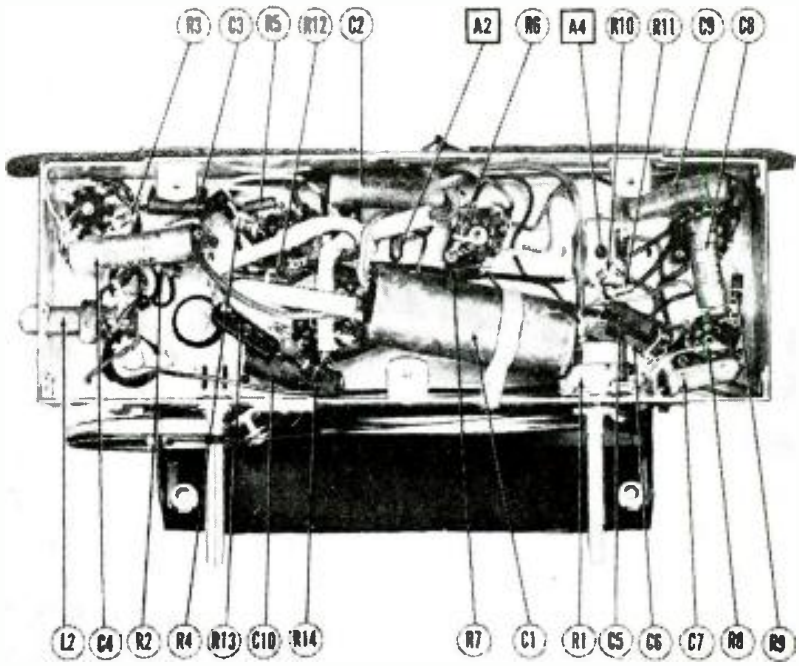
On the other hand, if you prefer resistance measurement, the correct resistance from every tube socket connection to the common ground is given; and if voltage measurement is more to your liking, the proper operating voltage at nearly every point of the circuit is indicated.

The diagram is right there in front of you. Only a service technician who has wasted time checking and rechecking a puzzling low-resistance condition by unsoldering the leads of every capacitor that might be involved—only to find the trouble caused by a shorted bypass hidden away *inside* an i.f. shield—can appreciate the value of working with a diagram. The intelligent use of printed data removes the wasteful lost motion from radio servicing.

The service data publishers are keenly aware that time is money in servicing, and they have worked out many time-saving features. Take, for example, an all-wave set in which only one band is out of order. Obviously the fault lies in one of the components used exclusively on this band. But if you have ever watched a poor technician mumbling to himself and making circles in the air with his finger like a man trying to describe a circular staircase, while he attempts to thread his way through the maze of a multibank band-change switch, you can realize how he should appreciate a data sheet showing an entirely separate circuit diagram for every position of the switch.

The value of photos

Another set of sheets gives photographs of every set taken from different points of view and with the various parts identified by numbered or lettered "call-outs" right on the picture. Fig. 1 shows a bottom-chassis view of this nature. To show how it helps, notice Fig. 2, which is a picture of the same receiver shown in Fig. 1. If you will look closely you will notice —as did the technician—that the resistors numbered R12 and R14 in Fig. 1 are badly charred in Fig. 2. Inasmuch as the positive filter capacitor leads attach to the opposite ends of R12, and R14 connects between one side of the line and the plate of the rectifier tube, it is not hard to diagnose the trouble here: the output section of the filter



Courtesy of Howard W. Sams & Co.

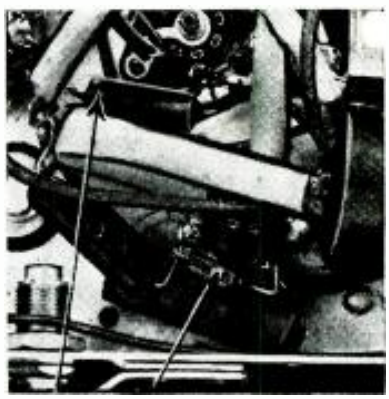
Fig. 1—Under-chassis view of receiver. Call-outs show location of all parts.

capacitor has shorted, causing both the filter resistor R12 and the ballast resistor R14 to char. Cutting loose the output filter capacitor lead and checking it with an ohmmeter quickly proved this deduction correct.

A glance at the parts list was all that was needed to find the correct replacement values for C1, R12, and R14. It was not necessary to locate the parts by tracing out the circuit diagram. Only seconds were needed to determine exactly what parts were required. Had the circuit diagram been needed, it was available; but it is surprising how many times, when there are visual symptoms of trouble, you can work directly from the pictures. The beginning radio technician who has some difficulty in "seeing" a receiver in diagram form is especially grateful for this feature.

Data helps beginners

Speaking of beginners, it is an unhappy fact that many fellows try to start into servicing without purchasing service data. If anyone needs such help, these beginners do. The veteran technician has a wealth of practical experience to fall back on when he runs into unusual problems, but the novice feels utterly at sea. The small successes he has had in locating open filaments and shorted bypasses in AC-DC receivers stand him in poor stead when he runs into a really tough set. He simply does not know where to begin. What he needs more than anything else is the wealth of data on normal operation that a manual presents. A methodical comparison between the resistances, voltages, and stage gain of the defective receiver and the normal values of these items as presented in the service data is almost certain to uncover the trouble.



Courtesy of Howard W. Sams & Co.

Fig 2—Charred parts are easy to spot.

What is more, the constant use of service data is the best possible way for the newcomer to become familiar with radio circuits and manufacturing practices. As he continues to study the diagrams of the sets upon which he is working day after day, he absorbs, with out any conscious effort, a knowledge of what constitutes standard circuits and normal values for components used in those circuits. Almost before he realizes it, he finds himself knowing what to expect when he makes a measurement, and is alert to any abnormality that may be encountered. The constant use of service data is about as quick a way to learn practical radio as there is.

It is paradoxical that the beginner's need for this material is indicated by the fact that successful veteran technicians invariably have them. These fellows *could* repair any receiver, using only their knowledge of radio theory

Curing I. F. Oscillations

FOR years I have had trouble when building receivers with two stages of 465-kc i.f. amplification. They invariably broke into oscillation when peaked to resonance. Detuning one stage to prevent this led to lower sensitivity and poor selectivity. I have tried all sorts of tricks to stabilize them—isolating resistors or chokes and bypass condensers in plate and screen supply leads, shielding plate and grid leads, lower plate potentials and higher bias, loading resistors across the i.f. coils, switching i.f. leads to change the feedback phasing—all with indifferent results.

I finally hit upon a system that works very well: Alter one transformer to an impedance-coupled stage as shown in Fig. 1. A 1-megohm grid resistor R1 replaces the secondary. The grid is coupled to the primary by C1, a small variable condenser such as a 100-μμfd trimmer. The trick is to reduce the capacitance of C1 until the i.f.'s can be peaked without the set's breaking into oscillation. (In one instance a "gimmick," two pieces of hookup wire twisted together, provided sufficient coupling.)

It was found that this system gave much more gain than the amplifier with one stage removed, had better selectivity than two detuned stages and provided better tone. It proved a very satisfactory arrangement.

An even better method is to separate and shield the primary from the secondary of one i.f. transformer as shown in Fig. 2. One coil can be left in the shield can, the other mounted below the chassis with a separate trimmer condenser. Usually stray wiring capacitance supplies sufficient coupling; however, it would be wise to try additional capacitive coupling such as the twisted-wire "gimmick." Reduce the coupling until the amplifier is stable.

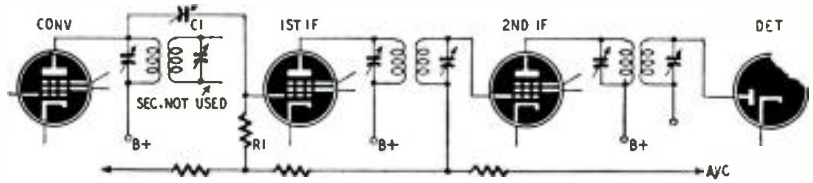


Fig. 1—Impedance coupling in the first i.f. stabilizes sets with two stages.

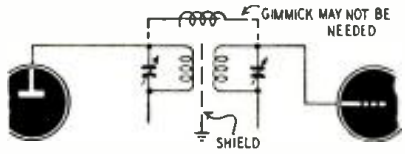


Fig. 2—Another cure for oscillations.

This method gives better gain than impedance coupling and the selectivity obtained is amazing. On one receiver in which it was tried it was possible to pull in a distant station 10 kc away from a strong local. The set has to be aligned very carefully to attain this degree of selectivity.—*John A. Dewar*

▶ SERVICE DATA, TECHNICIANS AND MONEY *(Continued from page 45)*

and their practical experience; but they are fully aware that they can do the same job in a fraction of the time when they have the books to help.

Moreover, they know that they will be able to do better work. Take, for example, the matter of alignment. Even with AM sets it is essential to know the correct i.f.; the position, use, and order of adjustment of the trimmers; and certain special information regarding such matters as triple-tuned transformers and a.f.c. circuits, all of which are plainly set forth in step-by-step fashion. Receivers can be aligned, after a fashion, without knowing these things, but the resulting performance will often be short of what it should be. The man who blindly aligns all i.f.'s at 456 kc is not much better than the one who maintains you do not really need a signal generator to do radio servicing! But when you go into FM and TV alignment, service information becomes an *absolute necessity*.

Another feature technicians new and old can appreciate is the listings of manufacturing changes. The service technician can frequently improve the operation of a set over what it was when new. That makes a decided hit with his customer!

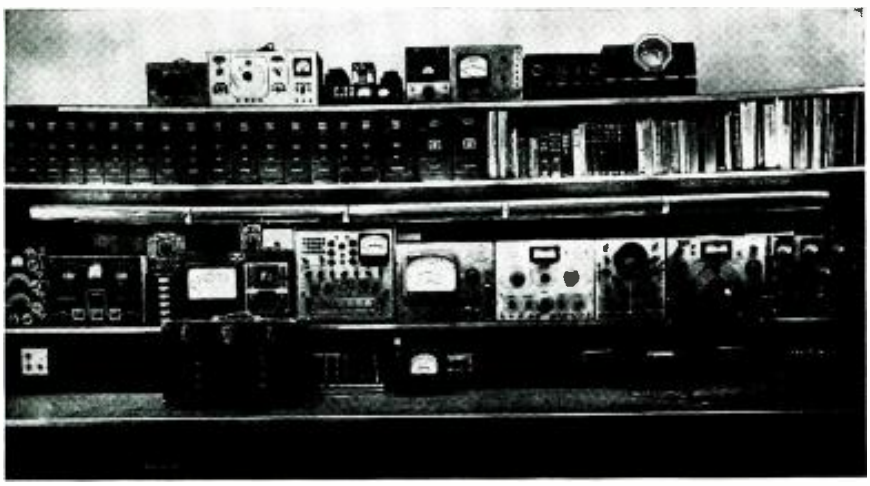
Equally helpful is the practice of giving the replacement part numbers of several different manufacturers for each component. This enables the technician to make a quick choice from available stock.

If there remains any lingering doubt in your mind as to just how helpful service data can be, a bout with a defective record changer should remove it. Without servicing information, you have to trace out the sequence of events that should take place during the change cycle by observation—and observing the action of a record changer is about as difficult and nerve-wracking as trying to read a long-winded title on a whirling phonograph record.

How different all this is when you have service data! You are shown an exploded view of the entire mechanism that reveals the exact shape and position of every single part. The change cycle is described in detail. For every possible fault in the operation of the changer, several possible causes and cures are listed.

The author has no connection with any radio service data publisher, but he is deeply interested in the future of radio servicing, and he feels that an increase in the use of service literature is a most important factor in improving both the quality of, and the profit from radio servicing.

He has no recommendations as to which of the leading service-data publishers you should patronize. The products of each have some distinctive features not found elsewhere. The important thing is to own *and use* at least one of them.



Courtesy John F. Rider, Publisher

The set of service manuals on the shelf is as important as the instruments below.

Home Study Courses Useful to Radiomen

Correspondence schools can be beacons on the path to success

By SAMUEL FREEDMAN

Mr. Samuel Freedman

I AM a firm believer in home-study or "correspondence-school" training. Of the many schools and colleges at which I have trained since 1920, I don't believe any did me as much good as the home-study radio course I took in 1929-31. That was my turning point from a dull routine in an unpromising job to an opportunity eight years later in being chosen to head the Maine radio program, and head the prewar NYA radio program and become a leader in mobile radio development. That in turn led to my commissioning as a naval officer and finally to my present position in the microwave field working for DeMornay Budd.

As I discovered later, after a thorough investigation of home-study schools, my history is by no means unique. But some people still look askance at "correspondence courses," and large numbers of men are unaware of the good a course of home training can do them.

The radio, communications, and electronic fields require a tremendous amount of additional manpower with suitable qualifications. Additional qualifications are also needed by the tens of thousands of men already in these fields, who still are wholly or partially unfamiliar with microwaves, television, radio aids to aviation and navigation, nucleonics, FM, mobile radio, and other postwar developments. For national defense, the nation also requires as a reserve pool of technical manpower, over 1,000,000 persons who will qualify themselves in these fields either as a hobby or as a secondary vocational occupation.

Most people who need training cannot afford to take the time or incur the expense and loss of income required for formal schooling. (A limited exception is veterans' training under the GI Bill of Rights.) The requirements of both individuals and industry definitely indicate that home-study training courses are most necessary.

Home-study schools are tried and proven. More than 1,500,000 students, mostly adults, were enrolled in them in 1948. More than $50,000,000 was spent on tuition for courses in every sphere of employment. There is hardly a field of specialization today which would not collapse if it lost its leading figures who received some or all of their training by way of home-study methods.

The home-study field which has the greatest record of success during the past 20 years is that of radio-electronics. It has been improved tremendously, and the student gets the benefit of visual aids and extensive laboratory practice in addition to complete printed reference material for study and for his future use. The quantity and quality of instruction may even exceed that of more formal schools carrying on classroom instruction in the old, time-honored manner.

The history of home study begins in 1891 when Thomas J. Foster, an editor in a coal-mining city, received a letter from a reader requesting information on how one of the dangers incident to coal mining might be minimized. He answered the inquiry in his newspaper. Other readers sent in similar letters, which were also answered. So the editor began to compile simply worded articles on the safety hazards of coal-mining and on self-protection against them. From this beginning was conceived a plan to furnish practical and reliable technical education by mail. Thus was born the International Correspondence Schools whose headquarters remain in the coal-mining city of Scranton, Pennsylvania. (*Continued on page* 48)

U.S. Army photo

One of over 20 Army laboratory plants built for electronics and nucleonics

When correspondence schools were first introduced, the new idea had to face prejudice and ridicule. Educating *via* the mails was pronounced foolish, and the classroom was declared to be the only suitable place for such a function and experience the only way to learn a trade or business. The record has proven otherwise, and today many of the nation's leading universities operate *extension* (a more refined word for correspondence) services patterned after the commercial home-study schools. It has made training possible for anyone, regardless of location and economic status. It has encouraged individuals to enter fields in which they have become outstanding, when otherwise they might have deprived themselves and the world of their talents and leadership.

Many noted educators admit the weaknesses of classroom teaching. Oftentimes, lectures prepared by the few real authorities in a field are available only in a few scattered classrooms. Every home-study student, on the other hand, may receive instruction prepared by a master. In a classroom, if attention fails and part of a lecture is missed it remains lost. Those who learn by home study can refer to their printed material as much and as often as necessary. It is always available for refresher or reference purposes since it remains the permanent property of the student.

The average home-study school may charge a tuition between $100 and about $400. The latter figure is normally for a master course covering several subfields of employment within the over-all field of radio and electronics. For this sum, the enrollee receives the following.

1. A series of lessons ranging from about 30 to over 100, depending on the size of the lessons adopted by a particular school and the type of course selected.

2. Various additional printed features such as reference textbooks, radio dictionary, books on starting one's own radio business, texts on prerequisite material such as mathematics, questions and answers for passing FCC examinations, and so on.

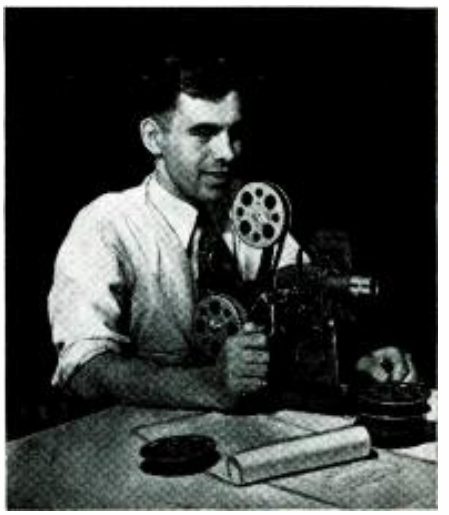
3. Kits of parts with which to make experiments. With the parts much useful equipment can be constructed—test instruments, receivers, transmitters, AM or FM modulators, and various other electronic devices. It belongs to the student permanently, and the retail value of the parts is appreciable with respect to course cost.

4. Consultation service, which continues for the life of the enrollee. I have personally verified and utilized this service over a number of years on a course which was started in 1929 and completed in 1931.

5. Free lifetime employment service. This has great value. The total cost of tuition is normally no more than a legitimate employment agency charges for a single placement. The service is available indefinitely, and during the lifetime of a student may repay many times the price of the course. Schools have full-time placement experts whose sole job is to discover or develop job opportunities. Many employers recognize these schools as sources of desirable employees. In view of the great technical developments now under way, only some of which are enumerated in the box on this page, no intelligent person, regardless of experience or education can help but benefit from a home-study course of some kind. The course may be for refresher purposes or it may acquaint one with new developments.

Basically, radio and electronics have never been nor are likely to be more than inductance, capacitance, resistance, and electron-tube circuits. It is only the size, number, and manner of connection of inductors, capacitors, resistors, and tubes which result in the thousands of items falling into the category of radio and electronics. These can be definitely mastered by home-study printed material implemented by training kits of basic radio components such as are offered by reputable schools advertising in leading radio-electronics journals.

Home-study schools offer the greatest opportunity for the maximum number to get a foothold in the radio-television-electronics field. The future depends on how many of the rank and file will emerge as creators and leaders to give industry and science new impetus. Such men can emerge *via* the home-study route just as surely as they can from the classrooms of the nation's schools of higher learning.

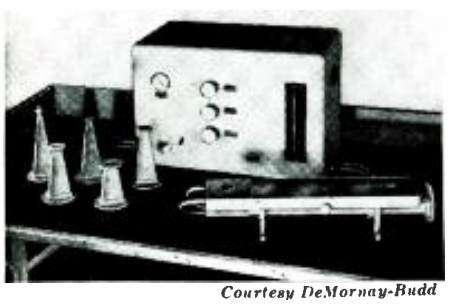


Movies showing electron action are a study aid. The projector is furnished.

NEW RADIO-ELECTRONIC OPPORTUNITIES

This list of fields developed since the end of the war shows only a few of the many opportunities for employment and advancement open to ambitious, well-trained men.

1. V.h.f. FM broadcasting.
2. Large-scale FM receiver manufacture.
3. Two-way, mobile radio for taxicabs, railroads, trucks, automobiles, etc.
4. The new citizens band.
5. Aircraft omniranges, which replace the older four-leg ronge stations.
6. V.h.f. aircraft communication.
7. Ground-controlled approach (GCA) systems for aircraft.
8. The expanded military radar program.
9. The tremendously expanded research carried on by the Armed Forces, government bureaus, and industry.
10. The radar fence around the U.S., which will cost about a billion dollars and require a staff of at least 25,000.
11. Placement of radar on all merchant vessels.
12. Airborne radar.
13. The tremendous expansion of the useful radio spectrum into microwaves.
14. Television broadcasting.
15. Television receiver manufacture, design, and service.
16. Food sterilization through electronics.
17. New methods of communication involving pulse transmission.
18. Supersonics.
19. R.f. heating.
20. Radioactivity detectors.
21. Upper atmosphere research and weather forecasting.
22. Radio-control and guided-missile development.
23. Radio spectroscopy.
24. Magnetic sound recording.
25. Electronics in medicine.



Courtesy DeMornay-Budd

Orders for this new microwave calorimeter now total more than $250 million.

CUT-PRICE CONTRACTORS

The Television Installation and Service Association of Chicago has warned television dealers against hooking up with cut-price service contractors who may jeopardize the dealer's future by giving unsatisfactory service (or, as past experience has proved, no service at all).

Dealers are reminded that their liability does not cease when the contract has been turned over to a service company, and that the customer will continue to associate the dealer with the service he receives on his televiser.

The wise dealer, says the Association, will check the repute, financial standing, distributor acceptance, and length of time a service company has been in busines before associating himself with it. Above all, he will deal with actual service companies, not with sales-and-service outfits which may have an interest in pushing a competing brand of television receiver.

"A slight saving in the cost of a policy at the expense of losing a customer and the future business of his friends and relatives is no saving at all," the release concludes.

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Radio Set and Service Review

Eicor Model 1000 Tape Recorder

EICOR'S model 1000 tape recorder (Eicor, Inc., Chicago), one of the lowest-priced sound recorders of any kind, performs at least as well and is as easy to handle as any home-type unit offered today in its price range. All of which indicates that the service technician may soon find the Eicor in the hands of many of his customers.

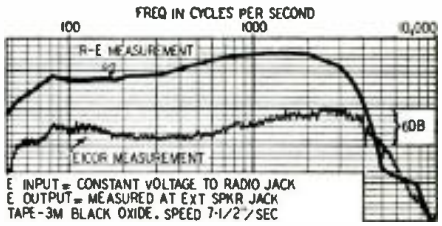
The appearance of the recorder is unusually neat. The black leatherette case is 14¾ inches wide, 8¾ inches high (with the lid down), and 11¾ inches from back to front. Three pockets are provided in the cover for the microphone and the cables. The whole unit weighs 27 pounds.

Operation is extremely simple. A reel of tape is placed on the left post; the tape is brought around the bottom of the head, over the top of the rubber-rimmed capstan, and threaded onto an empty reel on the right post. The center knob is the ON-OFF-VOLUME control. The left control sends the tape forward or backward, or stops it. The knob at the right switches the circuit to ERASE-RECORD or LISTEN.

To rewind the tape, it is lifted off the capstan and passed across the head only. It is not always necessary to rewind, however, as the unit has a "twin-track" feature. Recordings are made on the top half of the tape. When a reel is fully recorded, the full reel can be removed from the right post, inverted, and placed on the left post; a new recording can be made on the unused half. The metal roller shown just below the capstan in the photo was apparently added in later production; it is not shown or discussed in the instruction book. If, in rewinding, the tape is passed from the right reel, directly across the bottom of the magnetic head, to the left reel, no sound will be heard. If, however, it is looped over this metal roller before reaching the head, the high-pitched "Donald Duck" sound of the recording will be heard on rewind, a valuable feature if the tape is to be rolled back only to the beginning of a certain selection. Rewind time for a full 15-minute reel is 2 minutes; a half-hour reel requires 4 minutes.

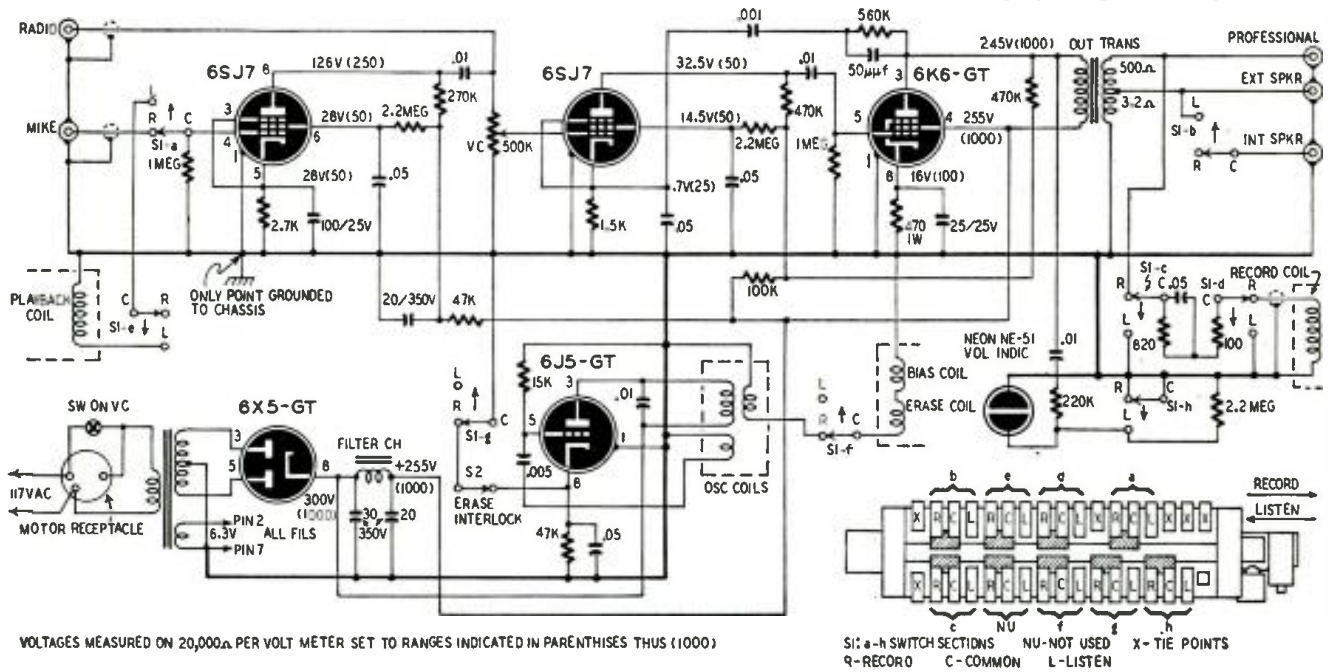
The audio quality of this recorder was judged on test to be acceptable. Jacks are provided for an external 3.2-ohm speaker and for signal feeds from an external source such as an AM radio, FM tuner, program line, PA system, etc. The built-in speaker is 6 inches in diameter—a bit larger than usual in this type of equipment.

No tone controls are provided for the operator. A typical response curve supplied by the manufacturer shows that the output on playback, with a constant-level, varied-frequency tone input while recording, stays within ± 3 db between about 50 and 5,500 cycles. Above the machine-run curve appears the result of a response check made in our own laboratory at a somewhat higher signal level. Wow and flutter in this recorder were extremely low.



Frequency-response curves for recorder.

The tape-pulling assembly consists



VOLTAGES MEASURED ON 20,000Ω PER VOLT METER SET TO RANGES INDICATED IN PARENTHESES THUS (1000)

SI: a-h SWITCH SECTIONS NU-NOT USED X-TIE POINTS
R-RECORD C-COMMON L-LISTEN

Complete amplifier schematic. Apparently the single-point ground is largely responsible for the complete absence of hum.

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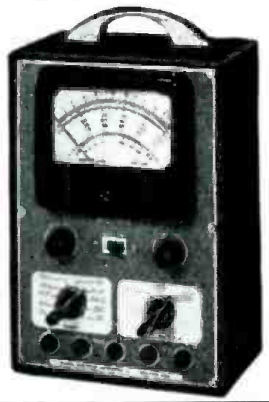

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MODEL KT-40 COMPLETELY WIRED READY TO OPERATE.....$29.50

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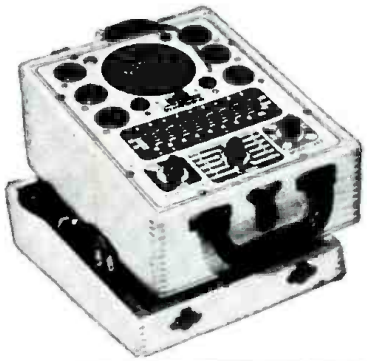

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FEATURES

- Newly designed element selector switch reduces the possibility of obsoleseence to an absolute minimum.
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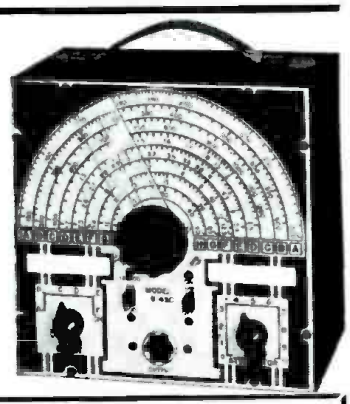

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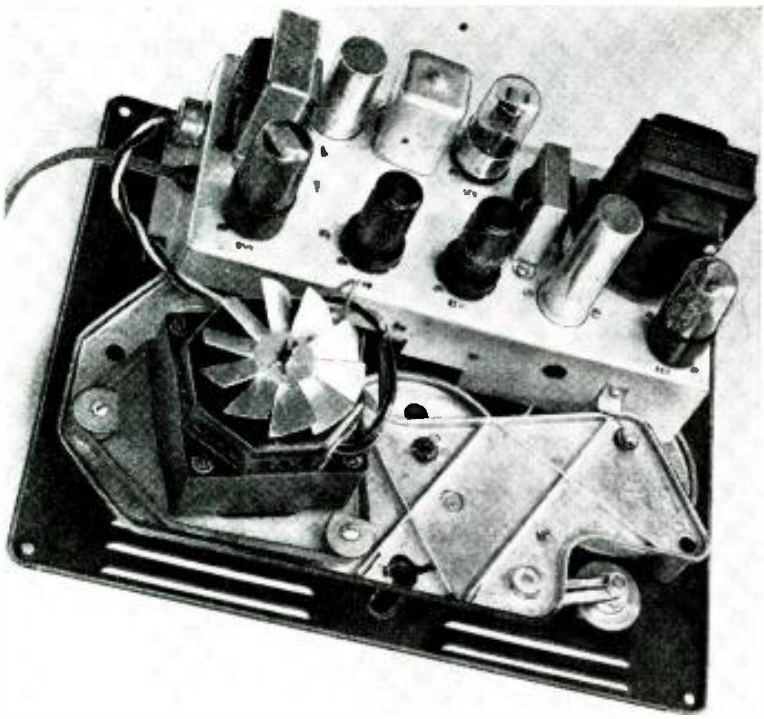

This upside-down view of the motorboard shows the amplifier chassis.

of a synchronous motor and a simple combination belt and friction drive, mounted solidly to the heavy metal motorboard. The motor runs at all times (when the switch on the volume control is turned on); the reels are started and stopped by a mechanical clutch arrangement operated by the FORWARD-OFF-REWIND knob on the left.

The chassis is screwed upside down to the motorboard. Plugs connect the internal speaker and the motor to it. The magnetic head is wired directly to the chassis and mechanically connected by a semirigid, copper bonding strip. Four screws atop the motorboard hold the chassis, but in disassembling for servicing remember to remove the two screws holding the magnetic head to the motorboard, too.

The schematic shown was redrawn from that given in the 24-page instruction book supplied with the recorder. In the drawing in the book the components are so arranged as to duplicate their physical placement on the chassis. Since most technicians try to diagnose trouble in terms of the symptoms, the functional drawing shown here is likely to be much more useful.

The manufacturer's drawing has one very interesting feature, however. Circuit grounds are shown to be made at unexpected points and contact is made to the chassis at only one place—pin 2 of the first 6SJ7. Since there is no other hum-reducing device apparent in the circuit, these peculiar ground connections are probably responsible for the phenomenally low hum in the loudspeaker. On both recording and playback, the volume control can be opened wide; with the ear right up against the speaker, the only hum to be heard is the slight whine of the motor.

The RECORD-LISTEN switch S1 (our numbering) is a multiple-contact slide unit attached to the chassis and actuated by a rod topped with a knob on the motorboard. It has been broken down in the drawing into separate s.p.d.t. sections for simplicity; the sections are lettered and identified on the inset drawing of the actual switch.

The four magnetic coils are all in the one head. Either playback coil or microphone is switched to the grid of the 6SJ7. The RADIO input is paralleled with the plate of this tube across the volume control. The 6K6-GT is the power amplifier, feeding either speakers or the record coil (the latter through an equalizer network). Note the provisions for attaching external 3.2- or 500-ohm speakers or lines. A 6J5-GT oscillator provides erase and bias signals.

There are four frequency-compensation networks in the amplifier. The series 560,000-ohm resistor and .001-μf capacitor between the plate of the 6K6-GT and the cathode of the previous tube feed back (and therefore roll off) highs, beginning at about 250 cycles. The apparent effect is a bass boost from 250 down. The 50-μμf capacitor across the 560,000-ohm resistor increases the treble cut, beginning at approximately 7,000 cycles, beyond the useful range of the recorder.

The .05-μf capacitor across the 1,500-ohm cathode resistor of the second 6SJ7 reduces degeneration of highs beginning at about 2,000 cycles. This is, of course, a high-boost circuit. The parallel 820-ohm resistor and .05-μf capacitor in series with the record coil boost highs beginning at about 4,000 cycles. This has very little effect and is the only one of the compensators not in the circuit at all times.

The functions of the switch sections are obvious, with the exception of S2. With the cathode of the 6J5-GT grounded only through its cathode resistor and capacitor, the bias prevents oscillation. S2 is a leaf-type interlock switch, which closes only when the mechanical clutch arrangement is in the FORWARD position. This prevents erasure when the tape is being rewound, even though S1 may be on ERASE-RECORD. When S2 is closed and S1 on ERASE-RECORD, the 6J5-GT cathode is grounded directly and the oscillator operates.

S1 is, not a stock unit, but a special slide switch built for the purpose. The technician should take great care, in adjusting any of the contacts, not to misalign them. The operation has been carefully timed—certain sections break quickly, others slowly, and some are of the shorting type. The sequence of contacts is also worked out in a specific order. So beware of tampering.

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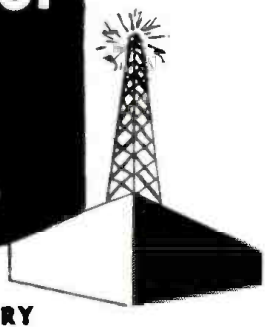

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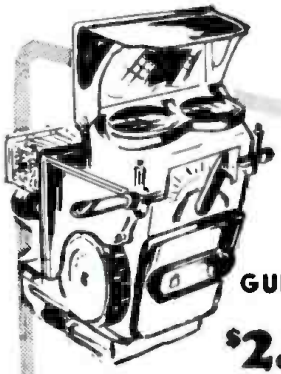

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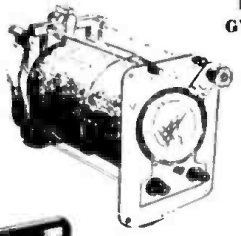

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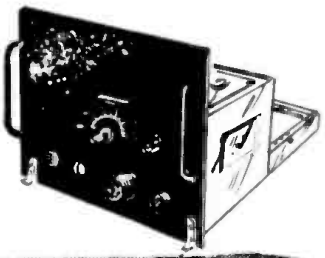

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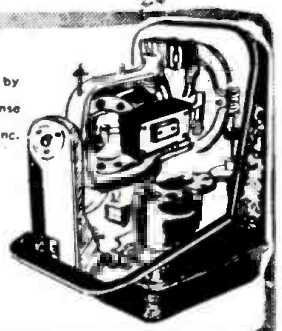

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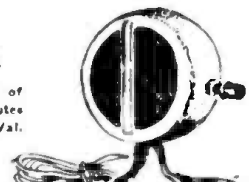

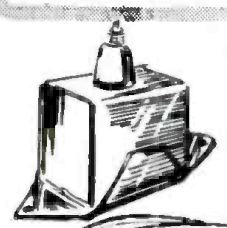

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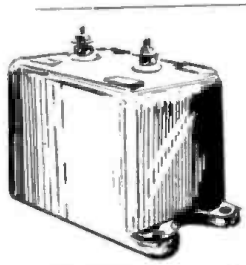

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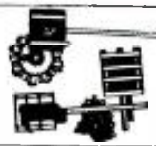

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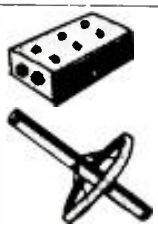

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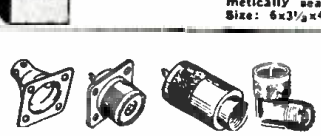

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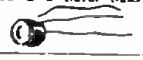

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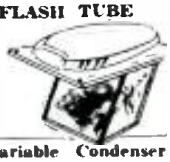

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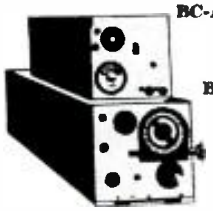

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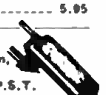

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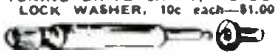

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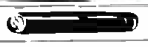

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Fundamentals of Radio Servicing

Part IX–The diode vacuum tube

By JOHN T. FRYE

HAVING spied on the busy electron while it skipped through conductors, resistors, coils, capacitors, and transformers, you may feel that you are an authority on the behavior of the little cuss; but until you have observed one doing its stuff inside a vacuum tube, you really have little idea of the power and versatility packed into one of these tiny charges of negative electricity.

Take a look at the experimental setup diagrammed in Fig. 1. The circle represents a hollow glass sphere in which are contained a couple of loops of resistance wire and a small metal plate mounted near to, but not touching, this wire. Leads are brought out from the plate and from both ends of the "filament" wire, and all the air possible has been pumped from the glass bulb before sealing it.

A low-voltage battery, an ammeter, variable resistor R1, and the filament are connected in series. Another, higher-voltage battery, with its negative terminal connected to the negative terminal of the filament battery, has resistor R2 bridged across it so that any positive voltage from zero (at the extreme left-hand position) to the full battery voltage (at the extreme right-hand position) may be selected by the moving slider. A voltmeter is arranged to read this voltage. The slider connects through a milliammeter to the plate of our "vacuum tube."

With the slider of R2 set at zero positive voltage (extreme left), let us slowly decrease the resistance of R1, permitting more and more current to flow from the battery through the filament. The passage of this current produces heat in the filament wire; and when enough current flows, the wire becomes red hot. Our ammeter reveals how much current is flowing through the filament, but our milliammeter still stands at zero. However, if we move the slider of R2 to the positive end of the battery, the milliammeter indicates pronto that current is passing through it!

Where does this current come from? It must be flowing from the high-voltage battery, but where is the complete circuit? Surely the current cannot pass through the space between the filament and the plate inside the glass sphere, for we have always thought of a vacuum as being a perfect insulator; yet, there is no other logical explanation of what that milliammeter pointer is saying. The current *must* be bridging the gap inside the bulb, but how?

Remember that back in Chapter I we found there are always a number of free electrons wandering aimlessly

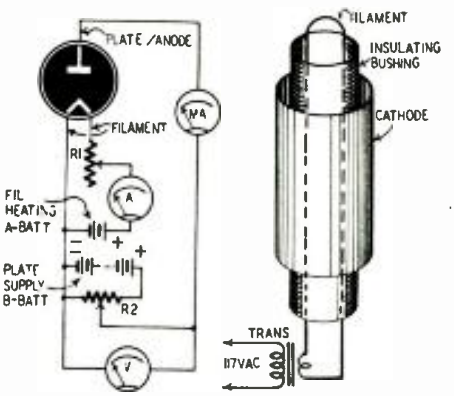

Fig. 1 (left)—Test setup illustrates diode action. Fig. 2 (right)—Cathode is cylinder surrounding the filament.

These are a few of the common diodes—all sizes and ratings are manufactured.

around through any conducting material? By applying voltage, we can control the direction and speed of this movement of electrons to a certain degree; but even with no e.m.f. applied, the restless little jiggers are constantly hopping around from one atom to another.

When they come to the surface of the conductor, however, they bump into a force, somewhat resembling the surface tension of water, that keeps them from passing through. While they possess some *kinetic energy* (kinetic energy is power acquired through motion; it is the reason a soft hand can slap so hard), they do not have enough to shoot through this surface barrier. They must have help if they are to escape into "the wild blue yonder."

Providing heat is the easiest way to supply this help. When the temperature of a body is raised, free electrons begin to feel freer and friskier by the second. They start to accelerate and to shoot madly about like a bunch of water bugs playing tag, and sooner or later one

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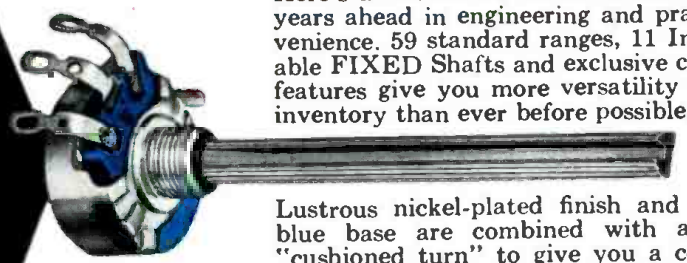

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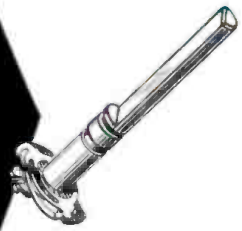

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of them takes a long running jump and pops right through the surface of the body into the air or vacuum surrounding it. As the temperature goes still higher, more and more of these heat-propelled electrons make the grade until finally the heated object is surrounded by a veritable cloud of fugitive particles that it has *emitted*.

Please note that it makes no difference *how* the emitting body is heated. It could be done with a blowtorch, a gas flame, the focused rays of the sun, etc., but inasmuch as the emitting material must be heated inside a vacuum in our radio tubes, the heating effect of an electric current has proved to be the most practical.

Sometimes the filament itself is the emitting body (or cathode), as is the case in Fig. 1; but in other instances the emission is from an *indirectly heated cathode*, as is shown in Fig. 2. Here the filament is heated by current from an alternating-current transformer, and this heat passes through a bushing made of electrically insulating but heat-conducting material and raises the temperature of the sleevelike cathode to the proper temperature for emission. Tubes are therefore loosely divided into "filament" and (indirectly heated) "cathode" types.

When an electron is emitted, its negative charge is subtracted from the total charge of the emitting body; therefore the body becomes unbalanced in a positive direction, tending to attract the negative electron back into itself if some other stronger force is not exerted on that negative particle. That is where the plate in our vacuum tube enters the picture. If the plate is positively charged with respect to the emitting filament, it tends to attract to itself the electrons that have escaped into the vacuum; and when there is a constant parade of electrons from the filament or cathode of a vacuum tube to the plate, we have a *plate current*.

These electrons pass from the plate to the positive terminal of the battery through the milliammeter, causing it to deflect. Incidentally, when only 10 ma is flowing, 6.28 times 10^{18} electrons are being emitted by the filament and attracted to the plate every second (*not* 6.28 times 1018, as the printer erroneously reported in Part I of this series). However, the electrons flow from the negative terminal of the battery into the filament at the same rate at which they return to the positive terminal *via* the plate; so no electrons are really lost or gained.

Now that the mystery of how current can flow through a vacuum has been cleared up, let us do a little more experimenting with the apparatus shown in Fig. 1. Suppose R1 is adjusted until our filament just begins to glow a dull red and that R2 is then manipulated so that the voltage applied to the plate starts at zero and advances in 10-volt steps. At each step, let us carefully note the values of the plate voltage and the plate current.

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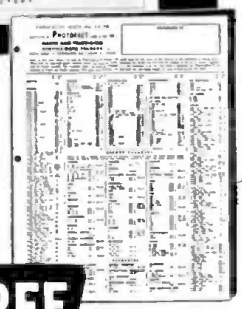

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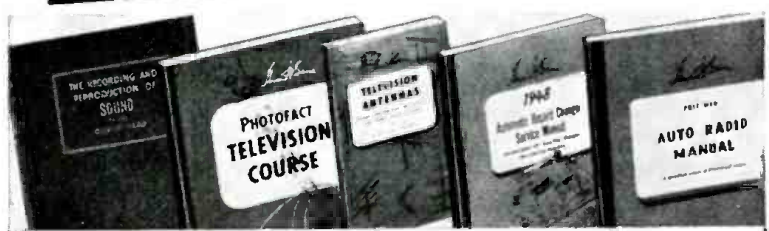

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Next, let us increase the current through the filament until the filament is a bright cherry red, and then let us repeat our step-by-step increasing of the plate voltage, again carefully noting the changes in the readings of the voltmeter and the milliammeter. Finally, let us combine the results of these two observations in one graph, Fig. 3.

From this graph we can see that as the plate voltage increases, the plate current for the low-filament-current condition also increases, rapidly at first and then leveling off until a further increase in plate voltage produces practically no increase in plate current. The same thing is true after we have increased the filament current, but now the leveling-off point occurs at a higher value of plate current. For low plate voltages, the plate current is practically the same for high or low values of filament current.

The total number of electrons emitted from the filament depends upon its temperature, which in turn depends upon the current passing through it. The total number of electrons attracted to the plate depends upon, first, how many are emitted by the filament and, second, what percentage of these the attraction of the plate voltage can win over from the attraction of the filament itself. The higher the plate voltage, the higher is this percentage.

When our filament glowed a dull red, a limited amount of electrons were released. When the plate voltage was low, only a small number of these could be attracted to the plate instead of returning to the filament; but as the voltage, and consequently the attraction, of the plate went up, more and more of the available electrons succumbed to its Siren call until finally it was getting *all* of them. Beyond this point, an increase in plate voltage obviously could not increase the plate current.

When we increased the filament current and raised the temparture of the filament, we increased the number of electrons emitted. Under these conditions, it was necessary to raise the plate voltage still higher before it was attracting the total increased output of the filament. It is apparent that for every value of filament current there is a certain value of plate voltage which will attract *all* the emitted electrons and beyond which no further increase will result in more plate current. This maximum current is called the *saturation current* of the tube, and it is important that the tube be so designed that this saturation condition is never reached with the normal values of filament current and plate voltage that are applied.

Why the vacuum?

Perhaps you are wondering why there is a "vacuum" in vacuum tubes. Emission *will* take place in the open air, but there are two good reasons for placing our tube elements inside a vacuum. In the first place, if the filament were heated red-hot in the open air, it would oxidize quickly and be destroyed. In the second place, if the space between the filament and the plate were not emptied, the poor little electron would have a tough time trying to shoulder its way through the bulky atoms of air and gas which have a mass some 1,800 time that of its own.

The two-element tube that we have been studying is a fundamental type, as we shall note in the next chapter, yet this *diode*, as it is called, is used in some form or other in nearly every radio and television set on the market today. Moreover, it is subject to practically all the ills suffered by its more complicated brethern.

If the filament breaks, we have no way of raising the temperature to the emitting point; and "open" filaments are one of the most common causes of tube failure. It is equally obvious that if any two elements, such as the filament and plate, actually touch each other, the tube cannot function normally. This "shorted element" route is one by which many tubes reach the junk pile.

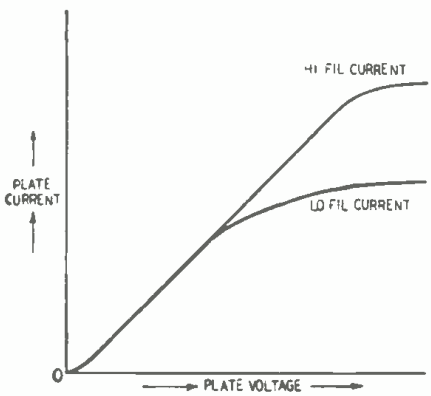

Fig. 3—Hotter cathode emits more.

As was pointed out before, the operation of the tube depends upon the elements being housed in a good vacuum, and anything that impairs this vacuum will ruin the operation of the tube. Occasionally minute amounts of gas remain in the tube or escape from some of the elements after sealing; then the tube becomes "gassy." Gassy tubes cause many headaches in the radio repair business, for they are not always as easy to detect as other defective types.

Even under normal conditions, the electron emission of a filament or cathode will fall off after a while, and this deterioration will be speeded up if the tube is subjected to overloads. Such reduced emission results in the "weak" tubes indicated by a tube tester.

Poor connections between the leads and the tube elements can result in "noisy" tubes that make a rasping, staticlike sound in the speaker; and if the various elements are not held rigidly in place, the tube will often make a ringing sound come from the speaker when the tube is touched or bumped. Such tubes, because they behave like a microphone, are called "microphonic."

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European Report

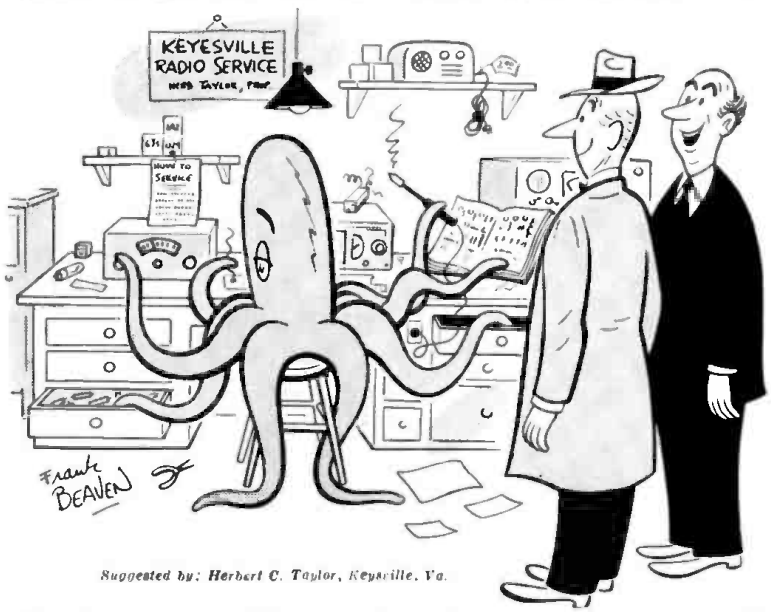
By Major Ralph W. Hallows

RADIO-ELECTRONICS LONDON CORRESPONDENT

THE first British Radio Exhibition, in the far-away days when broadcasting was a new thing, wasn't held at Olympia. The number of receivers in use away back then in 1922 or '23 (I forget which), cannot have been much over 30,000. Nor were there many radio manufacturers. The organizers felt that a hall of modest size would answer the needs of both public and manufacturers. Actually, the show was almost overwhelmed by the flood of visitors. It was staged the following year in the great London building known as Olympia, and there it has been held ever since, except during the war years and in 1948. I can claim an unbroken attendance record from the very first pre-Olympia show to the present time, except for 1939. The exhibition was held that year, but in September, 1939, the war began for us; hence during the few days that the show was open I was otherwise engaged in looking after anti-aircraft guns in the wide marshes near the mouth of the River Thames. I attended my first radio show as a youngster, thrilled by the marvels of what was then called wireless. I go now as a dyed-in-the-wool old-timer. I'm pretty well stunt-proof by now, but I get as big a thrill as ever I did out of the genuine advances in radio, radar, and television techniques that one is sure of finding at every Radiolympia.

The scope of Radiolympia has been very much enlarged. This year it covered not only broadcasting, but every form of telecommunications, besides television and land, sea and air radar. A word about TV first. Two important tendencies were noticeable here. Number one is the virtual disappearance of the small-image receiver using a 5-, 6-, or 7-inch tube and designed to attract the purchaser by its low price. Time has shown that the smallest image which folks will accept is one of about 45 square inches. The 8-inch tube is therefore almost the minimum size in televisers nowadays, and even that is not overpopular. Many people prefer to put off purchasing until they can afford a set giving at least a 63-square-inch picture. And that, I rather imagine, is going to be the standard for mass-produced, popular-priced British TV receivers.

In this connection there is an interesting advance in C-R tube construction by the British General Electric Co. The maximum size of the image that a tube of given size can show depends largely upon how much of its screen is wasted because of the curvature of the glass



Suggested by: Herbert C. Taylor, Keyesville, Va.

"It took me quite a while to train him. He's worth three servicemen."

What a show!

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SYLVANIA ELECTRIC

CATHODE RAY TUBES; RADIO TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, SIGN TUBING; LIGHT BULBS; PHOTOLAMPS

near its rim. To be acceptable to the eye, the image must be nearly flat, and this definitely limits the screen area that can be usefully employed. G-E has developed a new way of making the glass envelopes of tubes which allows the whole screen to be very nearly flat to within a short distance of the rim.

The secondary tendency is toward a brighter image. People are no longer content to have to draw blinds and curtains when they want to use the televiser by day, or to switch off most of the lights after dark. The aluminized screen is playing an important part here. Tubes fitted with it are not necessarily more expensive than others, and the process definitely insures a much brighter picture without the use of anything beyond normal high-voltage.

Many a housewife has told me in the past that *the* thing she would most like to have was a radio receiver of triangular cross section, which would fit into a corner of a room, standing on a wall bracket if a table model, or on the floor if a console. Some years ago I tried unsuccessfully to design such a set; tubes and other components of the old dimensions just didn't lend themselves to a triangular chassis. So much space had to be wasted that the resulting set was far from being a neat and compact piece of domestic furniture. I regretted this, for, if it could be realized, the corner set would have advantages far beyond its appeal to the feminine eye. The walls of the room would form an extension to its loudspeaker's baffle board and should also insure an almost ideal distribution of sound waves.

Miniature tubes and miniaturized components have made the corner set something more than a dream nowadays. Several of our firms showed models at Olympia, and I am looking forward to practical tests at home.

The corner radio doesn't stop there. The corner televiser has also appeared at the Exhibition and to me it seems to offer a very promising line of development. It is neat and space-saving; its loudspeaker profits in the way already mentioned from the convergence of the walls on its baffle. But there is more in it than just that. Its corner position makes it easier to arrange seats for a number of viewers. And there's another point. The corner set means that when need be, TV looking-in can be confined to just one part of the living room. There alone must lights be switched off. Those who want to read or to sew in other parts of the room can have all the illumination they require.

Phonographs and radiophonographs have always played an important part in our domestic entertainment. I believe, in fact, that Britons make more general use than Americans do of the record and the reproducer. That, possibly, is because the BBC offers a considerably smaller choice of radio programs than American stations. In the average home the more or less standard four- or five-tube superhet gives a

(*Continued on page* 66)

Sound Advice From One Serviceman To Another!

MAC'S *Radio* REPAIR

BOX 618 Choteau, Montana PHONE 71

John F. Rider Publisher, Inc.
480 Canal Street
New York 13, N. Y.

Rumors are running around financial circles to the effect that a good many ex G.I. radiomen who have gone into business for themselves are practically starving to death. I can well believe such rumors since I am an ex G.I., and after a year and a half I am just beginning to pull away from the deep part of that red ink pool. I think Dun & Bradstreet, Inc. still list me as a good cash-on-the-line customer. Since the above-mentioned rumors are probably true, I would like to take advantage of your advertising department to pass on some tips to ex G.I.'s who are now in or who contemplate entering the radio repair business.

A man entering radio repair must have some working capital, a good working knowledge of radio, adequate test equipment, and a GOOD REFERENCE LIBRARY. That good reference library cannot be stressed too much, because the big jobs, the mean jobs, and the tough jobs are dependent on that library.

Unfortunately there are quite a few radio wreckers operating, and the only complete key that I have found for setting those radios right is the use of Rider's manuals. If the manufacturer has made changes in the set, those changes are included in Rider's. In most cases all other changes should be discarded and the radio re-assembled according to schematic.

The SPEED with which repair work is completed has much to do with income. In the interest of speedy repair I recommend Rider's. A customer who is PLEASED with the work done on his radio doesn't mind paying a good price for it. Rider's manuals give you the information on nearly every radio made and if used will mean pleased customers. REPEAT BUSINESS and word-of-mouth advertising means extra money in your pocket. By doing conscientious work that proves satisfactory you will get both repeat business and good advertising.

There are many shops operating without Rider manuals, and that is especially true of newcomers to the business. I am sure that many of the newcomers will find that an investment in a complete set of Rider's manuals will mean the difference between success and failure in their business.

I have written this with the hope that it will help some of the boys who are busy pulling out what little hair is left in their heads, and also with the hope that it will serve to help a lot of men improve their work and thus give a better name to our business.

Yours truly. A. E. McCorkle

A. E. McCORKLE

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choice of three local programs, the Home Program (middle-brow), the Light (low-brow), and the Third (definitely high-brow). There are scores of possible alternatives from the continent of Europe, but fading, static (man-made or natural), heterodyne whistles, and other forms of interference severely narrow the choice. The number of worthwhile alternatives available to the discriminating listener is thus comparatively small. For these reasons the radiophonograph is very popular and there is great encouragement to manufacturers to develop its possibilities in the fullest way.

Phonograph record nowadays are appearing in an almost bewildering diversity of types. Diameters range from 10 to 18 inches; playing speeds from 33⅓ to 78 revolutions per minute; maximum audio frequencies from 8,000 to 20,000 cycles; recording systems from the standard to the microgroove; playing times from 2½ minutes upward. The demand here is for instruments that can deal faithfully with records of a wide variety of different types. This year's Radiolympia showed that the demand is being well met. There was, in fact, at least one instrument whose makers claim that it can play any type of record now on the market.

The discriminating listener, by the way, was well looked after at Radiolympia, for he could try out the radios, the phonographs, or the radiophonographs in sound-proof rooms specially provided for such purposes. And while he was thinking over his choice he could find diversion by flattening his nose against the glass walls of BBC's television studio or by gazing at the pictures of London "printed" on the PPI tubes of radar sets with the aid of a scanner revolving above the roof of Olympia.

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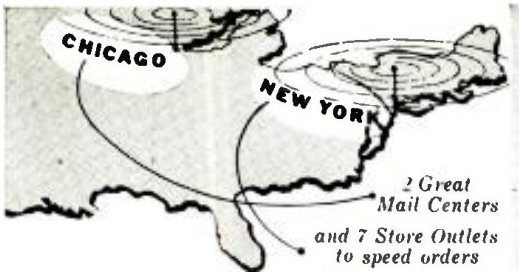

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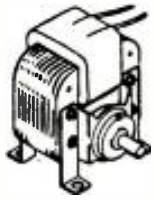

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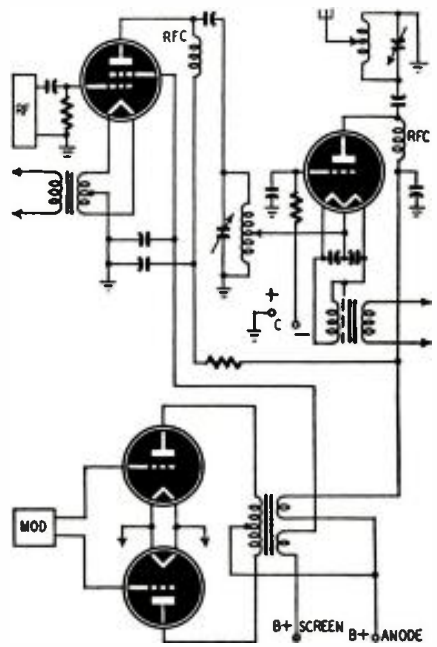
MODULATION SYSTEM

Patent No. 2,463,275
Roy A. Henderson, W. Collingswood, N. J.
(Assigned to Radio Corp. of America)

A high percentage of modulation with little distortion is produced by this circuit. The transmitter has a grounded-grid final amplifier and a screen-grid exciter. Since the final does not reverse the polarity of a signal applied to it, the r.f. at the final plate is in phase with the r.f. at the exciter plate, making it possible to modulate three elements simultaneously: the exciter screen, the exciter plate, and the final plate.



The modulation transformer has two secondaries. One modulates the exciter screen; the other modulates the plates. The audio voltages applied to the exciter elements should be proportional to their d.c. potentials for lowest distortion.

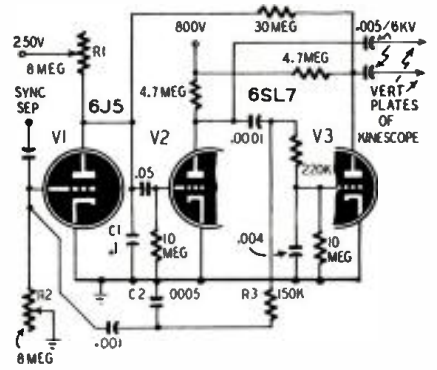
The final filament transformer should have adequate shielding for low capacitance to ground, since the filaments are at an r.f. potential above ground.

SAWTOOTH GENERATOR

Patent No. 2,458,367
George W. Fyler, Lombard, and
Garth J. Heisig, Chicago, Ill.
(Assigned to Motorola, Inc.)

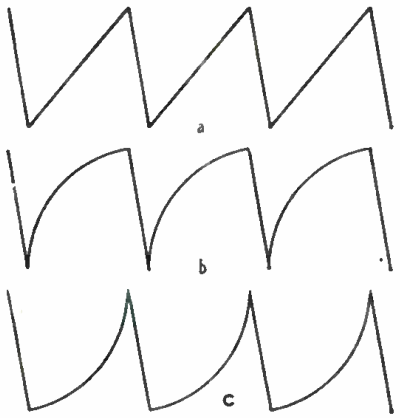
A multivibrator instead of a blocking oscillator is used in this vertical deflection circuit. It provides push-pull output to the electrostatic plates of a kinescope. Relatively small coupling capacitors to the deflecting plates of the kinescope are possible.

Tubes V1 and V2 form a free-running multivibrator at approximately the frequency of the vertical sync signals which trigger V1. Therefore it is possible to maintain sync in the presence of a certain amount of noise or with weak sync pulses. Capacitor C1 charges while V1 is



blocked and discharges abruptly when the tube conducts. The sawtooth voltage is amplified by V2 and applied to one of the kinescope deflection plates.

V2 and V3 are coupled by a differentiating network (to sharpen the pulses) and a voltage divider to reduce the input to V3, which feeds the deflecting plate. The voltage outputs from V2 and V3 must be equal and opposite.



Ordinarily, large coupling capacitors are needed to pass the 60-cycle sync pulses to the kinescope. Small capacitors distort the wave so that it looks like b instead of a. A feedback circuit compensates for the attenuation of the low frequencies due to small capacitors. A large resistor (30 megohms) feeds back voltages from V3 to C1. As C1 approaches the end of its periodic charge, the V3 anode is at maximum positive potential and therefore feedback is greatest. At the beginning of the charge feedback is minimum. The feedback voltage is shown at c. When curves b and c are combined, a good sawtooth a is produced.

C2-R3 is a low-pass network to attenuate the horizontal line pulses. R1 adjusts vertical picture size. R2 controls the frequency of the multivibrator.

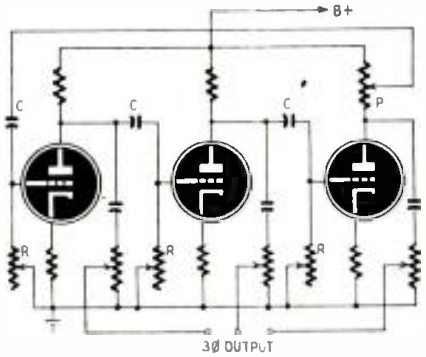
POLYPHASE GENERATOR

Patent No. 2,460,790

Charles W. Jarvis, Washington, D.C.

(Assigned to the United States of America as represented by the Sec'y of the Navy)

This polyphase generator is electronic rather than mechanical. Its output is weak, but amplifying stages may be added to bring it up to 117 volts if desired. The circuit shown here generates three phases, each of the tubes contributing one of them.



Each stage has an R-C phase shifting network. If each stage is designed to shift the voltage by 120 degrees, the total is 360 degrees. Since the output of the last stage is in phase with the input to the first, and is fed back to it, oscillation takes place.

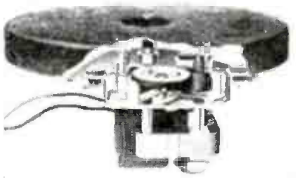
As in any phase-shift oscillator the frequency may be varied by changing the grid leaks R. For convenience all three may be ganged.

Individual phases are taken from potentiometers in the plate circuits. Each should be adjusted to give the same amplitude. P controls the over-all amplitude by governing feedback to the first stage.

THREE-SPEED PHONO MOTOR

Alliance Mfg. Co., Alliance, Ohio

Model J is suitable for playing records at 33-1/3, 78, or 45 r.p.m. The shift lever has two positions and a reversible disc allows for the third



speed. The motor is said to be free of vibration and wow. Either a 9- or 10-inch turntable is furnished.

SIGNAL TRACER KIT

Electronic Instrument Co., Inc., Brooklyn, N. Y.

The Eico model 145 permits audible signal tracing of r.f., i.f., FM, audio, and video circuits up to 200 mc. A test speaker is built into the case. A high-

frequency probe is provided. The instrument is isolated from the power line by a transformer.

TELEVISION TRANSFORMERS

Merit Coil & Transformer Corp., Chicago 40, Ill.

A complete line of replacement horizontal and vertical blocking oscillator transformers for television receivers is now available. Units may be had for any receiver.

RADIO HYPODERMIC

Walter L. Schott Co., Beverly Hills, Calif.

The Walsco Contactens Injector is a hybrid tool with the hollow needle of a hypodermic and the rubber bulb of an eye dropper. It is useful for getting cleaning fluid or lubricant into tight places in a radio receiver. The cover of a volume control need not be opened.

SOLDERING GUN

Weller Mfg. Co., Easton, Pa.

The WD-250, a new version of the Weller soldering gun, is rated at 250

watts as against the 135 watts of the first model. Especially suited to radio and television work, it heats in five seconds, and has a chisel head. The bulk has not been increased, and little weight has been added.

VIBRATOR TRANSFORMERS

Chicago Transformer Division, Essex Wire Corp., Chicago 18, Ill.

A new line of replacement vibrator transformers for automobile radios has just been introduced through jobbers. The units are exact duplicates of the originals, allowing installation without extra holes or components. All transformers are sealed in drawn steel cases for shielding and moisture protection.

HIGH-GAIN BOOSTER

Astatic Corp., Conneaut, Ohio

The Channel Chief model AT-1 is a four-tube television booster with much higher gain than ordinary boosters. Gain of all twelve channels is uniform.

Dual tuning controls are provided for separate adjustment of sound and picture signals. The dual tuning is said to improve the over-all selectivity so that much interference is minimized or eliminated. Another control varies the booster's gain so that the receiver is not overloaded by strong signals. The on-off switch controls the internal power supply and also removes the booster from the antenna circuit.

TELEVISION TOWERS

Penn Boiler & Burner Mfg. Corp., Lancaster, Pa.

The teletower is triangular, each section being formed of three pieces of ¾-inch, 18-gauge steel tubing braced by ¼-inch-thick straps. Standard sections are 10 feet high, from which a tower of any reasonable height may be constructed. Bases are available for flat mounting or for placing on a sloped roof.

3-SPEED CHANGER

Comet Corp., Chicago, Ill.

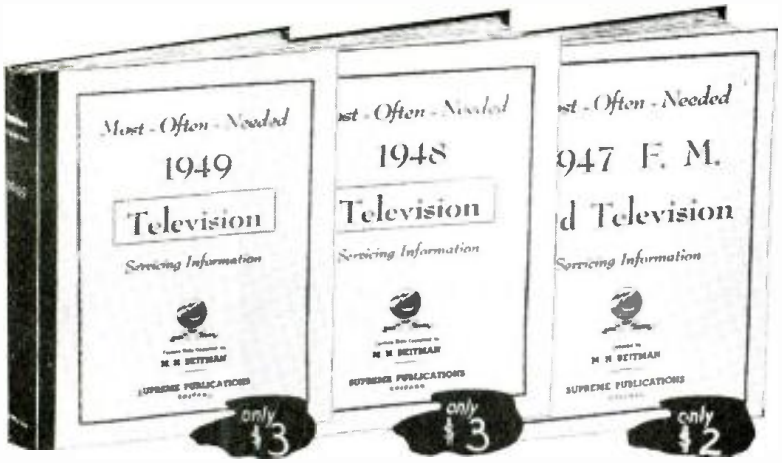
This fully automatic changer plays all records available today, 7-, 10- and 12-inch and 33 1/3, 45-, and 78-

r.p.m. All records are changed by the edge-push-off method. Two spindles are furnished, one with the standard diameter for ordinary records and the other with a diameter of 1½ inches for RCA 45-r.p.m. discs. A two-stylus crystal cartridge with tilt adjustment plays all records with a stylus force of 6 to 8 grams. A velocity trip is used.

LOW-COST TRANSFORMERS

Audio Development Co., South Minneapolis, Minn.

The Yeoman line of transformers is designed to afford economy along with high performance. All have open-frame construction and 10-inch leads. Impedance-matching, input, output, and power transformers are included.



Amazing SUPREME Values in New TELEVISION Manuals

All three giant Television Manuals shown at the left are available to you for only $8, total cost, nothing else for you to pay, nothing else to buy, and we will even prepay the shipping charges. (Or you can buy these manuals separately at only $3, $3. and $2.) Take advantage of this amazing *Supreme* offering to step into Television at a tremendous saving. For over 16 years, radio servicemen expected and received remarkable values in *Supreme Publications* service manuals. And now, the three-volume Television and F.M. series beats all previous bargains. Only a publisher who sold over one million of various radio manuals can offer such bargain prices based on stupendous volume-sales.

New 1949 TELEVISION

Use this new giant handbook of television servicing as your guide to quick fault finding and repair of any modern T-V set. Easy-to-understand description of circuits, pages of test patterns, response curves, alignment facts, waveforms, voltage charts, service hints, hundreds of diagrams many in the form of giant double-spread blueprints. Here you have approved factory data on every popular T-V set. Large size: 8½x11", 192 pages + 9 blueprints 11x15", manual style. Amazing Supreme value for only $3.

1948 T-V MANUAL

In this mammoth volume you have practical factory service data on all popular 1948 T-V sets of all makes. Let this manual show you how to make needed tests, guide you in carrying out adjustments, point to probable trouble spots, indicate location of all parts, trimmers, and controls. Includes hundreds of charts, waveforms, photographs, and many large 11x16" blueprints. Use coupon below to order, your special price only $3.

1947 T-V & F.M.

Here is your manual of instructions for trouble-shooting, repairing, and alignment of all popular 1947 F.M. and TELEVISION sets. The F.M. data covers tuners, AM-FM combinations, and all other types of F.M. circuits. Most complete information on various methods of F.M. alignment. A great deal of material on popular T-V sets including RCA 630-TS. Data on 192 large pages, 8½x11 inches. Sturdy manual-style binding. Price only $2.

FIND—FIX ALL TELEVISION FAULTS

Use these timely television manuals as your guide to quick fault finding and repair of any television set. Eliminates guesswork—tells you just where to look and what to do. Cuts hour-wasting jobs to pleasant moments. Use test patterns for quick adjustment, or look up probable cause of trouble in the pages of hints after simply observing fault in video picture. No equipment needed with these tests. Or use your voltmeter and compare values with many voltage charts included. With an oscilloscope you can get waveforms similar to hundreds illustrated using test points suggested and in a flash locate what used-to-be a hard-to-find fault. These manuals will give you the know-how of a television expert and will repay for themselves with time saved on the first TV job. Order at our risk for a 10-day trial. Use coupon below.

NEW 1949 DIAGRAM MANUAL

Use this newest SUPREME radio manual to repair quickly all modern 1949 radio receivers. In this big single volume, you have clearly-printed, large schematic diagrams, needed alignment data, replacement parts lists, voltage values, and information on stage gain, location of trimmers, and dial stringing for almost all recently released sets. A worthy companion to the 8 previous volumes used by over 128,000 shrewd radio servicemen. Like the previous volumes illustrated above, it sells at a give-away price and gives you a whole year of radio diagrams for a couple of dollars total cost—nothing else to buy the rest of the year, nothing else to pay. Giant size: 8½x11 inches. Includes index. Manual style binding. Available at your jobber, or send coupon, price only $2.50.

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Be money ahead with SUPREME Manuals. For the remarkable bargain price (only $2 for most volumes) you are assured of having in your shop and on the job, needed diagrams and other essential repair data on 4 out of 5 sets you will ever service. These manuals pay for themselves with time saved on a couple of jobs, after that you use them FREE. Don't spend large sums for bulky, space-wasting manuals of other publishers, don't buy additional drawings every few weeks, be wise, use SUPREME Manuals to get the most in diagrams for smallest cost.

Compiled by M. N. Beitman, radio engineer, teacher, author & serviceman

AMAZING SUPREME BARGAIN IN DIAGRAMS AND SERVICE DATA

Here is your low-priced, money-saving source of radio diagrams and service data for all popular sets. Above is a photograph of these giant-size manuals—available to radio servicemen at only $2 for most volumes. Let these easy-to-use manuals guide you to quick fault finding and simplified repair of any radio. Eliminate guesswork, cut hour-wasting jobs to pleasant moments. These manuals cover every popular radio of all makes, from old timers to new 1949 sets. Clearly printed circuits, parts lists, alignment data, and helpful service hints are the facts you need to be more expert in radio servicing. There are nine volumes in all as illustrated above. Each manual is 8½x11 inches, sturdy manual style binding, average manual has 194 pages of diagrams and practical service data. Use coupon below to order on 10-day no-risk trial or see these manuals at your jobber.

Record Changers
Post-War Manual

Service expertly all modern (1945-1948) record changers. Includes every popular make. Just follow simplified factory instructions to make needed adjustments and all repairs. Hundreds of photographs and exploded views. Large size 8½"x11 inches. 144 fact-filled pages. Available at your radio jobber, or sent postpaid, price only $1.50

Radio Servicing Course-Book

Here is your practical radio course of 22 easy-to-follow lessons. Review fundamentals, learn new servicing tricks, all about signal tracing, oscilloscopes, recording, P.A., test equipment, and T-V. Just like a $100.00 correspondence course. Everything in radio servicing. With self-testing questions and index. Large size: 8½x11" Price postpaid, only $2.50

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☐ 1926-1938—$2.50

Name .....

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PORTABLE ANTENNA

American Phenolic Corp., Chicago, Ill.

Amphenol Telestar antennas are a new version of the familiar table-top V. In this one the lengths of the elements are not adjustable; but there are two dipoles one for the low and another for the high band. The weighted base is equipped with rubber feet.

VOLTOHMMETER KIT

Heoth Co., Benton Harbor, Mich.

The new Heathkit Honditester kit has a 3-inch, 400-ua meter. A.c. and d.c. voltage ranges of 0-10-30-300-1,000-

5,000 volts are available as well as resistance ranges of 0-3,000-300,000 ohms. Two milliampere ranges are included, 0-10-100.

TV MASTER SYSTEM

Transvision, Inc., New Rochelle, N. Y.

A master antenna system which amplifies the signals is being offered for apartment houses. One antenna is erected for each occupied channel. The amplified signals are mixed and piped throughout the house. Each set is plugged into an outlet, getting maximum reception on all channels.

METAL VIEWING TUBE

Sylvonia Electric Products, Inc. New York, N. Y.

Sixteen-inch metal tubes are now available to distributors. The 16AP4 has a 6.3-volt, 600-ma filament and

requires magnetic deflection, focusing, and ion trap. High voltage required is 12,000, focusing anode voltage 300, and control grid bias —33 to —77 volts.

METALLIZED CAPACITORS

Aerovox Corp., New Bedford, Mass.

Aerolite metallized paper capacitors do not contain metal foil as do conventional units but substitute high-purity paper tissue coated with a film of metal one millionth of an inch thick or less.

Less space is occupied by the electrodes, allowing more insulation and better protection against voltage surges. R.f. impedance is lower than in standard units. The capacitor is essentially self-healing after high surges or momentary overloads.

The new type P82 is available in values from .01 to 2 uf and in voltage ratings of 200, 400, and 600. Size of the capacitors is small, the 2-uf unit measuring only 23/32 inch diameter and 1⅝ inches long.

MARKER GENERATOR

Radio City Products Co., Inc., 152 West 25th Street New York 1, N. Y.

Model TV 50 is a variable-frequency signal generator with four ranges covering 5 to 250 mc. It is used as a marker in conjunction with standard

television and FM sweep generators. Calibration accuracy is within 1%. A self-contained crystal oscillator may be used simultaneously with the v.f.o. or by itself. A phasing control is included. An internal mixing circuit is arranged so that the output of a sweep generator may be fed to the TV-50 and the marker's output leads carry both signals.

TELEVISION LAZY H

Technical Appliance Corp., Sherburne, N. Y.

The Taco Lazy H television antenna, first introduced in 1940, has been improved. Formerly made only for the low-frequency channels, the unit now has changed spacing and high-frequency whiskers to give good performance over all 12 channels. An additional reflector has been added especially for the high channels. Construction is all-aluminum except at insulation points.

ANTENNA ROTATOR

Crown Controls Co., New Bremen, Ohio

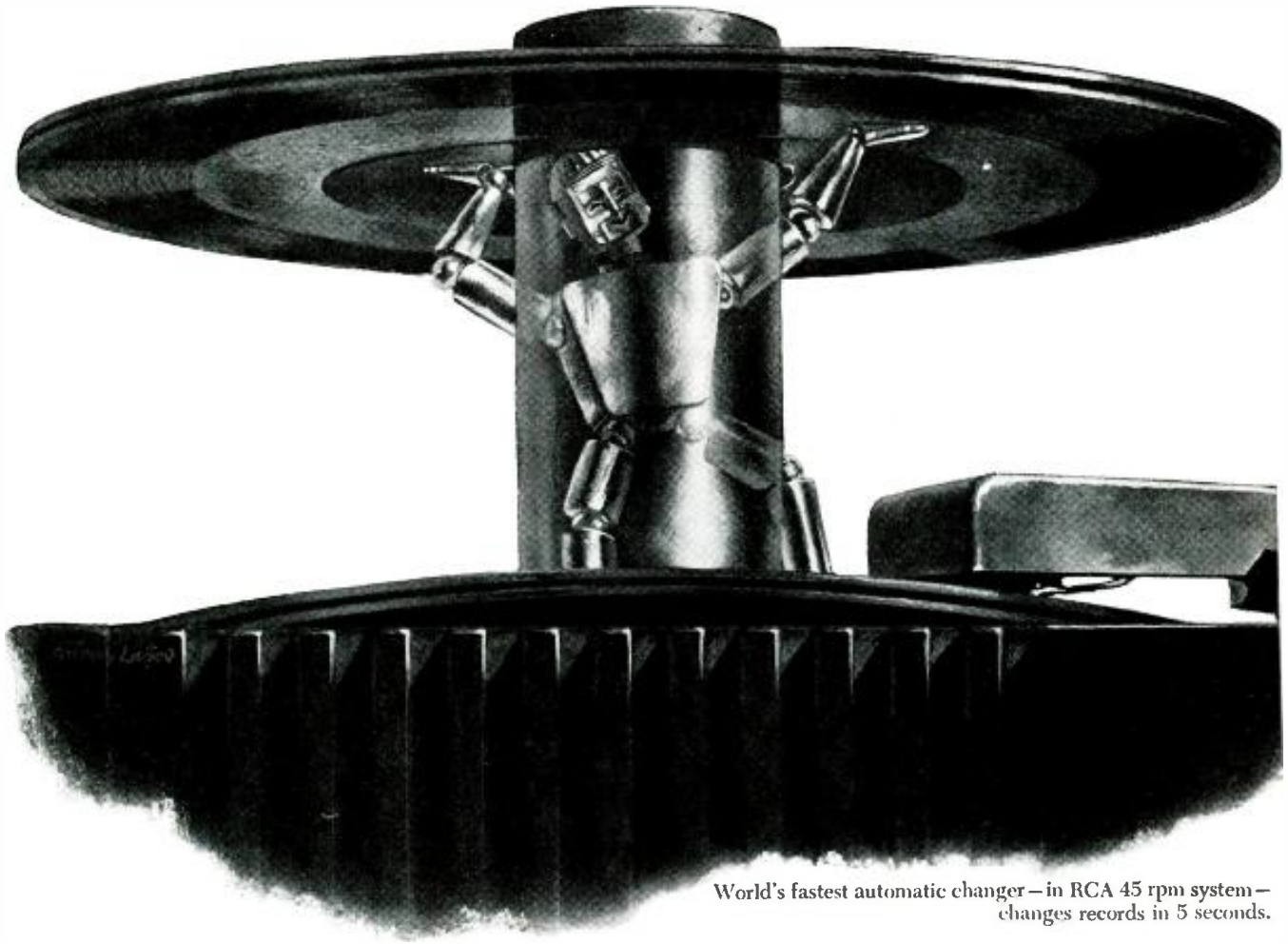
Designed principally for rotating television antennas but useful also for ham and other work, this rotator will support 175 pounds. It may be mounted

near the ground or roof with the antenna and mast supported by the rotator. The control unit has a meter indicating directions. A three-way momentary push switch rotates the antenna in two directions or lights the indicator dial. Castings are aluminum and the drive unit is weatherproof.

POCKET VOLTOHMMETER

Electronic Measurements Corp., New York, N. Y.

Model 102 is a pocket tester with a 3-inch square meter. Sensitivity is 1,000 ohms per volt. Ranges are: 12, 120, 600, and 1,200 volts a.c.; 6, 60, 300, 600, and 6,000 volts d.c.; 6, 30, and 120 ma. and 1.2 amperes d.c.; 30, 150, and 600 ma a.c. Two ohms ranges are also included.



World's fastest automatic changer—in RCA 45 rpm system—changes records in 5 seconds.

Quick change artist

Hundreds of thousands are now enjoying RCA's thrilling new way of playing records . . . they marvel at its wonderful tone . . . and the speed with which it changes records.

Prolonged research is behind this achievement, research which sought—for the first time in 70 years of phonograph history—a record and automatic player designed for each other.

Revolutionary is its record-changing principle, with mechanism *inside* the central spindle post on which records are so easily stacked. Result: *a simplified* machine, that changes records in 5 seconds.

Remarkable, too, are the new records—only 6⅞ inches in diameter—yet giving as much playing time as conventional 12-inch records. Unbreakable, these compact vinyl plastic discs use only the distortion-free "quality zone"... for unbelievable beauty of tone.

Value of the *research* behind RCA's 45 rpm system—which was started 11 years ago at RCA Laboratories—is seen in the instant acceptance, by the public, of this better way of playing records. Music lovers may now have *both* the 45 rpm system, and the conventional "78."

* * *

Development of an entirely new record-playing principle is just one of hundreds of ways in which RCA research works for you. Leadership in science and engineering adds value beyond price *to any product of RCA, or RCA Victor.*

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

REVERSIBLE TV BEAM ANTENNA

A novel 12-channel TV receiving antenna system, described in a recent issue of *RCA Review*, is a combination of two-element broadside and end-fire arrays producing a unidirectional pattern which can be reversed at will. Its elements are cut to one-half wavelength near channel 2 to keep the efficiency from falling off at low frequencies. Since the high-band channels bear a 3 to 1 frequency ratio to those in the low band, a half-wave, low-band dipole will constitute three half-waves on the high band and the radiation pattern will take the form of a four-leaf clover rather than the figure-eight of the dipole. "Vees," added to each dipole as shown in Fig. 1, have no effect on the low band, but change the high-band clover-leaf into a figure-eight, thus making each dipole bidirectional on all channels.

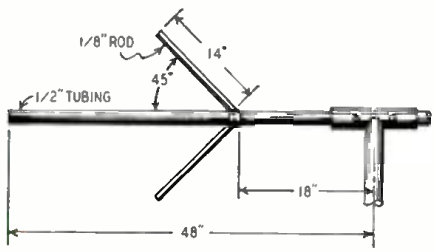


Fig. 1—"Vees" alter antenna pattern.

A diagram of the array is shown in Fig. 2. The dipoles of the broadside array—mounted above one another—are fed in phase at the center of a balanced transmission line. The end-fire elements—in a horizontal plane—are fed in the same manner; however, one half of the line is transposed to provide out-of-phase feed.

A and B are feed points for the broadside and end-fire arrays, respectively. These points are connected to opposite corners of a bridge consisting of four one-quarter wavelength lines, one of which is transposed as shown. A 150-ohm resistor and 300-ohm trans-

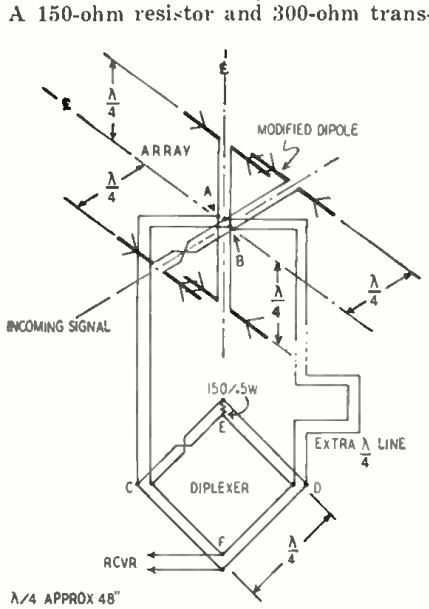
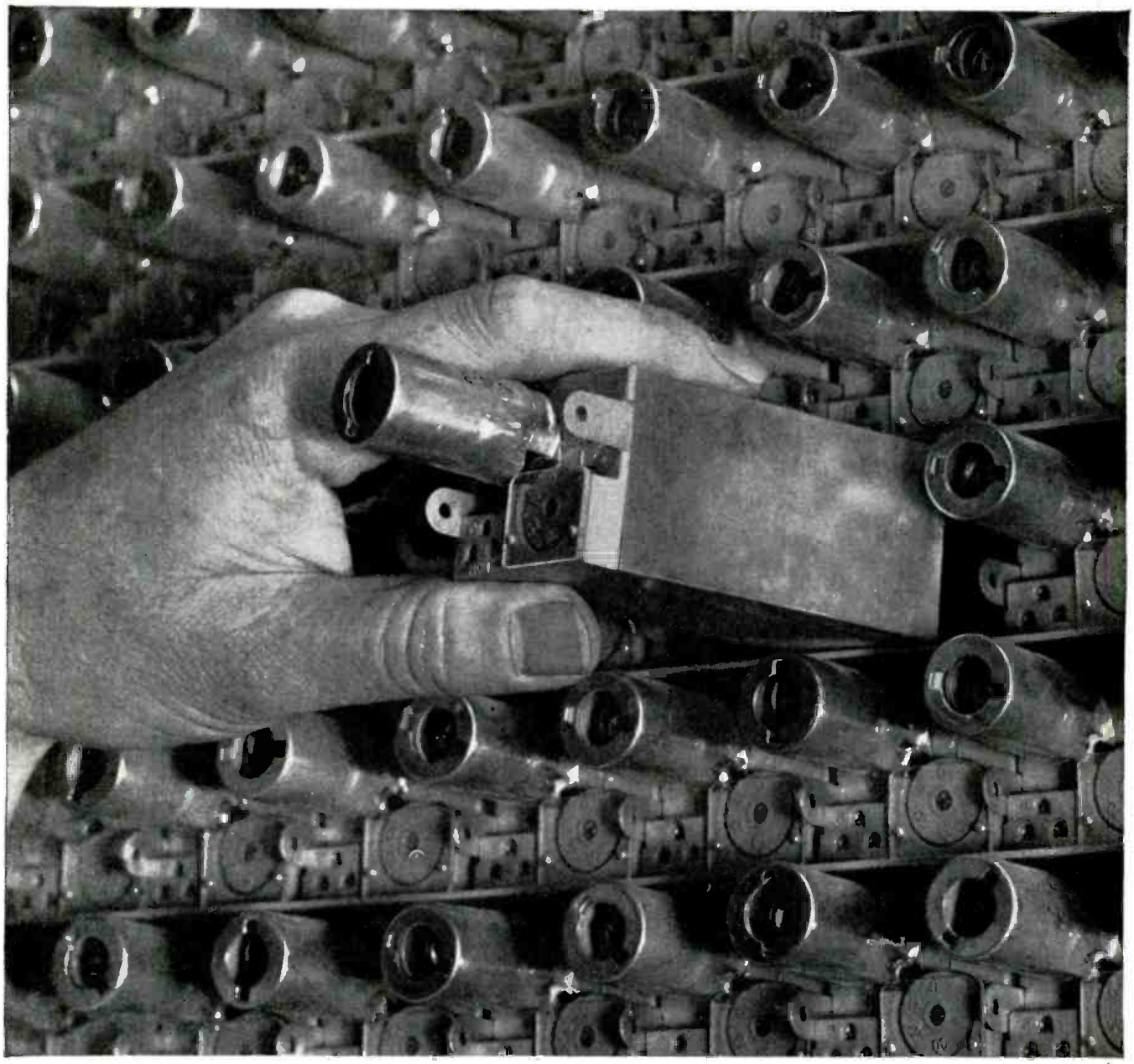


Fig. 2—Antenna array with diplexer.



ANOTHER SCORE IN THE

battle of the inches

It takes many costly buildings to house your telephone system. Every inch saved helps keep down the cost of telephone service. So at Bell Telephone Laboratories engineers work constantly to squeeze the *size* out of telephone equipment.

In the picture a new voice frequency amplifier is being slipped into position. Featuring a Western Electric miniature vacuum tube, tiny permalloy transformers, and special assembly techniques, it is scarcely larger than a single vacuum tube used to be. Yet it is able to boost a voice by 35 decibels. Mounted in a bay only two feet wide and 11½ feet high, 600 of the new amplifiers do work which once required a *room* full of equipment.

This kind of size reduction throughout the System means that more parts can be housed in a given space. Telephone buildings and other installations keep on giving more service for their size — and keep down costs.

The new amplifiers, which will soon be used by the thousands throughout the Bell System to keep telephone voices up to strength, are but one example of this important phase of Laboratories' work.

BELL TELEPHONE LABORATORIES EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

mission line are connected to the remaining corners of the network. This network is called a *diplexer*.

Assuming that an incoming signal approaches the array from the front (see Fig. 2), two main signals will arrive at A and B 90 degrees out of phase because of the spacing between elements and the transposition in one of the feed lines. Since transmission line B-D is one-quarter wavelength longer than A-C, the signals will arrive at the diplexer in phase. The in-phase voltages at C and D will buck each other at E because of the transposition in one leg of the bridge. Therefore, E is at zero potential, and the resistor will not absorb power. The main waves arrive at F in phase and pass through to the receiver.

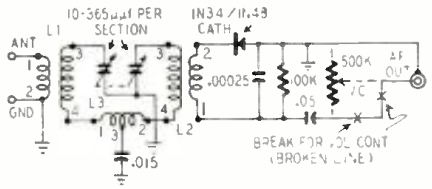
When a signal arrives from behind the array, main waves arrive at C and D out of phase. This out-of-phase relationship is maintained at F, and no signal goes to the receiver; instead, it is absorbed by the resistor, the signals being in phase at this point.

If there is a mismatch between the receiver and the transmission line, the signal will be reflected back toward the antenna where some of its energy is radiated and the remainder reflected back down the line toward the receiver. In this case, reflected signals are cancelled in the same manner as signals from the back of the antenna.

The directivity of the beam can be reversed by connecting a d.p.d.t. transposition switch in one of the transmission lines. The diplexer can be mounted on spreaders for positioning behind the TV receiver.

HI-FI CRYSTAL TUNER

Designed for high-quality local broadcast reception, the new Miller bandpass t.r.f. tuner kit should make a hit with crystal receiver fans and high-fidelity audio enthusiasts. The double-tuned bandpass circuit uses negative mutual coupling to provide adequate selectivity for separating most local stations. Bandwidth is approximately 25 kc at 2-db points when measured at 900 kc.



The 1N34 or 1N48 crystal diode detector develops between .05 and 0.5 volt on stations within a 20-25-mile radius when used with a good outside antenna 75 to 100 feet long. L1 and L2 are Miller 242-A antenna coils, and L3 is a type EL-55 negative mutual coupling coil.

Available in kit form, this tuner is the basis of a high-fidelity AM receiver when coupled to a hi-fi audio system.

A volume control can be connected as shown by the broken lines. If this control is included, the connection between points X must be removed.

(*Continued on page 79*)

FM-AM HALLICRAFTERS CHASSIS MODEL S-59 $32.95

11-TUBE FM/AM
MODEL S-56, $59.95

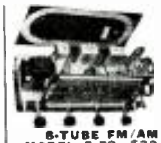
HALLICRAFTER'S S-56 $59.95

$110.00 VALUE 11-TUBE FM-AM CHASSIS

★AUTOMATIC FREQUENCY CONTROL ON F.M.

R.F. STAGE ON F.M.

Model S-56 Hallicrafters, high fidelity, 11 tube AM/FM radio receiver chassis for the broadcast band and FM 88 to 108 megacycles. Automatic frequency control on FM holds the station in tune. Phono connection on rear of chassis. Full range tone control with bass boost. Push pull 6K6 tubes in audio system. Frequency response essentially flat from 50 to 14000 cps. Wide vision accurately calibrated slide rule dial, with pre-selection on broadcast band. Output transformer matches 500 ohm line. 4 Antenna terminals; two for AM and two for FM. This is the finest type home radio that we know of today. Better get your order in early. Designed to be used in commercial radios selling in the $400.00 to $600.00 class. The regular dealer's net on this chassis is $100.00. However, a lucky purchase enables us to offer these S-56 Hallicrafters chassis complete with tubes and operation instructions, at only $59.95 less speaker. Sneaker matching transformer, 500 ohms to voice coil $2.50 extra. Chassis size 12¾ x 10 x 7¾". Weight 25 lbs. Combination offer—S-56 Hallicrafters chassis, speaker matching transformer and our model CR-13X 12 inch coaxial P.M. speaker, all for only $71.95.



8-TUBE FM/AM
MODEL S-59, $32.95

HALLICRAFTER'S S-59 $32.95

8-TUBE FM-AM CHASSIS

PUSH-PULL AUDIO—AC CONSTRUCTION

Model S-59 Hallicrafters, high fidelity, 8 tube custom receiver chassis, for FM/AM reception. Size 12½ x 7½ x 9". An excellently engineered chassis, equal to those used in $300.00 commercial sets. Wide range audio, 60 to 14,000 cps., tone control, phono input jack on chassis. Receives broadcast, 540 to 1700 kc. and FM 88 to 108 mc. Accurately calibrated slide rule dial. Any good PM speaker will work on this set. Output transformer matches 8 ohm voice coil. Priced complete with tubes, but less speaker. Weight 16 lbs. S-59 chassis and tubes. Net Price $32.95. 6 x 9" 4.64 oz. PM speaker (O.K. for console cabinet below) $2.95, extra. S-59 custom chassis and tubes, with our regular $12.95, CR-13X Coaxial 12" PM speaker, all for $42.95.

DETROLA-COILS, GANG-CHASSIS AND DIAL $2.95

Genuine Detrola Chassis ban with 6 octal sockets. Heavy glass slide rule dial. 3 Gang Tuning condenser, All RF and IF coils and band switch for standard broadcast and foreign short wave. Buy these parts for less than the coil value alone. These parts all fit the chassis properly. Only material pictured and listed above is offered. It is not a complete kit. You supply your own tubes, speaker, resistors, condensers, etc. Stock No. DET-1. Shipping Weight 9 lbs. Net $2.95.

CONSOLE CABINET FOR S-59 $19.95

Beautiful blond console cabinet. Size 17 x 21 x 33" high. This cabinet was intended for use on a nationally known $129.00 radio-phono combination. The lower half of the cabinet is divided for albums. The upper half has a hinged lid, which covers the radio and changer. Radio panel is 8 x 15" and may be ordered ready cut for Hallicrafters S-59 or with a blank panel for installing your own chassis. Changer panel is blank, will hold a changer up to 12 x 15". Cabinet will hold a 6" or a 6 x 9" speaker. Shipping wt. 40 lbs. Stock No. JB-4 blond cabinet, ready cut for the S-59 Hallicrafters (will not hold S-56). **$19.95**

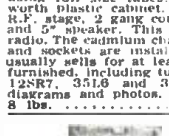
6 x 9"—Alnico V PM speaker..... **$2.95 extra**

Stock No. JB-5X same but blank radio panel..... **$19.95**

Stock No. B-1000 cabinet just as we bought them. You re-do the radio and changer area to suit your own need. Changer area is now 15 x 15" and radio area 5 x 15 x 11½". Stock No. B-1000. Shipping weight 40 lbs..... **$14.95**

6 TUBE AC DC KIT $9.95

6 Tube Superhet. Broadcast AC-DC Kit, using full size tubes. Housed in a Farnsworth plastic cabinet, with slide rule dial, R.F. stage, 2 gang condenser, loop antenna and 5" speaker. This makes a factory like radio. The cadmium chassis is ready punched and sockets are installed. This type of kit usually sells for at least $15.00. All parts furnished, including tubes: 12K8, 2-12SK7, 12SR7, 35L6 and 35Z5. Complete with diagrams and photos. Kit Model FS-6, Wt. 8 lbs. **$9.95**



3-WAY—PICK ME UP PORTABLE RADIO ONLY $12.95

Sensational New 3-Way Portable Radio Kit, 4 tubes plus rectifier. Housed in an all aluminum, leatherette covered case made by Farnsworth, pop up lid with loop antenna built-in. Size 5 x 9 x 6". Build yourself a professional looking radio with this kit. Every piece furnished including tubes; 1R5, 1T4, 1S5, and 3V4, as well as easy to follow diagram and photo. Receives broadcast 540 to 1650 KC. This set will make a full two gang superhet, that looks like a $40.00 radio. We should ask $17.00 for this kit. However, line production makes this $12.95 price possible. Stock No. FP-4X, complete kit less batteries. Shipping weight 9 lbs. Net price $12.95. Kit of batteries, 67½ volt "B" and "A". $2.25 extra.

12 INCH "COAXIAL" P. M. SPEAKER $12.95

- **REGULAR $32.50 LIST**
- **RESPONSE 40-17000 C.P.S.**
- **MOLDED ONE PIECE CONE**
- **AVAILABLE IN 12 AND 15" SIZES**

Newly designed by one of America's finest speaker builders. Made for FM and AM high fidelity radio and record players. This speaker is incorporated in radios of the 500 dollar bracket. It has an especially designed 12" 6.8 oz. Alnico V Magnet PM for the low range Woofer and is coaxially built in 3" Alnico V tweeter for the extended high range. The high pass filter is concealed under the pot cover. Just hook to any 8 Ohm output transformer. Will work in place of any home radio speaker as most speakers have an 8 Ohm Voice Coil, only 2 wires to connect. Will handle 18 Watts peak. Wide range response 40 to 17,000 Cycles. This speaker should sell for $35.00. Why buy any ordinary speaker when we offer a 12" Coaxial PM for only $12.95. Shipping weight 8 lbs. Model CR-13X, $12.95. Two for..... **$24.95**

12" Coaxial Model CR-13X $12.95

15" Coaxial Model 5-15X $24.95

15 INCH "KING COAXIAL" SPEAKER $24.95

WORLD'S BEST 15" COAXIAL VALUE

The King Coax. A 21.5 oz. 15 inch Alnico V PM speaker with a built-in high frequency tweeter. Will respond to from 40 to 17,000 cycles. This is a ruggedly built speaker with a curvelenier one piece molded cone. Built-in high pass filter. Just hook to any 8 Ohm output. Built by the maker of our ever popular 12 inch coax model CR-13X. This speaker has a retail list of over $60.00. We offer you our 5-15X 15 inch coax for only $24.95. Shipping weight 16 lbs.

TELEVISION PARTS

Sarkes Tarzian 13 CHANNEL T.V. TUNER ONLY $9.95

Sarkes-Tarzian, 13 channel tuner for Television receiver. This 3 tube front end is all wired, including tube sockets. The same TV front end as used by several nationally known manufacturers. Built in antenna trimmer. Offered with printed schematic diagram. Priced complete with 3 tubes; 6C4 osc., 6AG5 mixer and 6BH6 RF amplifier. This unit is worth twice our price. All wired, output is to be fed into your video channel. It can be mounted and used with the Farnsworth GVZ-60 chassis, advertised below. Weight 2 lbs. Stock No. SK-T3. Net price, Sarkes-Tarzian, 13 channel tuner with 3 tubes **$9.95**

G.I. T.V. FRONT END SCOOP $1.95

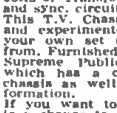
G I 13 Channel T.V. front end. Requires tubes 6C4 and 2—6AG5. These tuners are in damaged condition, but are ideal for the experimenter and for building TV boosters. Also for schools as class room aids for training. Stock No. MA-13XT weight 4 lbs. net $1.95; Kit of 3 tubes 99c extra.

T. V. SCOOP $5.95

Farnsworth Television Chassis Model GVZ60 partially built up Chassis Size 12x17. Has 16 Tube sockets and over 150 small parts (Resistor and Ceramic Condenseras) no coils or Transformers or tuning unit. Sweep and sync. circuits are all partially wired up. This T.V. Chassis is ideal for the student and experimenter. Learn T.V. by building your own set using this chassis to start from. Furnished with a 1948 regular $3.00 Supreme Publications Television Manual, which has a complete schematic of this chassis as well as 9 pages of service information.

If you want to play with Television here is a chance to get started. Farnsworth GVZ60 partially built up Chassis and 48 SuPreme T.V. Manual all for $5.95. Include postage for 11 lbs. GVZ60 Chassis only $2.95.

TELEVISION POWER TRANS.



$2.95

GVZ-60 Power Transformer, C-94230Z. A 135 ma. tapped 110 volt primary. Supplies plate voltage and filament for part of Farnsworth T. V. chassis. 475 volts D.C. 6.3 and 5 volt filament. Adjustable voltage. Size, 3¼ x 3¾ x 5½". high. Shipping weight, 7 lbs. Scoop price, GVZ-60 T. V. Power Transformer..... **$2.95**

JEFFERSON T.V. PWR. TRAN

T.V. Power Transformer, similar to R.C.A. 290 ma. 110 volts, 6C primaries. 600 volts D.C., filaments 5 volts at 3 amps., 5 volts at 3 amps and 6.3 volts at 8 amps. Trans. size 3¾ x 4½ x 5¼". Shipping weight, 12 lbs. Stock No. MR-4F. Net price.. **$6.95**

Television Vertical Deflection Output Transformer. Shipping weight 2 lbs. Stock No. VD-5000. Net price..... **$1.95**

Television Focus Coil. Top quality for 10 or 12" tubes. Similar to R.C.A. No. 202D1. Net price..... **$2.49**

Horizontal Oscillator Transformer. Stock No. H-MA. Net price..... **99c**

RCA Type 211T3 Horizontal Deflection Output and High Voltage Transformer. Sale price regular $5.70. Net $4.50.

RCA 203D3 Permanent Magnet Ion Trap. Sale Price 99c.

RCA 201D1-201D3 Deflection Yoke. Sale Price regular $4.50. Net $2.49.

10BP4 Picture Tube. Manufacturer says these tubes are guaranteed perfect except not quite up to their rigid specifications. Net $19.95.

Genuine Dumont 12QP4 Picture Tube. All in original factory cartons. Sale Price $27.95.

TELEVISION COURSE $3.00

Sam's Television Course book, 216 pages. T.V. explained to you in everyday langua·e. We think it's the finest value today. Net..... **$3.00**

Ward TVH-9 Television antenna. Stacked high and low band folded dipoles, with reflectors and mast. Regular $15.00 net. McGee's sale price..... **$6.49**

Olympic FM-AM Chassis and 12" Speaker $47.95

Olympic Model 9-925 10 Tube FM-AM Chassis. Latest 1949 Model with 10 tubes, push pull 6K6 audio base boat tone control, 12 Inch Dynamic Speaker, finest heavy construction superhet with A.V.C. and preselection on both FM and AM. Receives 550 to 1700 KC and FM 88 to 108 M.C. This set was designed for fringe area FM reception. Chassis size 12¼" long, 6¼" high, 12" front to back. Priced complete with tubes, 3, 6BA6, 6BE6, 6AL5, and 2, 6SQ7, 2-6K6, 5Y3, and 12 Inch speaker. This Chassis is the same as used in Olympic's highest prices phono combinations, and worth twice our prices. Shipping weight 30 lbs. Olympic Model 9-925 custom chassis ready to play, net **$47.95**

12 WATT KIT TM-12 $10.95

20 WATT KIT TM-20 $15.95

Kit Model TM-12. 12 Watt Amplifier kit, ideal for a high quality record player as a P.A. System or recording amplifier. Matched component parts ready punched chassis. One control fades from phono to mike. Input compensation for G.E. variable Reluctance pick up. Output matches 8 ohm Voice Coil. 100 Mill Power Transformer. Complete with tubes, diagram and photos 2-6SJ6, 2-12AX7 and rectifier. Variable tone control. Model TM-12. Weight 10 lbs. Net $10.95. Crystal utility mike and desk stand $4.95 extra. Model TM-12WT amplifier is TM-12 kit wired ready to operate net $14.95.

Kit Model TM-20. A high quality 20 Watt Audio Amplifier with 135 Mill Power Transformer and push pull 6L6's. Inputs for mike or phono pickup. Compensation for G.E. Variable Reluctance pick up. Tone and fader controls. Has heavy duty universal output transformer to match one or two speakers. Ready punched chassis. Price includes tubes, diagram and photos. 2-6L6 2-7N7 7Z4 Frequency response 50 to 12000 Cps. Kit Model TM-20, Weight 20 lbs. Net is $15.95 Model TM-20WT amplifier is TM-20 kit wired ready to operate net $20.95.

HIGH FIDELITY OUTPUT TRANSFORMER $6.95

We furnish you with a diagram to Build a Hi-Fi 6L6 Amplifier

6600 OHMS PLATE TO PLATE

Why pay $20.00 or $30.00 for an output? Supreme quality and high fidelity output transformer. Designed to match push-pull plates (2—6L6, 2—6V6, or 2—6AQ5) class AB, to 4-8-15-250 and 500 ohms; with 10Ω feedback winding. Housed in a compound filled case; 3⅞x4¼x3". Actual net weight, 6 lbs. If you want the best quality from your audio system, order this transformer. Response essentially flat from 20 to 20,000 cycles. We have tried several high fidelity outputs in our lab and find this to be the best value. Even though your amplifier only puts out 10 or 15 watts, this 34 watt job is what you should have. Connecting instructions are furnished. Stock No. A-403, shipping weight 8 lbs. Net price..... **$6.95**

REGULAR $35.00 LIST

"JUKE BOX" 15 INCH $9.95

P.M. SPEAKER SALE PRICE

HAS NEW MOLDED CONE

A carload purchase, from a number one builder of fine PM speakers, enables us to offer this regular $35.00 list 15" speaker for only $9.95. New one piece molded cone, with 8 ohm voice coil. 12 oz. Alnico V magnet, will take 18 watts average audio and 25 watts peak. If you want a speaker to woof out the low notes, buy this model. This is without a doubt the most speaker for the money that is available today. Include postage for 11 lbs. Stock No. 15-KR. Net price $9.95.

KINGJUKE 50-WATT 15-INCH P.M. SPEAKER SCOOP PRICE $16.95

Model 15-LS—The KING of all juke box speakers. Frequency response as low as 30 cycles. Will take 50 watts peak audio and 35 watts average, with ease. The most efficiently designed built today. 5 watts input to this speaker will give twice the air movement of an ordinary speaker. Has 1½" 8 ohm voice coil and molded one piece curved cone. Designed to retail for $50.00. Include postage for 18 lbs. Stock No. 15-LS. Net Price $16.95. 2 for $32.95.

CAPEHART TWO POST RECORD CHANGER $6.95

Require Adjustment

Capehart Changer Scoop. Used on famous, high priced combinations. These changers have been removed from sets; to be replaced with twin speed changers. Require Minor Adjustments. These have Capehart true-timbre variable resistance cartridges. Requires same gain as the G.E. VR cartridge. Connecting instructions furnished. Base size 14¼x14¼". Weight 23 lbs. Stock No. NK-3. $6.95 ea.

Extra tone arm, with MJP-1 Crystal cartridge and permanent needle. $1.00, extra. Extra tone arm, with G.E. RPX-010 variable reluctance cartridge. $2.95, extra.

MINIATURE BROADCAST STATION KIT $6.95

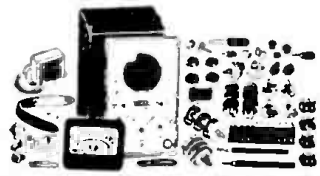
Kit Model DE-6X. Build your own miniature 110 Volt AC-DC 4 Tube Broadcast Radio Station (800 to 1500 K.C.). Broadcast from Crystal Mike or phono record. (Warning: this transmitter must be used with only a short aerial, otherwise you will broadcast two or three miles). Complete kit with tubes, diagram and operating instructions. Weight 4 lbs. Model DE-6X. Net ..... **$6.95.**

Model DE-6XWT Miniature Radio Transmitter wired ready to operate. Net.. **$8.95.**

Crystal Mike & Desk Stand $4.95 extra.

ONLY ONE NIAGARA FOR GREAT RADIO VALUES

Model 221K VTVM KIT



Complete—Nothing Else To Buy
A Must For TV Servicing

- AC&DC ranges 0-5, 10-10,000 volts
- Ohms .2 to 100 megohms in 5 ranges: R x 1, R x 100, R x 1000, R x 10,000, R x 1 megohm
- DB from minus 20 to plus 16
- DC input resistance 25 megohms, constant on all ranges
- AC input impedance over 1½ megohms on all ranges
- Large 4½" linear movement within 2% accuracy with minimum friction.
- Size 9⅝" x 6" x 5", wgt. 10 lbs.

EICO model 221K VTVM kit
Cat. # N-259
Your cost $23.95

EICO model 221 VTVM, wired and tested
Cat. # N-260
Your cost $49.95

$1,000,000 STOCK BRAND NEW TUBES

FAMOUS BRANDS . ALL BRANDED AND BOXED

REDUCED MORE THAN 50%

TRANSMITTING		RECEIVING	
E1148	$.34	1H5GT	$.55
2C26	.28	3A4	.27
5BP1	1.70	3B7	.29
10Y	.28	3D6	.29
211	.28	6C4	.28
803	3.63	6AR5	.54
805	3.63	6D6	.55
813	6.90	6K7GT	.54
815	1.37	6SH7	.27
843	.38	6SS7	.53
954	.18	7C4	.28
955	.18	12A6	.28
957	.18	12H6	.29
958A	.18	12K7GT	.53
1619	.18	12SH7	.29
1625	.18	12SR7	.29
1626	.18	28D7	.29
7193	.47	35L6GT	.53
9004	.18	50B5	.55
9006	.18	50L6GT	.54

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NIAGARA'S GOLD-PLATED SPECIAL!

An ultra-high freq. Gold Plated Cavity Resonator with a range of 231—258 Mcs.! Fully wired, including two 955 acorn tubes. Designed by the navy for use as a portable modulated test oscillator, CAN BE USED AS A MODULATED SIGNAL GENERATOR. Battery compartment is large enough to house speech equipment and power supply, making it a desirable portable UHF Transmitter for Ham use. Complete with tuning wrench, tubes, whip antenna, and circuit diagram on inside cover. Black wrinkle finished cadmium measures 3½ x 6½ x 6¾". *The Buy of a Lifetime!*

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SPECIAL $3.95

T-17 MIKE

Lowest Price Ever! Slightly used, guaranteed perfect and clean. Single button carbon handmike. Light, efficient. 200 ohms. Press-to-talk switch, 5-ft. rubber cord with PL-68 plug attached.

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SPECIAL ..... 69¢

WAVE TRAPS

Traps consist of two slug-tuned sectionalized coils and two ceramic condensers. All mounted on a cadmium plated bracket, conveniently drilled and ready for mounting. May be used to eliminate FM sound bars in TV sets, eliminate amateur interference (shock excitation) in TV Receivers. Match 111-Lo TV antennas, and dozens of other uses too numerous to mention. They're going fast, so order yours today!

Cat. No. N-128.
SPECIAL ..... 39¢ each
3 for $1.00

Famous UTAH 15 and 25 Watt Potentiometers

Body: 2 11/16" dia., 27/32" depth behind panel. Bushing: 7/16" dia., 3/8" long. Shaft: 1/4" dia., 7/16" long from bushing. Effective rotation 300 degrees. Mounts in 7/16" hole. 15 W. "PW" type wirewound on bakelite strip. 25 W. "SW" type wirewound on asbestos-covered steel strip, for greater heat dissipation. PW type has 3 terminals, no off position. SW type has 2 terminals with off position.

15W Stock No.	Resistance In Ohms	25W Stock No.	Resistance in Ohms
PW-100	100	SW-1	1
PW-150	150	SW-2	2
PW-200	200	SW-3	3
PW-250	250	SW-6	6
PW-300	300	SW-10	10
PW-400	400	SW-15	15
PW-500	500	SW-20	20
PW-800	800	SW-30	30
PW-1M	1000	SW-40	40
PW-2M	2000	SW-50	50
PW-3M	3000	SW-60	60
PW-5M	5000	SW-75	75
PW-7500	7500	SW-100	100
PW-10M	10,000	SW-150	150
PW-20M	20,000	SW-200	200
PW-50M	50,000	SW-250	250
		SW-300	300
		SW-400	400
		SW-500	500

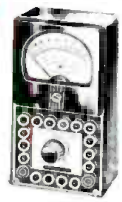
Stock No. PW-15 watt. ALL SIZES . . . List $150. SPECIAL 39c

Stock No SW-25 watt. ALL SIZES . . . List $1.75. SPECIAL 49c

REINER New Super TYPE "Z" HIGH VOLTAGE MULTIPLIER LEADS

Reiner H.V.M. Leads utilize the lowest range on your meter scale. Absolutely safe for 1½ volt measurements. Available for all VTVM & Multipliers. Measures high voltage in TV, FM, X Ray, etc. Specify make and model VTVM when ordering. Cat. No. N-261.
YOUR COST $12.95

POCKET MULTI-TESTER Radio City Model 449A

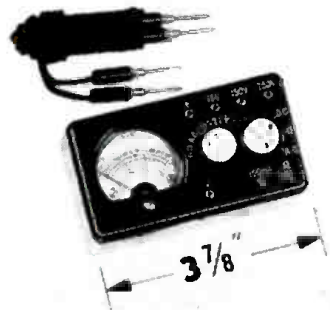


Remarkably accurate, versatile multi-tester using a 3" sq., 5,000 ohms per volt meter with a basic 200 microampere movement. Batteries mounted in special spring clips.

Ranges

AC-DC Volts 0-5-50-250-1000 volts.
DC MA 5-10-100-1000 MA.
Ohms 0-2000-20,000-0-2-2 megohms.
DB -6 to +52 DB in four ranges.
Output meter: 0-5-50-250-1000.
Pocket multitester supplied in black metal case complete with batteries.
Size 5⅞ x 3½ x 2¼", wgt. 1¾ lbs.
Cat. N-262.
Your cost $24.50

TINIEST V. O. M. IN THE WORLD!



NIAGARA *exclusively* presents the "Universal Baby Tester," measuring 3⅜" x 2¼" x 1⅝". Contains a sensitive 0-240 microammeter with the following ranges.

- 0-15 V AC or DC
- 0-150V AC or DC
- 0-750V AC or DC
- 0-150V DC MA.
- 0-100,000 ohms

Ohms adjust and DC-AC ohms switch. Includes 1 pair test leads. Will fit into your watch pocket. Fully guaranteed.

Cat. N-258.
Special $8.95

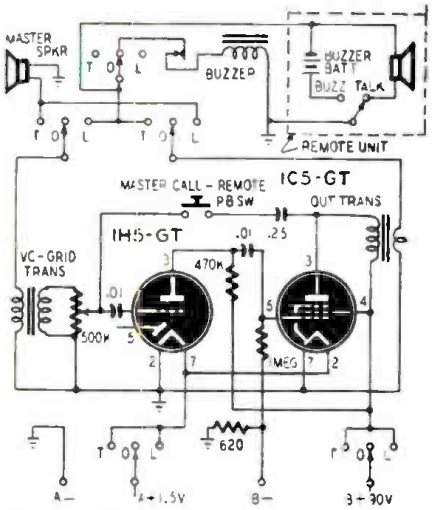
Niagara Radio Supply Corp.

Phone Digby 9-1132-3-4

Dept. C119 — 160 Greenwich Street, New York 6, N. Y.

BATTERY INTERCOM

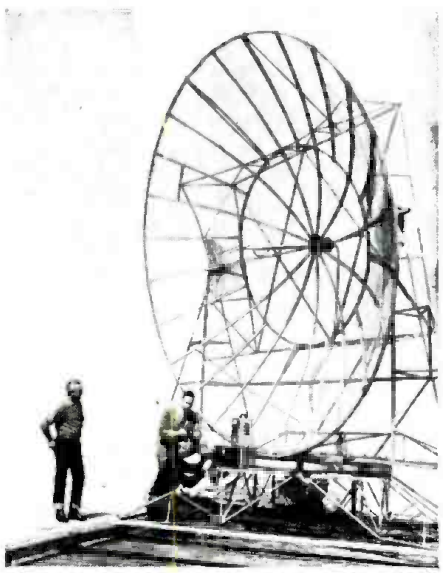
Operated from a battery power supply, this intercom provides for one master and a single remote station. The remote may call the master by sounding a buzzer even when the power is off. The master calls the remote by connecting the input of the amplifier to the output and creating a feedback whistle with the switch set at TALK.



T-TALK – O-OFF – L-LISTEN – ALL GANGED

The circuit is given in the diagram. The TALK-LISTEN switch is a five-circuit three-position rotary. The center OFF position disconnects the batteries to save power. Note that if the remote buzzes the master when the three-position switch is not at OFF, the battery current will go through either the input or output transformer. It may burn up the transformer and will certainly discharge the buzzer battery. Between calls, therefore, the switch should always be set at OFF.—*F. D. Crisp*

BIGGEST REFLECTOR

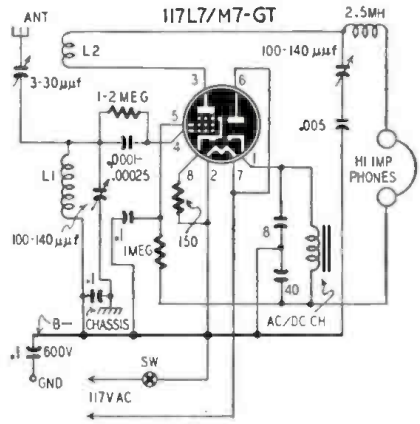


Used for reception of television signals from field pickup units, this parabolic receiving-antenna reflector is the largest in the U.S. It operates on a 100-foot track atop Mt. Lee in Hollywood, Calif. Constructed for the Don Lee Broadcasting System, the reflector stands 16 feet high. It can be pointed at any location in the surrounding area to pick up r.f.

ALL-WAVE 1-TUBER

? *Please print a circuit of an all-wave one-tube receiver using a 117L7/M7-GT. I want to wind my own coils, so please supply coil data.—A.C.B., Charlotte, N.C.*

A. This circuit will give good results when used with an efficient antenna. The coils are to be wound on 1½-inch plug-in forms.



Band (Meters)	Turns (L1)	Wire size	Turns (L2)	Wire size	Spacing (L1)
200-500	126	28	28	34	close wound
135-270	82	28	16	30	1⅞ inches
66-150	38	26	11	30	1⅝ inches
33-75	18	24	6	30	1½ inches
17-41	9	16	5	30	1¼ inches
9-20	3½	14	3	30	1 inch

L2 should be wound at the lower end of L1. The spacing between windings should be adjusted for smooth regeneration control. The average spacing will be about ¼ inch. The chassis connects to one side of the a.c. line, so place the set in an insulated cabinet and use insulated knobs on the tuning and regeneration control capacitors. Dead spots are eliminated with the antenna trimmer.

ANTENNA MATCHING

? *I have an antenna array consisting of a folded dipole mounted one-half wave above a simple dipole. How do I match this combination to a 300-ohm transmission line? Please show how these can be connected and give me the data on which your design is based.—H.L.M.F., US Navy*

A. The antennas can be connected by transforming the impedance of each to 600 ohms and paralleling them across the 300-ohm transmission line.

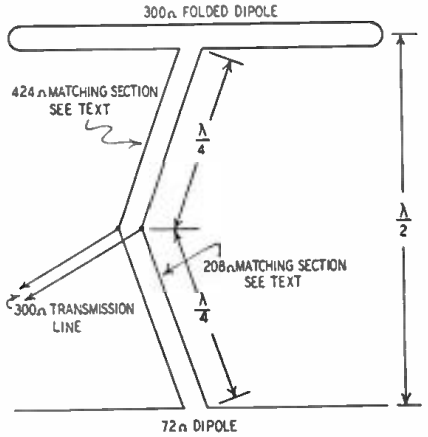
Quarter-wave transmission lines are the impedance-transforming devices. The impedance (Z_1) of the matching section is

$$Z_1 = \sqrt{Z_2 Z_3},$$

where Z_2 is the impedance of the transmission line and Z_3 is the impedance of the antenna.

When the matching section is constructed from two air-insulated parallel conductors, its characteristic impedance Z_1 is equal to 276 log b/a, where b is the center-to-center distance between conductors and a is the radius of the conductor. Note that a and b must be in the same unit of measurement.

If both matching sections are made of ¼-inch tubing, the center-to-center spacing should be 1 inch and 4⅜ inches for the 208- and 424-ohm sections, respectively.



The electrical length of the quarter-wave section can be calculated from

$$L = \frac{2952 \times K}{f},$$

where L is length in inches, f is frequency in megacycles, and K is the velocity constant (0.95 for open-wire lines).

TROUBLES IN BC-223-AX

? *I have a BC-223-AX transmitter that has been converted for a.c. operation. There is an indication of r.f. in the antenna even when the key is up when operating c.w. What causes this, and how can it be cured?—C.P.B., Gray, Maine.*

A. I do not know how much the original circuit was altered during conversion; therefore, it is somewhat difficult to put a finger on the trouble. It does seem that the final amplifier is not neutralized. The neutralizing capacitors are in the tuning units, so you will have to neutralize each unit. Neutralizing procedure is as follows:

1. Tune the transmitter to 3,000, 4,500, and 5,200 kc when neutralizing tuning units TU-17, TU-18, and TU-25, respectively.
2. Turn the transmitter on.
3. Adjust the antenna-circuit tuning controls for maximum r.f. current into a dummy antenna consisting of a 100-μμf, 5,000-volt capacitor between the ground and antenna terminals of the BC-223-AX.
4. Hold the meter switch in the OSC position and close the key.
5. Adjust the neutralizing capacitor (marked PA NEUT COND) for minimum antenna current. A sensitive neon lamp or a low-current flashlight lamp in series with the 100-μμf capacitor may prove a little more sensitive than the antenna-current meter in indicating complete neutralization.
6. Rotate FREQUENCY CONTROL throughout its range to make sure that the amplifier is fully neutralized on all frequencies.
7. Follow the above precedure on all tuning units.

RADIOMEN'S HEADQUARTERS ✈ WORLD WIDE MAIL ORDER SERVICE !!

$12.95 FOR BIG BARGAIN "V". (All 3 items listed below)

1. SENSATIONAL, FASCINATING, MYSTERIOUS SELSYNS. Brand new Selsyns made by G. E. Company. Two or more connected together work perfectly on 110V AC. Any rotation of the shaft of one Selsyn and all others connected to it will rotate exactly as many degrees in the same direction, following unerringly as if the units were connected together by shafting instead of wire. This is true whether you twist the shaft of the master unit a fraction or a revolution or many revolutions. Useful for indicating direction of weather vanes, rotating directional antennas, or controlling innumerable operations from a distance. Complete with diagram and instructions. Per Matched pair $4.95.

2. ALUMINUM GEAR BOX 1xxxx7 that contains two powerful electric motors and two matched gear trains. 62 gears in all varying in size from ½ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar use $5.00

3. HOME WORKSHOP AT BARGAIN PRICE. Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 36" of belting for connecting to any available electric motor or power take-off. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel and a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

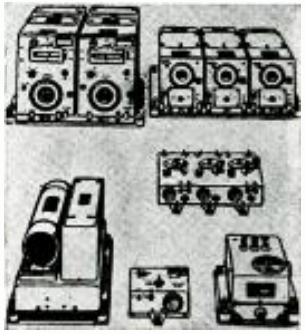
SENSATIONAL VALUE IN AC-DC POCKET TESTER

This analyzer, featuring a sensitive repulsion type meter housed in a bakelite case, represents the culmination of 15 years achievement in the instrument field by a large company specializing in electronic test equipment.

Specifications of the AC-DC Model Volt-Ohm-Milliammeter:
AC Volts—0-25, 50, 125, 250
DC Volts—0-25, 50, 125, 250
Milliamperes AC—0 to 50
DC Milliamperes—0 to 50
Ohms Full Scale—100,000
Ohms Center Scale—2400
Capacity—.05 to 15 Mfd.

Total Price, prepaid anywhere in the USA—$7.00. Similar DC Meter, lacking the AC operated ranges of above, $5.50 prepaid.

SCR 274N Command Set (Made by Western Electric) THE GREATEST RADIO EQUIPMENT VALUE IN HISTORY

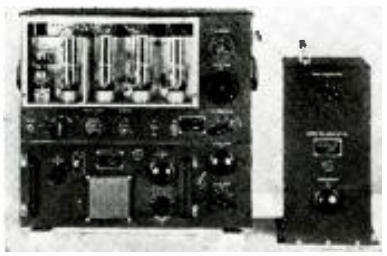


A mountain of valuable equipment that includes 3 separate Communications Receivers, covering up to 9.1 MC, 2 separate 40 watt Transmitters including crystals, 4—28v Dynamotors (easily converted to 110v AC operation), Pre-Amplifier and Modulator, 2 Tuning Control Boxes, and 1 Antenna Coupling Box complete with R.F. Ammeter, 29 tubes supplied in all. Receivers and Transmitters instantly detached from mounting racks for use in separate locations. Removed from unused aircraft and in guaranteed electrical condition. A super value at $59.95 complete.

Bayonet type radio pilot light sockets for model railroad enthusiasts, etc. $5.00 a hundred. Mazda licensed bulbs, per 10, 50c.

GENERAL ELECTRIC 150 WATT TRANSMITTER COST THE GOVERNMENT $1800.00 • COST TO YOU—BRAND NEW—EXPORT PACKED $100.00

This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-in tuning units which are included. Each tuning unit has its own oscillator and power amplifier, coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: FREQUENCY RANGE: 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter band with slight modification for which diagrams are furnished. OSCILLATOR: self-excited, thermo-compensated, and band calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with dynamotor which furnishes 1000V at 350 MA. from either 12 or 24 volts. Complete instructions are furnished to operate set from 110V AC. SIZE: 21"x23x34" H". Total shipping wgt. 300 lbs., complete with all tubes including a full set of spares besides those necessary for operation, dynamotor power supply, seven tuning units, antenna tuning unit and the essential plugs.



FCC AUTHORIZES RADIO FOR PRIVATE SERVICE!!!!

(The FCC announced that effective June 1, any American over 18 years of age is eligible for a 5 year station permit. In the "Citizens" band, neither code test nor technical knowledge is necessary.)

GENERAL ELECTRIC 15 TUBE TRANSMITTER-RECEIVER SET. This brand new 15 tube transmitter-receiver was designed for mobile storage battery powered service. It will operate in the "Citizens" band where no amateur license to transmit is necessary. It's a cinch for any experimenter to connect this unit for 110 V AC operation by following the instructions and diagrams supplied, which cover numerous applications, including television. For those intending to use on car or boat, a new dynamotor, exactly as originally supplied, costs only $15.00. Don't fail to write for FREE descriptive bulletin. Order our RT-1248 for only $29.95, or two for $53.90.

HEAT GUN

Streamlined pistol grip heat gun. Vivid red housing. 20 cubic feet per minute blast of hot air at 160° Fahrenheit. Ordinary blowers have small fan motors, but this has a lifetime-lubricated AC-DC motor of the rugged vacuum cleaner type, that produces a hurricane of either hot or cold air. Blow out dirt or dust from radio chassis. Dry out ignition systems. Heat carburetors. Quick-dry paint. Thaw out radiators or water pipes, etc. Warning:—Keep this away from your wife. She will use it to dry her hair because it will do it in half the time of her ordinary hair dryer, to say nothing of her using it to dry stockings or clothing, or defrost the refrigerator instantly. Only $12.95. Satisfaction guaranteed or money refunded if returned prepaid within 5 days.

Our PE-109 Power Plant Direct Current

A gasoline engine coupled to a 2000 watt 32 volt DC generator. Can be adjusted to give 12 to 40 V. output. Ideal for use in locations not serviced by commercial power or to run any of the surplus items that require 24-32v DC for operation. The price of this power plant tested and in good condition is only $79.95. We can also supply a converter that will supply 110v AC from the above unit or from any 32v DC source for $12.95. We also have a limited supply of brand new PE-109a in original factory packing for $125.00 each, F.O.B. Buffalo.

SUPER SPECIAL

New 1950 Model 500 Signal Generator Kit. Modulation On-Off switch, internal modulation and external modulation jack provided. Internal 400 cycle sawtooth audio available for external testing and fidelity checks on receivers. Precision coils for greater accuracy and maximum stability on all 5 bands. Dial calibrations from 150 K.C. to 104 M.C. This signal generator is 115 V.A.C. 60 cycle operated and comes with everything, including complete detailed instructions. Assembly is an easy job, even for the least experienced. The lowest price and the best signal generator on the market for only $18.75. Also available factory-assembled for $26.75.

LINE FILTERS

Each unit contains two 4 mfd oil filled condensers and a high inductance 50 amp choke in fully shielded case. Suitable heavy current connectors are provided to attach to the input and output connectors at each end of the filter from your input and output wires. A filter with innumerable uses on oil burners, refrigerators, boats, automobiles and wherever noise is to be suppressed or interference abolished. A $17.00 value for $3.98.

MICROPHONES

Super Special-Highest quality all chrome bullet shaped CRYSTAL MIKE of top flight nationally known brand—$5.95. Bullet DYNAMIC MIKE—$7.95. MIKE Jr—60c. PUSH-TO-TALK MIKE with switch on handle—98c. LAPEL MIKES—(Specify whether carbon or magnetic 93c.

T-32 Microphone with desk or table stand $2.95

AUDIO AMPLIFIER—Brand new dual stage triode amplifier having 2 of the valuable and scarce ouncer type audio transformers that sell for over $10.00 a piece. Neat aluminum case, fully enclosed (largest dimension 6 inches). Perfect for intercom system, phono amplifier, mike amplifier or signal tracer amplifier for testing radio sets. A sensational bargain at only ..... $3.40 each

SIGNAL GENERATOR

Genuine Laboratory-type precision signal generator. Manufactured and sold for $68.00 each in large quantities during the war by Northeastern Engineering Corp., one of the top manufacturers of electronic equipment for the U.S. Govt. Five fundamental bands starting at 150 KC. Strong harmonics up to 120 MC. Five step ladder type attenuator as well as potentiometer output control. Regular 1000 cycle audio oscillator using vacuum tube, not a cheap neon sawtooth audio oscillator. Audio output separately available externally. Weight without packing material 16 lbs. which should show what a world of difference exists between this signal generator and the ordinary cheap oscillator used by the average serviceman. Complete with fused plug and coaxial output lead. Super Special $38.75.

POWER RHEOSTAT

Exceptionally Rugged, Trouble-free design. Withstands severe overloading to many times the nominal 25 watt rating without burning or smoking. Perfect for motor speed control or line voltage adjustment. 3 sizes available: 50, 60 and 200 ohms. Regular price $5.20. Special—$1.00.

RT1655

Only $14.95

11 tube-crystal controlled super-heterodyne receiver that covers the FM band. The ultra modern circuit uses the latest type of tubes including 7 miniature 6AJ5's. Beautiful chassis and aluminum cabinet. Tubes and diagram included.

1950 MODEL MUTUAL CONDUCTANCE TUBE TESTER $56.95

Attractive panel and case ... Large 3½" meter ... Calibrated mercurio scale as well as Bad Good scale ... Front panel fuse ... Individual sockets for all tube base types. Proper filament voltage supplied to test any tube ever made. Unequalled switching flexibility allows all present and future tubes to be tested regardless of location of elements on tube base. Indicates gas content. Detects shorts or opens on any element of any tube. Tests cold cathode, magic eye and voltage regulator tubes as well as all ballast, amplifier and rectifier types.

Model "C"—Sloping front counter case $56.95
Model "P"—Handsome hand-rubbed portable case 59.95

Built-in roll chart with either of above $5.00 extra.

VACUUM TUBE VOLT-OHM-CAPACITY METER

There are more features engineered into this all-purpose instrument than in any other instrument on the market, regardless of price.

Here are a few of the many features of this outstanding meter:

- 5 inch easy to read meter.
- 6 DC voltage ranges from 0 to 1000 V (Input resistance as high as 1 megohm pr volt.)
- 5 AC voltage ranges from 0 to 1000 V (No dry disc rectifier to age and destroy the accuracy of this VACUUM TUBE BOLT METER).
- 6 Resistance ranges from 2 10 ohm to 1000 megohms.
- 4 Capacity ranges from .000025 to 20 MFD.
- A zero center range for balancing FM discriminators.
- Isolating resistor built into probe.
- Sturdy natural finish hard wood case.

This outstanding development of one of the leading manufacturers of test equipment costs only $39.50 complete with all leads, as illustrated.

20,000 ohm per volt SUPERTESTER. Similar in appearance and made by same manufacturer as Vacuum Tube V-O Capacity Meter pictured above. Specifications as follows:

DC volts at 20,000 ohms per volt:
0-3v, 15v, 60v, 300v, 1500v, 6000v
AC volts at 10,000 ohms per volt:
0-6v, 30v, 120v, 600v, 3000v, 6000v
Current: 0-60 Microamps, 0-6MA, 60 MA, 600MA, 6 Amperes
Resistance: 0-3000, 300,000, 3 Megs, 300 Megs
Decibels: Minus 4 to plus 77 DB divided into 6 ranges

All special 1% accurate multipliers used. No external source of power required for AC measurements although there is no frequency error in the range from 30 cycles to 1 megacycle.

This SUPERTESTER has valuable features found in no other tester on the market, such as WIDEST resistance range coverage, HIGHEST AC voltage sensitivity, WIDEST power level (DB) coverage, and the lowest Price—only $29.95. We urge comparison with this instrument before buying any other tester.

"DRILLMASTER" ELECTRIC DRILL

Low-priced electric drill. Ideal for hobbyists. Complete with sander, buffers, grinding wheels, etc. This is bankrupt stock and only a few are available.

A sensational bargain at $9.95. Satisfaction guaranteed or money refunded if returned prepaid within 5 days.

ALL PURPOSE NEON TESTER. 60 to 550 Volt. Indicate all kinds of current, AC, DC or RF, and comes complete with instruction booklet outlining various tests on radio sets, including the location of fading, dead stages, shorts, and making screen-grid and plate circuit tests. 35c ea. Per doz. on attractive display card—$3.50.

Universal 4 lead broadcast band oscillator coil (can be converted to 3 lead type by addition of jumper). Ten for $1.00

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept... RT9 BUFFALO 3, N. Y.

HUM DETECTOR

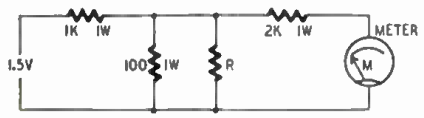
It is often important to know whether or not a potentiometer on an amplifier chassis is free of magnetic fields. To determine this, wind a small choke of about 100 turns on a core made of a thin iron nail. Connect the two leads from the choke to the amplifier input, or connect one to the grid of the first a.f. amplifier tube and the other to ground (in a receiver). Hold the choke on the spot being tested. If any hum is present, it will be heard in the loud speaker.

This method can also be applied to oscilloscope construction when it is necessary to locate and eliminate electro-magnetic fields which may distort the pattern on the cathode-ray tube.

A. A. BOSCHAART,
Amsterdam, Holland

RELAY CHECKER

In electronic circuits where relay contacts carry currents in the order of a few microamperes, it is essential that the contact resistance be less than 0.1 ohm. Ohmmeters and resistance bridges being unsatisfactory measuring devices for production work, this system was devised.



The meter M is a laboratory-type galvanometer having a deflection of .004 μa per millimeter, and R is the contact resistance. Deflections of 10 to 12 millimeters are obtained with good contacts. Heavy low-resistance conductors should be used between the contacts and the test circuit. The loop resistance effect can be observed by shorting the conductors and taking a reading.

WILLARD MOODY,
Washington, D. C.

SAFE HOME-MADE TV SETS

It is a good idea to use separate a.c.-line cords on the high- and low-voltage power supplies in home-made TV receivers, oscilloscopes, and other similar equipment. This makes it possible to remove all unnecessary voltage from the equipment when it is being serviced or adjusted.

CHARLES ERWIN COHN,
Chicago, Ill.

AID FOR ORGANIZERS

One of the important stumbling blocks in the path of new association organizers is the formation of a set of rules, bylaws, and procedures. Howard W. Sams & Co., Inc., publisher of the Photofact Service, has reprinted the *Manual of Procedure*, the application blank, and the technical examination set up by the Radio Electronic Technicians Association of Ontario, Canada, an outstandingly well organized group.

The reprints are offered without charge to any service organization for use as a guide.

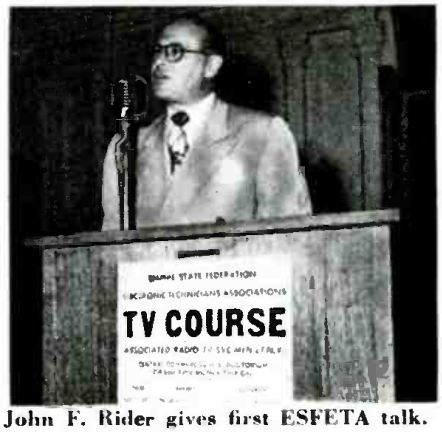
ESFETA LECTURES

The Empire State Federation of Electronic Technicians opened its 1949-1950 lecture season September 7. The initial lecture was given in New York City by John F. Rider, who spoke on "The Nature of TV." The lecture included such points as general transmission and reception problems, modulated waveforms and high-frequency propagation and reception.

The opening meeting was attended by several hundred radio-television technicians, including a number from points outside New York City. These were largely from the Long Island Television and Radio Technicians Guild and the Independent Radio-Television Technicians of Westchester County.

The meeting is the first of 16 lecture-sessions, each of which will be held in four areas in New York State—New York City, Poughkeepsie, Binghamton-Endicott, and Rochester. The complete program will extend to May, ending with a final examination-meeting.

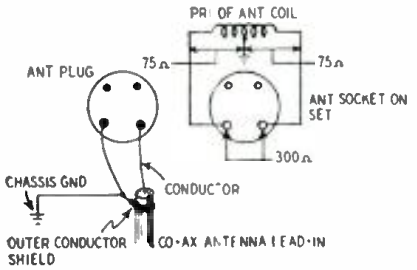
Association Officials at September 7th meeting. Left to right: Joseph D. McNamara and John A. Wheaton, Long Island Television and Radio Technicians Guild; Arthur Silverberg, ARSNY; John Rider; Sam Marshall and Max Leibowitz, ARSNY; Karl Nelson, Karl Richter, and C. E. Cypher, Independent Radio-Television Technicians of Westchester; Noel Payne, ARSNY; Pat Avery and Paul Prochnau of the Westchester technicians association. Attendance figures ran high.



John F. Rider gives first ESFETA talk.

PHILCO 48-700, 48-1000 AND OTHERS

These and several other Philco TV sets have a center-tapped primary on the antenna transformer. The input impedance is 300 ohms across the ends of the primary and 75 ohms between the grounded center tap and either outside terminal. Co-axial lead-ins are connected between one terminal and ground. Signal strength and picture



quality will be improved if the unused part of the coil is shorted out by grounding the remaining terminal. This connection can be made on the antenna plug by connecting the co-ax across the 300-ohm terminals and grounding the outer conductor to the chassis as shown in the drawings.

CLARENCE J. JONES,
Cleveland 9, Ohio

BIRDIES IN A.C.-D.C. SETS

Squeals and birdies may be eliminated from compact a.c.-d.c. sets by replacing the i.f. tube. The old tube may test perfect and can be used in another set.

ALAN MCFARLANE,
Aberdeen, S. Dak.

BRUSH B.K.-401 SOUNDMIRROR

Intermittent noise on playback and recording has, on several occasions, been traced to a bad plate resistor (220,000 ohms) in the first 6SJ7 amplifier. A ½-watt resistor was used in the original circuit. Replace it with a 1-watt unit.

ALBERT HOWE,
Vancouver, B.C.

TELEVISION INTERFERENCE

Look around for old-fashioned clear tungsten lamps when unable to identify or localize the source of television interference. One such lamp caused two entirely different interference patterns on two receivers in one installation. The offending lamp was removed to the service shop where it produced a third interference pattern on a set there.

R. L. CONHAIM,
Dayton, Ohio

STABILIZING THE MODEL 900 VOMAX

Early models are unstable on the 3-, 12-, and 30-volt a.c. ranges. This instability can be cured by inserting a 1-ohm resistor in series with one of the 6.3-volt heater leads. This reduces the voltage and increases the life of the tubes.

WILBUR HANTZ,
Columbus, Ohio

(The McMurdo Silver Co. has installed a 0.9-ohm, 1½-watt resistor in the filament lead of the latest models of the Vomax.—*Editor*)

ELECTRONIC LITERATURE

Any or all of these catalogs, bulletins, and periodicals are available to you if you write to us on your letterhead (do not use postcards) and request them by number. It is necessary to send only the number of item you want. We will forward the request to the manufacturers, who in turn will send the literature directly to you. This offer void after six months.

NV-1—VIBRATOR GUIDE

The Mallory Vibrator Guide is a 40-page book listing receivers using vibrators, with the correct type of vibrator for each. Notes are included on installation, building a vibrator tester, and servicing auto radios.—15¢

B10/120

NV-2—ROTATOR FOLDER

This 4-page folder—published by the E. F. Johnson Co. describes their *Rotomatic* beam rotator and amateur antenna.—*Gratis*

NV-3—PARTS CATALOG

This is a 128-page catalog of standard radio parts of many manufacturers sold by Bill Sutton's Wholesale Electronics in Fort Worth, Tex., at standard "net" prices.—*Gratis*

NV-4—SPEECH CLIPPER BULLETIN

The Electro-Voice Bulletin No. 145 describes the advantages in limiting audio modulation peaks in amateur and emergency communication services. It describes the uses of the Model 1,000 Speech Clipper.—*Gratis*

NV-5—RESEARCH WORKER

Aerovox Corporation has resumed publication of *The Aerovox Research Worker*, a monthly technical publication dealing with various aspects of radio and electronics.—*Available to manufacturers upon request. Gratis to interested parties with indorsement of a radio parts dealer.*

NV-6—FOR TV TECHNICIANS

The Care of Television Customers, a handbook on courtesy and proper handling of television customers, has been prepared by the RCA Service Company for use by TV technicians.

NV-7—CLAROSTAT CATALOG

Catalog No. 49 has 15 pages describing and illustrating the various types of fixed, adjustable, variable, and flexible resistors made by Clarostat Manufacturing Company, Inc. Also included is a description of the Clarostat beam bender designed for use with 10-inch C-R tubes.—*Gratis*

NV-8—WORKSHOP TV ANTENNAS

An eight-page illustrated catalog describes the TV antennas and accessories made by The Workshop Associates, Inc. A short section on television receiving problems illustrates some of the antennas that may be required for good reception in certain localities. Graphs illustrate the radiation pattern and standing-wave characteristics of the antenna systems.—*Gratis*

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Electrical 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 in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In the November 1915 issue of ELECTRICAL EXPERIMENTER

Increasing Wireless Range by Kites
Wireless Telephony Now From Washington to Honolulu
Construction of an Inductive Tuner by Milton B. Sleeper
The Amateur Radio Station Which Aided Uncle Sam
A Machine That Captures and Holds Wireless Talk
The Smallest Loose Coupler
How Wireless Waves Travel Around the Earth's Curvature
How to Build a Wave Meter by Samuel Cohen
Loading Coil Mounted on Slider
A Home-Made Tuning Coil by Samuel F. Dunn
An Efficient Detector by William Guier

Dr. Oliver D. Sledge has been appointed to the staff of the NATIONAL BUREAU OF STANDARDS, where he will do research in the Microwave Standards Section of the Bureau's Central Radio Propagation Laboratories.

Formerly a professor of electrical engineering at the Georgia School of Technology, Dr. Sledge will engage in research on microwave attenuation standards for frequencies above 300 mc and on radio measurement methods.

He has done extensive work in electronic and radio engineering, including electronic digital computer circuits and radar equipment. Before he joined the Bureau, Dr. Sledge was Associate Professor of Electrical Engineering at the Georgia Institute of Technology, where he also conducted radar research.

Octave Blake, president of CORNELL-DUBILIER ELECTRIC CORP., South Plainfield, N. J., was elected chairman of the board of RADIART CORP. of Cleveland, Ohio, a wholly owned subsidiary of Cornell-Dubilier. **L. K. Wildberg**, formerly vice president and general manager, has been advanced to the post of Radiart president.

The parent company bought all the stock of Radiart from Maguire Industries in 1948, and continued its operation as a manufacturer of television and automobile antennas and automobile radio vibrators, with Mr. Wildberg as vice president.

John V. L. Hogan, president of Station WQXR, New York, has withdrawn from the management of the Interstate Broadcasting Company, operator of the station. He will concentrate his efforts on facsimile and other fields.

William Warren Davis has been appointed to the Electronics Division of the NATIONAL BUREAU OF STANDARDS, where he will do research on the high-speed electrostatic memory of the electronic digital computing machines. His work will include tube characteristics and general applications.

Before he came to the Bureau, he was engaged in research on components for electric fuzes and has designed and developed equipment for vacuum-tube measments. Davis was on the staff of the Naval Ordnance Laboratory at White Oak, Md., from 1947 to 1949. He was an electronics engineer with the Naval Research Laboratory from 1942 to 1947.

George R. Sommers, formerly director of Pacific Coast sales for SYLVANIA ELECTRIC PRODUCTS, INC., has been appointed assistant to C. W. Shaw, general sales manager of the radio tube division, according to an announcement by R. H. Bishop, vice-president in charge of sales.

George K. Konz has been appointed assistant manager of advertising and sales promotion of NATIONAL UNION CORP., Orange, N. J., according to an announcement by Emil J. Maginot, sales manager of the company.

Konz, formerly with National Union's advertising department, has since served as assistant director of public relations for the American Insurance Co. of Newark.

Lloyd M. Hershey has been appointed director of research for GENERAL INSTRUMENT CORP., Elizabeth, N. J. it was announced today by Richard E. Laux, president.

Hershey previously was assistant to the chief engineer at the Hallicrafters Co. in Chicago, and prior to that was in charge of development research operations for the Hazeltine Corp.

C. G. Roberts has been appointed product manager for broadcast and television equipment for GENERAL ELECTRIC'S transmitter division, Syracuse, N. Y.

Edward Maged has been appointed sales manager of RACON ELECTRIC CO., INC., New York City, where he will coordinate sales advertising and sales promotion, according to the announcement by Mr. A. I. Abrahams, president. Maged was formerly sales manager of the distributor division of University Loudspeakers, Inc.

Frank A. Hinners has joined the staff of JEWEL RADIO and TELEVISION CORP., Long Island City, N. Y., it was announced by Don J. Ferraro, president of the company.

Walter L. Stickel has been appointed national sales manager for the receiver sales division of ALLEN B. DU MONT LABORATORIES, INC. He was formerly manager in charge of the RCA-Victor Division of the Leo Mayberg Company, located in Los Angeles.

William R. Kennaugh, who has been associated with the radio and television production field for more than 19 years, has been appointed chief process engineer at JOHN MECK INDUSTRIES, INC., Plymouth, Indiana, manufacturers of television and radio receivers.

DON'T STOP TV DOPE!

Dear Editor:

William Krider (July issue, page 97) had better find himself a hole and crawl into it, because he's going to get jumped on!

He says there is no possibility of TV in his town for at least ten years as he is over 90 miles from any city of 50,000. My Rand-McNally map shows that he is less than 90 miles from Tulsa, Okla. And if he can't get the station Tulsa will have pretty soon, he really does need TV articles.

We are over 90 miles from one station and more than 130 miles from another. We get them every night, and television is pretty popular in our town. I have repaired several TV receivers, installed antennas, and checked sets.

CHARLES F. JOHNSON

Denison, Tex.

LIKES READING ABOUT TV

Dear Editor:

I disagree with William Krider. I don't think you publish enough about television!

On a set which I installed myself after reading TV articles I get good reception from all Detroit stations, 53 miles away. Even if certain articles don't help me personally, I get a kick out of them, as do at least 100 out of the 1,200 in my high school—many of whom borrow my copy of R-E just to read about TV. Anyone who tells you there is too much about TV in the magazine when it is the coming thing must want to live in the old era of silent movies.

LARRY SHAW

Port Huron, Mich.

SOME DO ADVERTISE

Dear Editor:

I would like to express my views on your article, "Manufacturers Versus Service Technicians."

I notice that Stevens, Jensen, Brooks, Meissner, Browning, and others of the same caliber do advertise directly to those who know. As regards schematic diagrams, I must give Philco due credit for getting out diagrams for their new models. Yes, I have seen some of those before the radios. I also appreciate their stand for the technician in regard to TV.

C. E. RICE

Newport, Vt.

LOOKS AHEAD TO TV

Dear Editor:

The last two issues of your magazine were especially good. I particularly like the way articles are headed under different classifications such as FM, TV, Test Equipment, etc. Let us have more articles on transmission lines, wire recorders, and FM.

Television has not yet come to this city, but I am trying to keep up with it through your magazine. I hope you will keep up the good work.

RICHARD COOVERT

Portland, Oregon

RADIO WILL CLEAN HOUSE

Dear Editor:

I thoroughly agree with your editorial in your June issue. I believe, with you, that TV will compel radio to clean house. No other means or arguments have been able to achieve that.

It will be another crowning achievement of television if, by its competition, radio is impelled to give us more of the high-class, worth-while music, and less of the drip and gutter stuff which has befouled our loudspeakers for the past 15 years.

Of course, the soap operas for Maggie and Maisie and housewives generally must endure as long as such can endure to listen. There TV cannot compete—at least if we want to have housework carried on with any appreciable degree of efficiency!

LEE DE FOREST

Chicago, Ill.

VALIANT DEFENDER

Dear Editor:

You have published many good letters and articles defending the radio technician's reputation for integrity, but I think the best was "Why Pick on Radio Technicians?" which appeared in the August issue.

Why indeed? Just call in a plumber, carpenter, or electrician to have a repair job done, and see what the charge is. And some of these repairs aren't exactly perfect either.

It doesn't seem probable that licensing is the answer. The "better mousetrap" theory ought to work so that the technician who does good work will be patronized and the ones who don't or who charge too much will go out of business.

GRANT R. BERKEBILE

Johnstown, Pa.

(But does it?—and do they?—*Editor*)

PHILCO HELPS TECHNICIANS

Dear Editor:

I just finished reading "Manufacturers Versus Service Technicians" in your August issue, and I want to thank you for going to bat for the men who make their livings in service work.

My own experience is that I never fail to speak well of and have confidence in the products of the company that treats me as a businessman rather than a necessary evil.

Radio manufacturers could benefit by the example of Philco Corp., which supplies full technical data to all members of its service organization—of which I am extremely proud to be a member.

During my wartime service in the RCAF I serviced sets for people where I was stationed. Running into a problem with a Philco set, I wrote to Philco Corp. of Canada. By return mail I received a circuit diagram plus complete alignment and service instructions. I have been a Philco booster ever since that experience.

CHARLES E. BEAN

Toronto, Ontario

OPPORTUNITY AD-LETS

Advertisements in this section cost 25c a word for each insertion. Name, address and initials must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than ten words accepted. Ten percent discount six issues, twenty percent for twelve issues. Objectionable or misleading advertisements not accepted. Advertisements for December, 1949, issue, must reach us not later than October 24, 1949.
Radio-Electronics, 25 W. Broadway, New York 7, N.Y.

AMATEUR RADIO LICENSES. COMPLETE THEORY preparation for passing amateur radio examination. Home study and resident courses. American Radio Institute, 101 West 63rd St., New York City. See our ad in Page 94.

MAGAZINES (BACK DATES)—FOREIGN, DOMESTIC. Arts, Books, booklets, subscriptions, pin-ups, etc. Catalog, 10c (refunded). Cicerone's, 863 First Ave., New York 17, N. Y.

RECORD CHANGER PARTS for leading makes. We ship everywhere. Friends Wholesale Distributors, 106 North Sixth Street, Philadelphia 6, Pa.

HERMAN LEWIS GORDON, REGISTERED PATENT Attorney. Patent Investigations and Opinions. Warner Building, Washington, D. C.

WE REPAIR ALL TYPES OF ELECTRICAL INSTRUments, tube checkers and analyzers. Hazleton Instrument Co. (Electric Meter Laboratory), 140 Liberty Street, New York, N. Y. Telephone—BArclay 7-4239.

BARGAINS: NEW AND RECONDITIONED HALLIcrafters, National, Collins, Hammarlund, Meissner, RME, other receivers, tuners, television receivers, transmitters, etc. Wholesale prices. Terms. Shipped on trial. Liberal trade-in allowance. Write, Henry Radio, Butler, Missouri and 11240 West Olympic, Los Angeles, California.

BARGAIN HUNTING? RADIO SERVICEMEN WRITE. Sensational catalog. Henshaw Radio Supply, 3619 Troost, Kansas City 3, Missouri.

RADIO PARTS FOR SALE. Details. Knight, Radio, 9418 Ave. A., Brooklyn 12, N. Y.

LANCASTER, ALLWINE & ROMMEL, 436 BOWEN Building, Washington, D. C. Registered Patent Attorneys. Practice before United States Patent Office. Validity and infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request.

15 TESTED ONE-TUBE CIRCUITS, including "Radiobuilder," Catalog—25c. Laboratories, 578-B, San Carlos, California.

SURPLUS TUBES: 80% off List F.O.B. Pittsburgh, Pa. Obtained from army signal corps in original cartons, all guaranteed perfect. Following types available: 6F6, 6J5, 6K6GT, 77, 78, 6AC7, 6AG5, 6H17, 6L6, 3S1, 1N5, 1J6G, CIS721A, CTI954, 1299. Minimum quantity $5.00 net. Send all orders to Monarch Electric Company, 411 Wood Street, Pittsburgh 22, Pa.

Aluminum tubing, etc. Beams for Amateurs, TV, FM. Lists free. Willard Radcliff, Fostoria, Ohio.

27 years experience radio repairing. Simplified system. No calculations. No formulas. Total price $2.00 postpaid or COD. Moneyback guarantee. Ross Radio, 14615 Grandriver, Detroit 27, Mich.

"TAB" Sensational 6V CARTER Dynamotors 400V/150ma, $8.98, 250V/100ma $4.98, BOTH $12.49. Guaranteed Tube Bargains! 6J6, 6AK5, 6AG5, ea. 37c—6C4, 21c—388A, 40c—954, 14c—955, 16c. 1N34 Crystal, 84c. GE-2J161 SEL-SYNS Used Tested PAIR $1.49. Tuning Meter 5ma, 93c. 30Cm/12"UHF Mobile HAMBAND Antenna AT5/ARR1 39c, 4/$1. Hi-Gain Dynamic Mike Transformer PLUS Excellent Fidelity Dynamic Mike, BOTH $1.49. Write for Bargain "TABOGRAM" "TAB," Dept. 11RE, 6 Church St., NYC.

Wire Recorder, table top, Silvertone, with radio & record player. $100.00. Unger, Box 188, Salamanca, N. Y.

Build your own Geiger Counter. Save money! Write for free parts list and diagram. Woodwid Industries, 5217-G Hollywood Blvd., Hollywood 27, Calif.

RADIO-ELECTRONICS will print—without charge—small classified advertisements for radiomen who live in exchange-restricted countries and who wish to swap something available in their countries for American radio parts or books.

American radio men may then correspond with the advertisers direct. RADIO-ELECTRONICS cannot, of course, act as intermediary in or be responsible for any deals that may be made. Ads must be under 40 words in length. State your needs exactly and give full name and address.

Note that most countries (including the U.S.A.) have import and export regulations and duties. Both correspondents should check with their customs authorities before arranging that any goods be shipped to them.

RADIO DATA BOOK. New, 8 x 12 inches, with more than 300 diagrams of European receivers. Will exchange for Essentials of Radio, or American Radio Data book. Jaro Kober, Jilšin 56, Czechoslovakia.

WANT: Genuine E. H. Scott spares, G.E. pickup with arm. Will swap custom-built audios to your specs, ffrr recordings, etc. Austen Graham, 33 Warriston Crescent, Edinburgh 4, Scotland.

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY
(Pages 94-95)

American Radio Inst.
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YMCA Trade & Technical Schools

RADIO AND TELEVISION MATHEMATICS. by Bernhard Fischer. Published by the Macmillan Co., New York. 5½ x 8¼ inches, 484 pages. Price $6.

This book is not a text but a tool—and one of the most useful this reviewer has ever seen. The woods are full of volumes explaining mathematics; there are even plenty which carry right through with radio-electronic examples for each explanation. But there are very few, if any, to which the designer may turn in his moment of need and be reasonably certain that full instructions for whatever calculation he needs to make will be spread before him like a blueprint. This is such a book.

The first 348 pages are taken up with actual problems, about three to the page, such as, "What is the secondary voltage of a transformer which has a primary voltage of 100, primary turns 200, and secondary turns 40?" Then the formula is given and the answer worked out in the necessary number of stages—so that all the reader need do is substitute the values of his own problem for those of the illustrative one and follow the author's footsteps. The problem quoted is one of the simplest; the remainder run the gamut from the lowest level to the highest and cover almost every common case the radioman is likely to run into.

Only a few mathematical points are actually explained. A chapter each is given to powers of 10, the principle of the slide rule, the j-operator, and polar vectors. Each of these is short and informative. There are 27 pages of numbered formulas (which are referred to in the problems) and 18 pages of tables. Both index and contents table are unusually complete, the latter listing each problem to save time in using the book.

The cut-and-try experimenter will probably find little use for this book, but it is recommended to the more serious radioman and the engineer as a candidate for the place of honor beside its natural partner the slide rule. —*R.H.D.*

ELEMENTS OF SOUND RECORDING. by John G. Frayne and Halley Wolfe. Published by John Wiley & Sons, Inc., New York. 6 x 9¼ inches. 686 pages. Price $8.50.

This book is remarkable for—among other things—its exhaustive treatment of film recording. Of the 32 chapters, 14 are devoted to the techniques of sound-on-film.

Disc recording is analyzed in detail, and several chapters are devoted to the techniques and equipment which are associated with recording—the nature of sound, amplifiers, filters, tubes, speakers, acoustics, and so on. The method of analysis is not entirely mathematical so that the book may be read for general information. Vast quantities of formulas, graphs, and quantitative data are given, however, making this a thoroughly informative text and handbook. A single chapter on magnetic recording is included, but the treatment is rather superficial in comparison to the attention accorded the other systems mentioned.—*R.H.D.*

WELLS RADIO-ELECTRONIC Components by the Thousands!

TOGGLE AND PUSH SWITCHES

FIG. A FIG. B FIG. C FIG. D FIG. E FIG. F FIG. G FIG. H FIG. K FIG. L FIG. M FIG. N

STOCK NUMBER	FIG.	CONTACT	CONTACT ARRANGEMENT	MANUFACTURER & NUMBER	TYPE LEVER	MOUNTING DATA	UNIT PRICE
370-1	A	5a - 125v.	SPST MOMENTARY	CH AH-3022-MR	RAT ⅝	1-13/16 MTG/E.	$0.25
370-4	A	5a - 125v	SPDT CENTER OFF	CH B-9A	RAT ⅝	1-13/16 MTG'C.	.30
370-14	A	5a - 125v	SPDT CEN. OFF 1 SIDE MOM.	CH B-7A	RAT ⅝	1-13/16 MTG'C.	.30
370-25	A	5a - 125v	SPST MOMENTARY	CH R-9A	RAT ⅝	1-13/16 MTG'C.	.25
1T-104	A	5a - 125v	SPDT CENTER OFF	CH AH-3022-1A	RAT ⅝	1-13/16 MTG'C.	.38
1T-102	A	5a - 125v	SPDT MOMENTARY	CH B215A2	RAT ⅝	1-13/16 MTG'C.	.30
1T-103	A	5a - 125v	SPST	CH B-8-A	RAT ⅝	1-13/16 MTG'C.	.35
1T-104	A	20a - 24v	SPDT 1 SIDE MOMENTARY	CH B6065A568	RAT ⅝	1-13/16 MTG'C.	.35
1T-109	A	5a - 125v	SPST MOMENTARY	CH R-19	RAT w/ARM	1-13/16 MTG'C.	.35
360-65	C	20a - 125v	DPST	CH AH-3023-2	RAT	1-13/16 MTG'C.	.45
309-163	C	20a - 125v	DPDT CEN. OFF MOMENTARY	CH C-11	RAT ⅝	1-13/16 MTG'C.	.55
309-162	C	30a - 125v	DPST	CH C-1	RAT ⅝	1-13/16 MTG'C.	.45
309-164	C	20a - 125v	DPST MOMENTARY	CH 8711K3	RAT	1-13/16 MTG'C.	.40
370-31	C	20a - 125v	DPDT	CH C-12	RAT ⅝	1-13/16 MTG'C.	.85
308-87	D	5a - 125v	1 SIDE DPST MOM 1 SIDE SPST	AH&H	BAIL	8-32 BUSHING	.95
308-111	E	5a - 125v	SPST MOMENTARY	CH 8817K2	BAT	7/16-32 BUSHING	.28
308-153	F	3a - 125v	SPDT CENTER OFF	CH AH-3021-1A	RAT ⅝	7/16-32 BUSHING	.35
1T-100	F	3a - 250v	SPST	CH	BAT	7/16-32 BUSHING	.22
1T-101	F	6a - 125v	SPST MOMENTARY	AH&H w/LEADS	BAIL	7/16-32 BUSHING	.20
301-51	G	5a - 125v	4PDT MOMENTARY	CH B6069A14	RAT ⅝	1-13/16 MTG/C.	.75
1T-108	G	20a - 125V	SPDT	CH 8714A5	BAT	18 x 8 MTG/C.	.90
308-140	H	3a - 125v	DT MO MAKE EACH SIDE	OPEN FRAME	BAIL	3/8-30 BUSHING	.25
309-161	K	50a - 125v	SPST	CH H7813K3	RAT ⅝	1-13/16 MTG'C.	1.95
301-12	L	20a - 125v	DPST	AH&H	BAKELITE	2-3/8 MTG/C.	1.25
308-76	L	30a - 250v	DPST	AH&H (OPEN FRAME BAKELITE		3-1/4 MTG'C.	.75
301-12	M	5a - 125v	DPST	AH&H SPECIAL FOR HANDY TALKIE		7/16-32 BUSHING	.40
1T-107	A	30 - 250V	DPST	AH&H	SHORT BAT	7/16-32 BUSHING	.25

⅝ INDICATES A LUMINISCENT TIP

FIG. A FIG. B FIG. C FIG. D FIG. E FIG. F FIG. G FIG. H FIG. K FIG. L FIG. M FIG. N

STOCK NUMBER	FIG.	CONTACTS	MOUNTING DATA	BUSHING LENGTH	KNOB	ADDITIONAL INFORMATION	UNIT PRICE
301-39	A	N.O.	3/8-32 THD.	3/16	BLACK BAKELITE	USED ON HCH-300	$0.18
303-68	A	SPDT	3/8-32 THD.	3/8	BLACK BAKELITE		.25
303-75	A	3 MAKE	3/8-32 THD.	3/8	RED OR GREEN PLASTIC		.36
303-77	R	N.O.	3/8-32 THD.	3/8	BLACK BAKELITE		.25
308-183.	R	DPDT	3/8-32 THD.	3/8	BLACK BAKELITE		.37
303-70	C	DPST N.C.	7/16-32 THD.	1/2	METAL w/ PLASTIC TIP		.25
370-13	C	N.O.	7/16-32 THD.	7/16	METAL w/ PLASTIC TIP		.25
1P-101	C	N.O.	7/16-32 THD.	1/2	METAL	GENERAL ELECTRIC	.25
1P-102	G	DPST N.C.	7/16-32 THD.	1/2	METAL	CUTLER HAMMER	.25
1P-103	C	N.O.	7/16-32 THD.	1/2	METAL	CUTLER HAMMER	.30
308-155	D	N.O.	END OF CORD		BLACK BAKELITE	MARKED 6A-20'U	.60
370-35	E	N.O.	4-7/16 MTG/C.		METAL CAP	SIGNAL CORPS SW-140	.35
309-166	G	2 MAKE	3/8 MTG'C.		BLACK BAKELITE	SW-109 FOR T-17 MIKE	.35
370-9	F	N.O.				CH 6B0118K50	.80
311-77	O	2 N.O.	END OF CORD		BLACK BAKELITE	SIGNAL CORPS SW-141-C	.30
370-26	H	N.O.	1-1 8 MTG/E.		BLACK BAKELITE		.25
309-99	K	N.O.	5/8" PRESS FIT		BLACK BAKELITE		.25
370-21	K	N.O.	3/4" PRESS FIT		WHITE PLASTIC	8 SCREW TERMINALS	.35
301-40	L	N.C.	7/16-32 THD.	7/16	BLACK BAKELITE		.36
303-69	I	N.C.	7/16-32 THD.	1/2	BLACK BAKELITE		.25
301-86	M	N.O.	5/8-28 THD.	1/4	BLACK BAKELITE		.18
370-37	M	N.O.	5/8-28 THD.	1/4	WHITE BAKELITE		.25
303-35	M	N.O.	5/8-28 THD.	1/4	BLACK BAKELITE		.18
370-39	N	SPST N.O.	B/M PRESS FIT		CHROME		.30
309-139	-	3 N.O. & 3 N.C.	15/32-32 THD.	1/2	BLACK BAKELITE	ASSEMBLY OF 2 SWITCHETTES	.60
370-3	-	N.O.	1" CABLE CLAMP		GREEN ENAMELED	WITH 3 CONDUCTOR CABLE	.85
370-40	-	N.O.	1-13/16 MTG C.		METAL	SIMILAR TO MICRO SWITCH	.80

Micro Switches

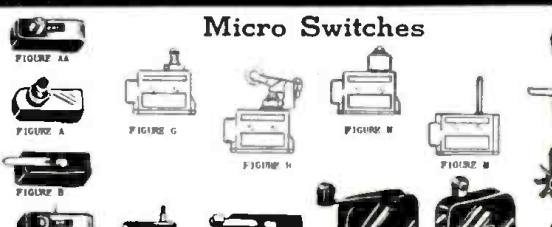


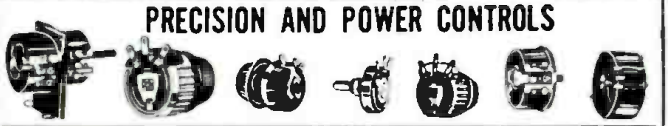
FIGURE AA FIGURE A FIGURE B FIGURE C FIGURE G FIGURE D FIGURE H FIGURE E FIGURE M FIGURE F FIGURE N FIGURE H FIGURE K FIGURE L FIGURE P FIGURE Q

STOCK NUMBER	MANUFACTURER	MFR. TYPE NO.	CONTACTS	ILLUSTRATION	TERMINALS	OUTER CASE	PRICE EACH
305-10	Micro-switch	BZ-RW5	N.C.	FIG. AA	SCREW	Bakelite	$0.40
307-219	"	1T-3A	N.O.	FIG. AF	"	"	.50
306-75	"	1Z-R01 "	N.O.	FIG. A	SOLDER	"	.92
303-62	"	1Z7R6	N.O.	FIG. A	SCREW	"	.71
1-1001	"	R-81	SPDT	FIG. B	SOLDER	"	.88
301-18	Micro-switch	MCR-321	SPDT	FIG. B	"	"	.85
301-63	Micro-switch	1Z-211T61	SPDT	FIG. B	"	"	1.00
301-30	MC-S-itch	R02W	SPDT	FIG. B	"	"	.98
301-76	"	Green Dot	DPST	FIG. B	"	"	.75
303-79	Micro-switch	BZ-RL3T	SPDT	FIG. B	"	"	.75
305-154	Acro	XD1-51	SPDT	FIG. B	"	"	.79
311-115	Micro-switch	1ZR31	N.C.	FIG. C	SCREW	"	.71
305-161	"	1Z3R3	N.O.	FIG. C	SOLDER	"	.71
311-127	"	1Z-7R	N.C.	FIG. C	"	"	.86
370-24	"	1Z-R31	N.O.	FIG. C	SCREW	"	.60
370-6	"	XT57	N.C.	FIG. F	SOLDER	"	.45
360-1	"	1Z7R7C	N.C.	FIG. C	"	"	.85
311-116	"	SM-1R6	N.C.	FIG. D	"	"	.80
303-45	"	1Z21ST	SPST	FIG. D	SCREW	"	.68
309-60	"	MR538	SPDT	FIG. D	"	"	.98
370-17	MC-Switch	QR5	DPST	FIG. D	SOLDER	"	.75
305-64	Micro-switch	1ZR12	N.C.	FIG. E	"	"	.85
305-52	"	R-R13	N.C.	FIG. E	"	"	.85
311-25	MicroSwitch	61N24139	N.C.	FIG. F	"	"	.65
370-10	Acro	BO2W12T	N.O.	FIG. E	SCREW	"	.70
303-32	Micro-switch	1Z-3R-2T	N.O.	FIG. F	"	"	.85
306-10	"	RZE-2BOVTW1	SPDT	FIG. G	"	Metal	2.40
309-101	"	RZ-2W221	SPDT	FIG. H	SOLDER	Bakelite	.60
1306-1010	Acro	R-T-R5A6	N.O.	FIG. K	SCREW	"	.88
370-14	"	HR0T1P2T5F1	N.O.	FIG. K	"	"	.80
370-19	Micro-switch	1ZR41	N.O.	FIG. K	"	"	.65
370-60	Cutler Hammer		N.O.	FIG. K	"	"	.65
303-31	Micro-switch	BZ-2RVTC	SPDT	FIG. I	SOLDER	"	.92
370-4	"	BX-11-R03	SPDT	FIG. M	Screw	Metal	1.80
309-157	MC-S-itch	"	N.C.	FIG. N	"	"	1.10
371-15	"	AM9203	SPST	FIG. N	"	"	1.25
370-7	Micro-switch	BZE-2RQT4	N.C.	FIG. M	"	"	1.05
303-11	Acro	2MR31A	N.O.	FIG. P	SOLDER	Bakelite	.37
305-71	"	2MD41A	SPDT	FIG. P	"	"	.37
309-50	Micro-switch	Open Type	SPST	FIG. Q	"	"	.38
370-29	"	1ZE-RQ22	N.O.	FIG. R	SCREW	Metal	2.25

SWITCHETTE

STOCK NO.	MANUFACTURER'S TYPE NUMBER	CONTACTS	TERMINAL LOCATION	UNIT PRICE
303-20	CR1070C 103-A3	N.C.	SIDE	$0.47
301-29	CR1070C 103-B3	N.O.	END	.47
303-34	CR1070C 103-C3	1-N.O. 1-N.C.	END	.47
303-18	CR1070C 103-F3	1-N.O. 1-N.C.	END	.47
303-19	CR1070C 103-E3	N.O.	SIDE	.47
303-47	CR1070C 123-B1	N.O.	END	.47
303-23	CR1070C 123-C3	1-N.O. 1-N.C.	END	.47
305-83	CR1070C 123-J2	SPDT	END	.47
303-82	CR1070C 123-T4	SPDT	END	.47
303-17	CR1070C 128-W4	SPDT	SIDE	.47
303-16	CR1070C 128-C3	1-N.O. 1-N.C.	END	.47

PRECISION AND POWER CONTROLS



STOCK NO.	RES. OHMS	WATTS	BODY DIA.	SHAFT LGTH.	MFR.	GENERAL DESCRIPTION	PRICE
331-151	200	6	3"	4"	De Jur.	Meter type, pivot shaft	$1.25
400-1	10M-dual	6	3"	1½"	De Jur.	Meter type, with mtg. bkt.	3.00
303-90	20M	6	3"	¾"	De Jur.	Meter Type.	1.25
331-143	5	25	1-9/16"	SD. Slot.	Ohmite.	Type H, lock type bushing.	0.94
RH-25	4	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	0.94
331-150	8	25	1-9/16"	¼"	Ohmite	Type H.	0.94
331-149	10	25	1-9/16"	¼"	Ohmite.	Type H.	0.94
331-134	50	25	1-9/16"	SD Slot.	Ohmite.	Type H, lock type bushing.	0.94
RH-39	40	25	1-9/16"	SD. Slot.	Ohmite.	Type H, lock type bushing.	0.94
349-8	75	25	1-9/16"	7/16"	Ohmite.	Type H.	0.94
331-142	100	25	1½"	¼"	Ohmite.	Aircraft. AN 3155-25-100	0.96
331-153	100	25	1-9/16"	SD. Slot.	Mar-Min.	Type B25	0.96
353-112	125	25	1-9/16"	7/16"	Ohmite.	Type H.	0.96
353-111	131	25	1-9/16"	7/16"	Ohmite.	Type H.	0.96
331-144	300	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	0.96
353-74	140	25	1-7/8"	7/16"	Ohmite	Cockpit lamp type.	0.96
400-2	185	25	1-5/4"	7/16"	Grloco.	Cockpit lamp type.	0.94
331-137	150	25	1-5/8"	7/16"	Clarostat		0.96
313-42	175	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	0.96
305-146	175	25	1-9/16"	SD.Slot.	Mar. Min.	Type B25	0.96
331-164	175	25	1-9/16"	7/16"	Yard L.		0.96
RH-27	200	25	1-5/8"	7/16"	Ward L.		0.96
313-72	200	25	2-3/4"	7/16"	Ohmite.	Type D.	0.96
331-141	350	25	1-9/16"	5/16"	Mar-Min.	Type B25.	0.96
331-165	750	25	1-9/16"	7/16"	Ohmite.	Type H.	0.98
331-145	1M	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	1.10
RH-28	30M	25	3-3/8"	1/2"	Mutter	Type 433AC, Linear.	3.14
331-163	5	50	2-1/2"	7/16"	Ohmite.	Aircraft. AN-3155-50-5	1.08
315-42	30	50	2-1/2"	7/16"	Ohmite.	Type 03A. Aircraft Enclosed.	1.08
309-133	50	50	2-3/8"	7/16"	Ohmite.	Aircraft Power Type.	1.08
331-134	135	50	2-1/2"	S.D.Slot	Mar-Min.	Type B50 630 Amps.	1.10
313-73	150	50	2-1/2"	7/16"	Ohmite.	Aircraft Type AN-3155-50-150	1.10
353-110	150	50	2-1/2"	S.D.Slot.	Mar-Min.	Type B50 .513 Amps.	1.10
301-94	200	50	2-1/2"	7/16"	Ohmite.	Aircraft Typ AN-3155.50-200	1.10
313-71	300	50	2-1/2"	SD.Slot.	Mar-Min.	Type B50	1.10
309-131	500	50	2-1/2"	SD.Slot.	Mar-Min.	Type B50	1.12
331-133	1000	50	2-1/2"	SD.Slot.	Mar-Min.	Type B50	1.12
309-123	5	100	3"	1/2"	Mar-Min.	Type C100	1.68
309-120	5	100	3"	7/16"	Ohmite.	Type E-4.47 Amp.	1.68
353-113	100	100	3"	1/2"	Mar-Min.	Type C100, 1 Amp.	1.75
400-3	10	100	3"	1/2"	Mar-Min.	Type C100, 3.18 Amp.	1.68
321 153	1.5	150	4"	1/2"	Mar-Min.	Type D150, 10 Amp.	2.35
331-108	5	150	4"	7/16"	Ohmite.	Type L, 5.48 Amps.	2.35
331-155	750	150	4"	1/2"	Mar-Min.	Type D150, .447 Amp.	2.73
309-132	3250	150	4"	7/16"	Ohmite.	Type L, .25 Amp.	2.95

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3.75	150.	Lugs	Utah	59¢
4.	10.	Leads	-	17¢
5.	100.	Lugs	-	50¢
10.	25.	Lugs	Mallory	23¢
10.	20.	Lugs	-	19¢
15.	20.	Lugs	Mallory	19¢
35.	35.	Lugs	Ward-L.	23¢
30.	300.	Lugs	Ohmite	82¢
35.	50	Lugs	Ohmite	33¢
90.	10	Lugs	Ohmite	15¢
90.	20.	Lugs	Clarostat	19¢

OHMS RES.	WATTS	TYPE	MFR.	PRICE EACH
100.	20.	Lugs	Ward-L.	19¢
100.	10.	Leads	Ohmite	17¢
110.	45.	Lugs	Mallory	34¢
200.	10.	Lugs	Ohmite	17¢
225.	50.	Lugs	Mallory	35¢
280.	20.	Lugs	IRC.	20¢
750.	25.	Lugs	Utah	23¢
3500.	100.	Lugs	Lectrohm	83¢
2500.	25.	Lugs		24¢
5M.	300.	Lugs	Clarostat	92¢
7500	50.	Lugs		50¢
25M.	50.	Lugs		58¢
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1N23 Xtal Diode	.85	6SK7/GT	.65	205B	1.95
1N23A Xtal Diode	.85	6SL7/GT	.85	211 (VT-4-C)	.66
1N27 Xtal Diode	.85	6SN7/GT	.80	215A	9.95
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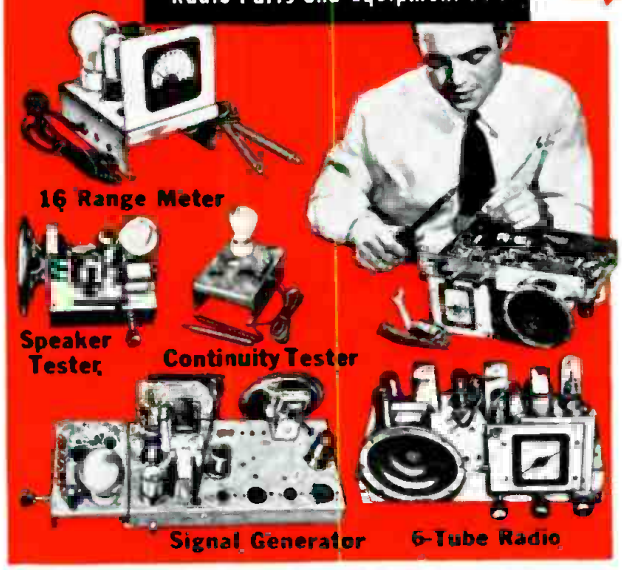

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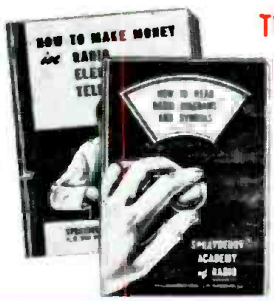

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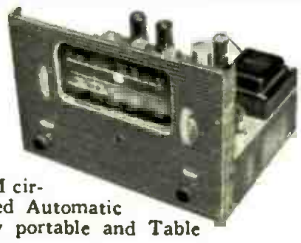

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