RADIO — ELECTRONICS

K

See Special
TELEVISION NEWS
Section

HUGO GERNSBACK, Editor

formerly RADIO CRAFT

MID-OCEAN RADIO STATION
SEE BROADCASTING & COMMUNICATIONS

1949 TV YEAR

DEC
1949

30¢

LATEST IN RADIO — ELECTRONICS — TELEVISION

RADIO — ELECTRONICS

formerly RADIO-CRAFT

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

Lee Robinson, General Manager
G. Aliquo, Circulation Manager
John J. Lamson, Sales Manager
Robert Fallath, Promotion Manager

Hugo Gernsback, Editor-in-Chief
Fred Shunaman, Managing Editor
M. Harvey Gernsback, Consulting Editor
Robert F. Scott, W2PWG, Technical Editor
R. H. Dorf, W2QMI, Associate Editor
I. Queen, W2OUX, Editorial Associate
Angie Pascole, Production Manager
Wm. Lyon McLaughlin, Technical Illustration Director

Contents — **December, 1949**

ON THE COVER: Part of the superstructure of the Coast Guard's Ocean Station Vessel *Spencer*, showing the many radio and radar antennas. Kodachrome by Avery Slack.

RADIO-ELECTRONICS, December, 1949, Volume XXI, No. 3. Published monthly. Publication Office: Erie Ave. F to G Streets, Philadelphia 32, Pa. Entered as second class matter September 27, 1948, at the post office at Philadelphia, Pa., under the Act of March 3, 1879. SUBSCRIPTION RATES: In U. S. and Canada, in U. S. possessions, Mexico, South and Central American countries, $3.50; $6.00 for two years; $8.00 for three years; single copies 30c. All other foreign countries $4.50 a year, $8.00 for two years, $11.00 for three years. Allow one month for change of address. When ordering a change please furnish an address stencil impression from a recent wrapper.
RADCRAFT PUBLICATIONS, INC. Hugo Gernsback, Pres.; M. Harvey Gernsback, Vice-Pres.; G. Aliquo, Sec'y.

EDITORIAL and ADVERTISING OFFICES, 25 West Broadway, New York 7, N. Y. Tel. REctor 2-9690. BRANCH ADVERTISING OFFICES: Chicago: 308 W. Washington Street. Telephone RAndolph 6-7363. Los Angeles: Ralph W. Harker, 1127 Wilshire Blvd., Tel. MA 6 1271. San Francisco: Ralph W. Harker, 582 Market St., Tel. GArfield 1-2481.
FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, Fleet St., London E.C.4. Australia: McGill's Agency, 179 Elizabeth Street, Melbourne. France: Brentano's, 37 Avenue de l'Opera, Paris 2e. Holland: Trilectron, Heemsteedsche, Dreef 124 Heemstede. Greece: International Book & News Agency, 17 Amerikis Street, Athens. So. Africa: Central News Agency, Ltd., Cor. Rissik & Commissioner Sts., Johannesburg; 112 Long Street, Capetown; 369 Smith Street, Durban, Natal. Universal Book Agency, 70 Harrison Street, Johannesburg. Middle East: Steimatzky Middle East Agency, Jaffa Road, Jerusalem. India: Susil Gupta (Distributors) Co., Armita Bazar Patrika Lt., 14 Ananda Chatterjee lane, Calcutta. Broadway News Centre, Post Bag #5557, Dadar, Bombay #14. K. L. Kannappa Mudaliar, 30 General Patters Road, Mount Road, Madras 2. Pakistan: Paradise Book Stall, Opp. Regal Cinema, Preedy St., Karachi 3.

Editorial and Executive Offices:
25 West Broadway, New York 7, N. Y.

ABC — MEMBER AUDIT BUREAU OF CIRCULATION

The Parts Distributors' Conference and Show will be held at the Hotel Stevens, Chicago, the week of May 22, 1950. Dedicated primarily to the interests of all electronic parts jobbers, it will, for the first time, be open to the industry without attendance restrictions, according to an announcement by the board of directors of the Show Corporation following action taken at their August meeting in Chicago.

Jerome J. Kahn of Chicago was elected president, succeeding another Chicagoan, William O. Schoning, who becomes secretary for the 1950 term. Walter W. Jablon of New York was elected vice president, and Les A. Thayer of Chicago was named treasurer.

The 1950 Show will be exclusively for exhibitors' distributor customers, and throughout the four-day session will feature a comprehensive educational program for jobbers. Preliminary plans include seminars and discussions on such subjects as ways and means of stimulating sales, market research, cost accounting, merchandising, and inventory control. Emphasis, the directors said, will be placed on helping manufacturers increase distributor business and, in turn, on helping distributors expand business with their customers.

Radio Corp. of America, Camden, N. J., has prepared a "Radio-Repair and Tune-Up" merchandising campaign for the RCA Tube Department.

With an estimated 10 million radio receivers now needing repairs in homes all over the country, the new RCA campaign is aimed directly at the consumer and strongly slanted to emphasize the fact that, for relatively low cost, the average noisy or inoperative radio can be restored to first-class condition.

The purpose of the campaign is to stimulate new business for the radio service dealer by overcoming the average consumer's impression that radio repairs are expensive. In addition, the campaign provides the dealer with the ready-made means to merchandise and price his services effectively and professionally.

Built around an eight-point "Radio Repair and Tune-Up Special," the campaign lists eight definite services and advertises the total price. To meet the requirements of individual dealers, provision is made for imprinting prices on the advertising material to order.

Covering all requirements for a comprehensive local promotion, the new campaign ranges from direct mail to window display material. Included are a colorful five-piece display kit, a three-piece direct-mail campaign, a window streamer, newspaper ad mats, and several radio-spot announcements.

In addition to the new "Radio Repair and Tune-Up" campaign, the RCA Tube Department is making available a special pricing kit to enable radio service dealers to price clearly and attractively such window and counter merchandise as radios and appliances. Consisting of numerals, dollar signs, and bases, finished in black, red, and yellow plastic, each pricing kit contains six sets of numbers and six bases. Identification slips are also provided to note other information such as model number, terms, and down payment.

Skiatron Corp. has opened offices at 381 Fourth Avenue, New York City, Arthur Levey, president, announced. The new company has been formed for the exploitation of certain basic television patents formerly owned by Scophony Corp. of America, in which Paramount Pictures, Inc., and General Precision Equipment Corp. were participants. The patents were freed only after the entry of a consent decree in the Paramount-General Precision-Scophony antitrust suit, which was based upon the Government claim that "commercial development in this country of an important advance in the television art has been postponed and the opening of a new field of public entertainment and education has been unnecessarily delayed." Skiatron Corp. owns many of these patents outright and controls others through an operating agreement with Scophony Corp. of America.

Speer Carbon Co. of St. Marys, Pa., announces that it has acquired sole ownership of both the Speer Resistor Corp., of St. Marys and of Angelica, N. Y., and Jeffers Electronics, Inc., with plants at Dubois and Driftwood, Pa.

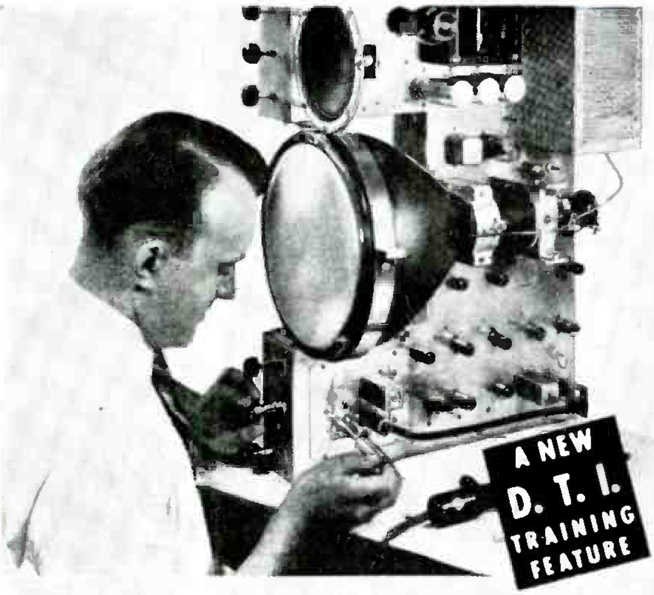
Sheldon Electric Co., Irvington, N. J., has entered the television field with a line of 10-, 12½-, and 16-inch flat-face, all-glass television picture tubes. Sheldon has merged with Allied Electric Products, Inc., and is being operated as a division of that company.

National Television Film Council has started a survey to correct "demoralizing trade practices" in the use of motion picture films by television stations. The Council aims at establishing standard film-rental charges based on the population in the area covered by the station or on the station's time rates or both.

Motorola, Inc., Chicago, Ill., reports that dollar sales volume on television receivers in the month of September was up 424% over the same period in 1948. Unit sales were up 403%.

Allen B. Du Mont Laboratories, Inc., dedicated in East Paterson, N. J., last month what president Allen B. Du Mont called the world's largest and most modern television assembly plant. Covering 480,000 square feet, the structure is located on the 58-acre site of the former Wright aeronautical plant. It was purchased from the WAA.

Crosley Division of Avco Corp., Cincinnati, Ohio, is introducing its plan of "pay-as-you-see" television meters to New York dealers after successful tests in Cincinnati.



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.

Oscilloscope

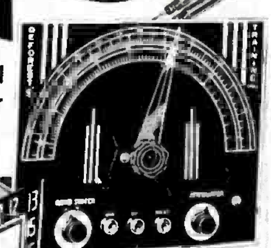
Multimeter

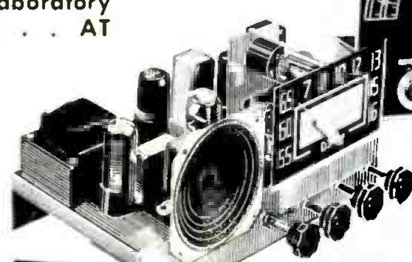
Mail Coupon NOW for FREE Information!

You also build and keep this Professional Type Equipment

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 Radio-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!

R-F Signal Generator





6-Tube Receiver

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 12
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..............

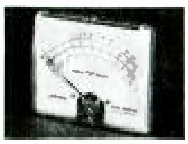
A NEW MODEL V-4 *Heathkit* VACUUM TUBE VOLTMETER KIT

New
...4½" 200 UA METER
...BALANCED AC CIRCUIT
...SIMPLIFIED SWITCHING
...SNAP-IN BATTERY MOUNTING

Features

- Meter scale 17% longer than average 4½" meter.
- Modern streamline 200 ua meter.
- New modern streamline styling.
- 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.
- Uses 1% precision ceramic divider resistors.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.


Quality GE tubes for long life


Beautiful 4½" streamline 200 ua meter


Varnish impregnated power transformer


Five highest quality controls for accuracy


Highest quality Mallory selector switches


Precision ceramic divider resistors 1% accuracy

The new Heathkit Model V-4 Vacuum Tube Voltmeter has dozens of improvements. The new modern streamlined 200 microampere meter uses Alnico V magnet for fast accurate readings. The streamlined case is molded of shatterproof plastic. The scales are long—17% longer than average 4½" meters and nearly twice as long as previous Heathkits.

The new electronic AC voltmeter circuit incorporates an entirely new balance control which allows a complete elimination of contact potential. This removes meter shift with various ranges, giving accurate readings on all ranges, and compensates for variations in tube elements. This feature is exclusive in Heathkits.

New simplified switching reduces by nearly one-half the number of connections made to the switches, giving easier, quicker assembly. New snap-in battery mounting for ohmmeter battery mounts on chassis for quick, easy replacement and simpler assembly.

The Heathkit VTVM with true electronic AC voltmeter and push-pull DC voltmeter circuit gives positive automatic meter protection on all functions.

The Heathkit is the only kit using precision ceramic permanent divider resistors instead of matched pairs of common carbon resistors which wander with age. The best laboratory meters available use the same ceramic resistors you find in your Heathkit.

The Heathkit VTVM is powered by a quality 110 V. 60 cycle varnish impregnated transformer manufactured by Chicago Transformer Corporation who produce some of the finest transformers used by the military services — you will find the best of materials in your Heathkit. A new power supply rectifier circuit greatly reduces the heat inside the cabinet to eliminate warm-up drift. Only the tremendous demand for Heathkit VTVM's would afford the fine engineering which has produced this new model. The Heathkit is the only VTVM Kit giving all the ranges. Check them: DC and AC full scale linear ranges of 0-3V., 0-10V., 0-30V., 0-100V., 0-300V., 0-1000V., and can be extended to 0-3000V., and 0-10,000V. DC with accessory probe at slight extra cost.

Electronic ohmmeter has six ranges measuring resistance accurately from one tenth of an ohm to one billion ohms, all with only two flashlight cells. The drain on the cells is so slight that they last for years.

Meter pointer can be offset from zero for FM and TV alignment.

The DC probe is isolated for dynamic measurements of receiver voltages without disturbing receiver operation. Constant 11 megohm input resistance allows use of standard accessories.

Has db scale for making gain—noise level and other measurements on audio amplifiers.

New instruction manual uses step-by-step instructions with pictorial diagrams for ease of assembly. The Heathkit VTVM is complete — light weight aluminum cabinet — all tubes — Mallory switches — power transformer — test leads — 1% precision resistors — beautiful two color panel—200 ua 4½" meter—instruction manual. A few hours work gives you the finest quality VTVM available — universities use them for atomic research — you will find it the handiest tool you'll ever own. Order now and enjoy it this entire winter season. Shipping Wt., 8 lbs. Model V-4.

The FINEST VTVM KIT AVAILABLE FOR *Only*

$24.50

ORDER ACCESSORY PROBES..LISTED ELSEWHERE IN THIS AD.

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

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 30 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.

Only **$69.50**

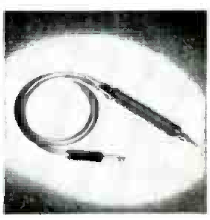
Nothing ELSE TO BUY

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



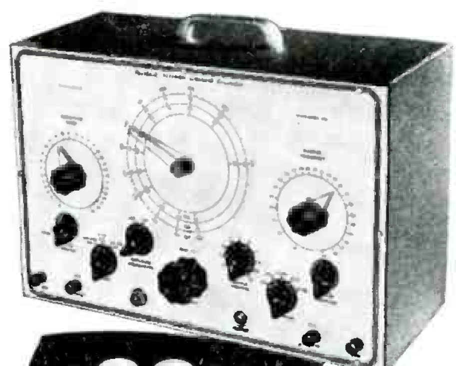
New Heathkit

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 TV frequencies 0 - 46 54 to 100 — 174 to 220 Megacycles, a marker indicator covering 19 to 42 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 three 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.

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 — heauty — 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 ⅔ 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

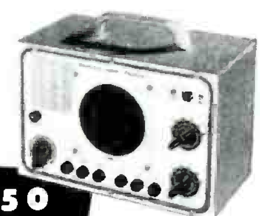
Nothing ELSE TO BUY

$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

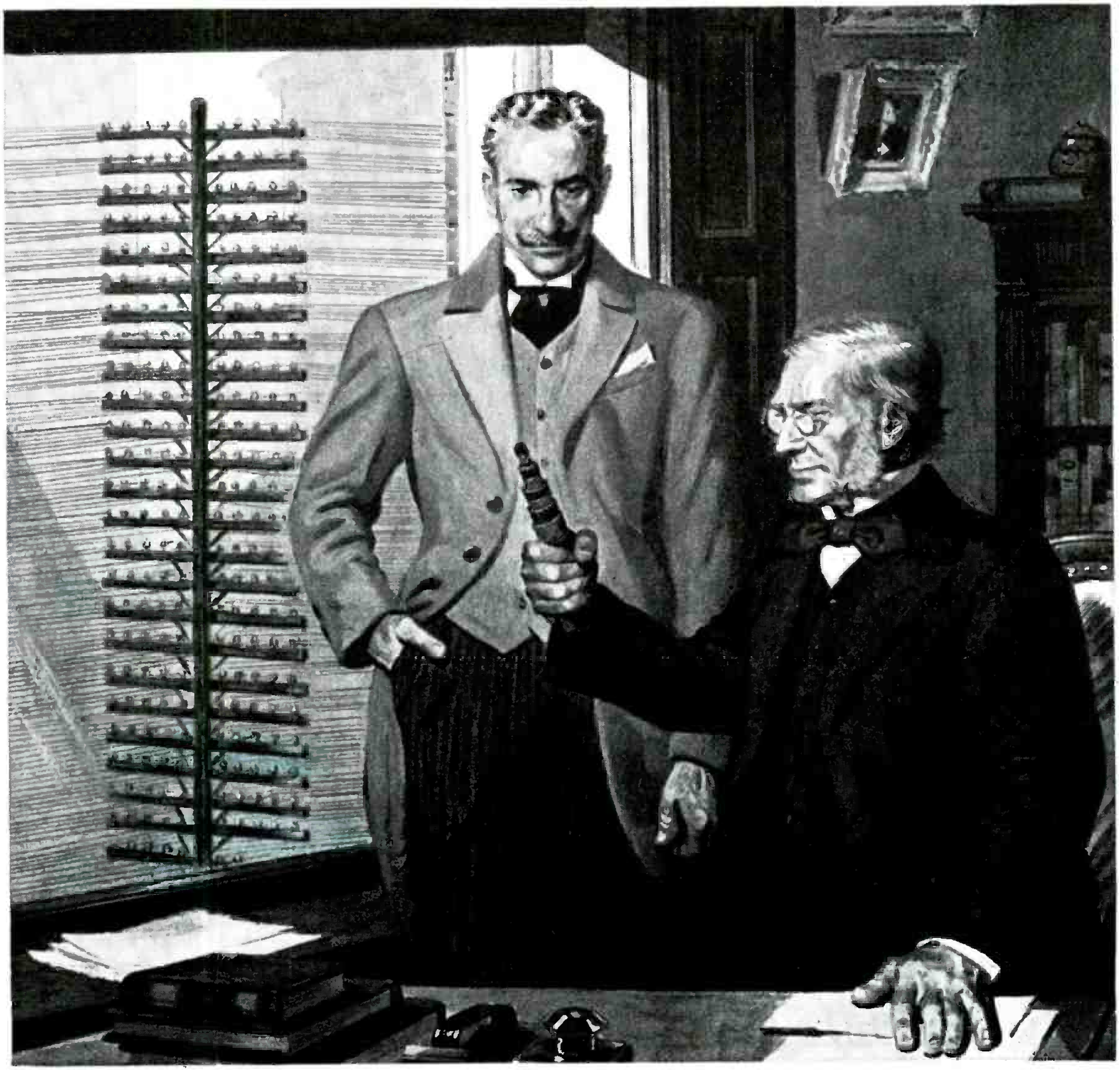


$19.50

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



ELECTRONIC EXPERIMENTATION

. . . There are now over one-half million electronic experimenters in the U. S. . . .

By HUGO GERNSBACK

SINCE the beginning of World War II—even previous to it—electronic experimentation in the United States has taken an extraordinary upsweep.

Authorities consulted seem to be unanimous that today there are in the United States well over 500,000 radio-electronic experimenters, of which we here name only the major classes.

First we have the industrial laboratory experimenters who work for the large radio manufacturers and allied interests. An entirely new class of these sprang up in the early 40's, i.e. the atomic electronic research experimenters. This particular class is growing by leaps and bounds.

The next large body is connected with various institutions of learning, such as universities, colleges, etc. Then we have the professional engineers who are given assignments for electronic research by various manufacturers, business houses, architects and a vast number of others, for special devices needed for specific purposes.

Our armed forces, the Army, Navy, and Air Forces, all maintain large, ever growing staffs of electronic research-experimenters. Further, there are the private experimenters who pursue their hobby for personal instruction. Finally we come to the inventors. The latter class is by no means a small one and apparently it is growing larger as time goes on.

As electronic applications and new industrial requirements increase at an extraordinary pace, hundreds of new electronic devices are urgently needed almost daily. A list of several thousands of such applications and improvements can be made up by anyone who knows the electronic field.

It would seem, therefore, that electronic experimentation is an unusually worthwhile endeavor today. How far this can be expanded not even the most enthusiastic proponent of electronics can possibly foresee. Here are a few suggestions for needed electronic improvements and devices, given simply as examples.

BLAST-PROOF MIKES. Recently we were sitting in one of the largest motion-picture houses in New York. Our location was roughly halfway back in the auditorium. A shrill female singer who had never been taught microphone technique put her mouth as close to the mike as was humanly possible. This literally started to blast the audience out of their seats *via* the house public address system. The result was physically painful to the eardrums, so much so that a ten-year-old boy sitting next to us tightly clapped his hands over his ears. A number of persons walked out, including the writer, when the blasting became unbearable. This is not an unusual performance, as many motion-picture houses which give stage shows work on the same decibellow principle. It is also true in night clubs, concert halls, etc.

Some public address systems have been built with an audio a.v.c. system (volume compression) so that the output into the loudspeaker system is automatically controlled to keep the decibel range within comfortable limits. These systems, however, are expensive and are therefore not used universally. It should be possible to devise a *simple, low-cost* electronic system that, by the addition of perhaps a single tube and a few other components, will accomplish an automatic constant-level sound output. *It is badly needed.*

PHOTOELECTRIC TAXI INDICATOR. In most of our larger cities it used to be a problem to hail a passing taxi because you never knew if it was free or not. After the war, these cities made mandatory a system of roof lights which at night are lit so that the public may see if the taxi is occupied or not. At present the roof indicating lights are switched on when the taxi driver puts on the headlights and the taxi-meter flag is *up*. The driver, however, may forget to put on the driving lights when darkness comes with the result that the roof lights remain dark. In this case the taxi passes many would-be passengers because once the speeding taxi is abreast of you it is too late to hail the cab driver. In the daytime nothing is done for would-be passengers, who from a distance cannot possibly see if the taxi is occupied or not.

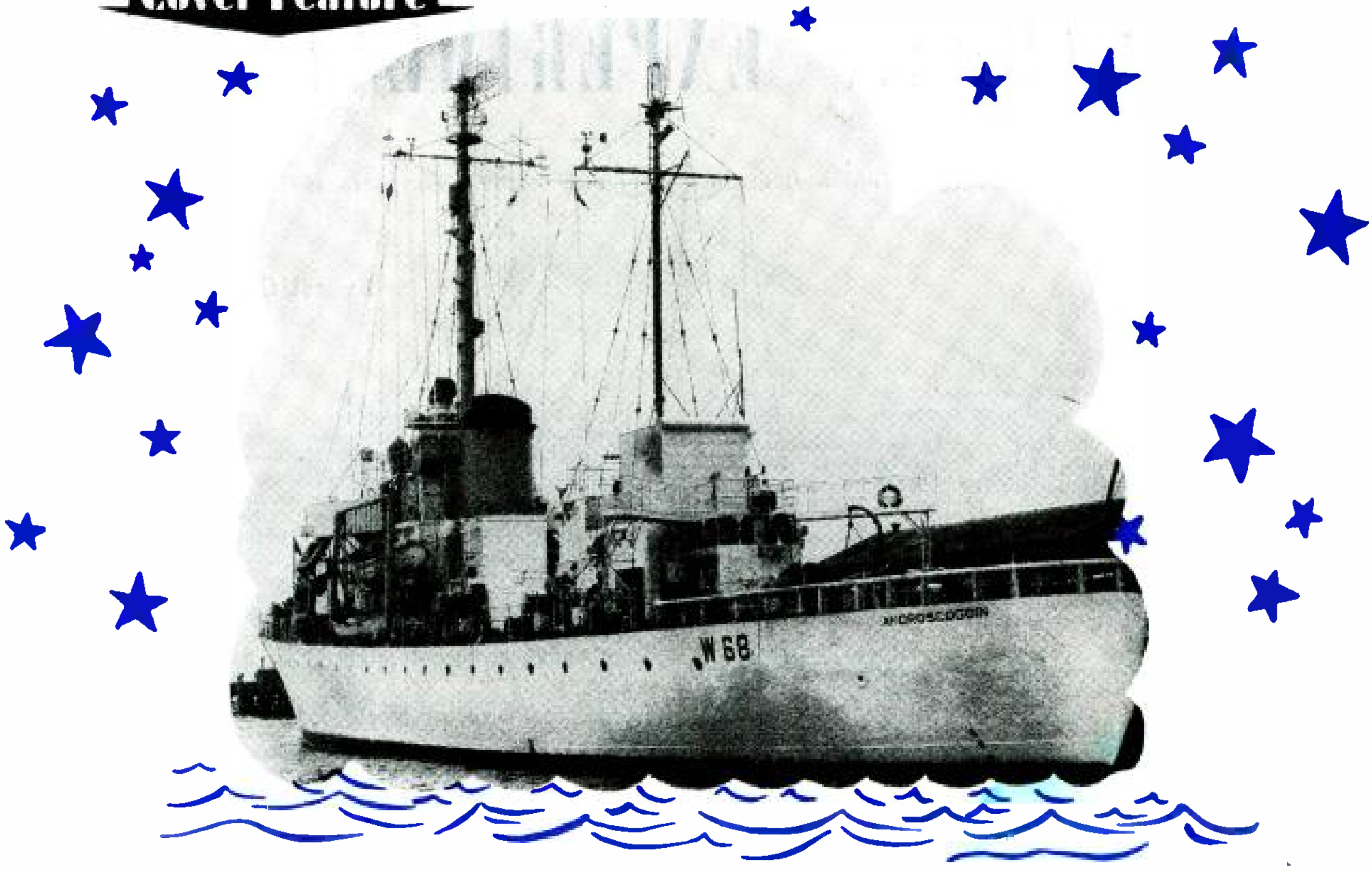
What is needed is a simple, low-priced photoelectric system which puts on the roof lights *automatically* in failing light—whether at night or in the daytime. On very cloudy or foggy days when it gets almost dark, few taxi drivers switch on their headlights. Consequently the roof lights stay dark.

A photoelectric, automatic relay arrangement would solve this problem nicely. The same device then could also be doing double service during daylight. It would switch on, say, an intense yellow searchlight on the right side of the taxi. This light could be constructed on the same principle as the stationary red and green street lights which are easily seen during the daytime. Thus, a high-power yellow light would mean that the taxi is unoccupied. In case a yellow light is objectionable a different visual system could be operated by the photoelectric system.

Such a system would be *wholly automatic.* It would, first, be of great service to all taxi riders. Second, the taxi owners would benefit from it due to higher revenue. In New York City there are over 20,000 cabs run by large fleets, all of whom are most interested in a device of this type. The same is true in various percentages in other cities. Independent taxi drivers are even more interested and would be glad to pay a fair sum for such a device because they know that their revenue would be increased.

AIRPLANE PUBLIC ADDRESS. If you have used one of the fast airplanes you must have noticed the almost impossible performance of the planes' public address systems. These are usually installed in the pressurized larger planes so that the captain of the plane can speak to his passengers. Very often his information is important and it is always of interest to the passenger who wants to know over what part of the country he is flying and hear special news bulletins, weather reports, when the plane will arrive at its destination, etc., etc. The trouble with aircraft public address systems today is that in a pressurized cabin the ears of the passengers become affected in such a way that they do not hear as well as at sea level. The pressurizing is usually made roughly equivalent to the atmosphere at about 8000 feet altitude, although the plane may be flying at 20,000 feet or more. Also, when the plane begins to descend the air pressure gradually increases to normal. All of this affects the public address loudspeakers and microphone adversely; it makes the transmission of speech often totally incomprehensible. What is needed badly is an electronic equalizer which changes the output in such a manner that it will automatically be suited to the hearing ability of the passengers, regardless of changing air pressure. This need not be a difficult assignment for an alert electronic experimenter. On account of aviation procedure, it should be remembered that not a great deal of extra weight can be added to existing systems. This is the first thing that airplane companies frown upon. The device, therefore, must be reasonably simple and above all not be too expensive. Such an improvement is certain to find a ready sale and quick adoption by all major airlines.

Cover Feature



Mid-Ocean Radio Stations

The Ocean Station Vessels of the U. S. Coast Guard perform a little-known service to ships and aircraft

THE world's most compact assemblage of widely variegated electronic and radio equipment is without doubt to be found on one of the Ocean Station Vessels of the United States Coast Guard. These little ships—averaging about 2,000 tons in displacement and 300 feet in length—are scattered over the Atlantic Ocean to report on weather conditions and to aid transoceanic air service.

Crowded into the ship's 300 feet are seven communications transmitters, 14 communications receivers, four all-wave broadcast receivers, five speaker-amplifiers, three transceivers, five "handi-talkie" type transceivers, one beacon transmitter, one standard direction finder, one Loran receiver-indicator, three radars with their associated IFF equipment, a remote PPI radar repeater, and receivers and recording equipment for radiosonde transmissions.

Additional electronic equipment includes underwater echo-ranging equipment and two echo sounders, as well as the internal communications system, comprising ten 10-station talk-boxes and a 250-watt amplifier which drives a bull horn and 30 speakers in all parts of the ship, operating on voice and with special signals produced by a tone oscillator.

The power of the various transmitters ranges from .027 watt to 750 watts, with frequencies anywhere between 300 kc and 156 mc. Ten remote control units permit operating transmitters and monitoring their receivers from various spots aboard ship. For example, some of the main radio room transmitters may be operated from the pilot house, plotting room, or emergency radio room.

Most of the equipment is concentrated in the main and emergency radio rooms, pilot house, and plotting room. Compactness of the installation becomes evident whenever it becomes necessary to install new equipment. Since the duties of the little Ocean Station Vessels are expanding continually, such new equipment becomes necessary regularly, and finding a spot for it is work for a genius.

Though the equipment itself may be jammed, its congestion is nothing compared with that of the signals—both incoming and outgoing. The ships have two masts about 100 feet apart, on or between which all the antennas must be mounted or hung.

The resulting interference resembled a radioman's dream of Hell, and its reduction called for even more equipment. By using multicouplers, eight receivers are operated from one antenna. Band-pass filters keep the powerful beacon transmitter signals on 312-314 kc out of the receivers tuned to the distress frequency at 500 kc. Tunable filters trap pulse interference which would otherwise paralyze receivers on the v.h.f. ranges, and automatic antenna changeover relays switch receiver and transmitter onto the same antenna in a number of operations, thus doubling the antenna efficiency. Complex patch panels enable the operator to choose between a number of antennas for any given transmission or reception, under varying conditions of noise level, signal strength, selective fading, or other circumstances.

The equipment is used in carrying out the four main duties of an OSV:

1. Weather observations and reporting;
2. Transoceanic aircraft check point;
3. Distress;
4. Preparedness.

The Weather Service

Weather data is gathered by RAWINS (radio wind observations) in which a balloon carrying a radar reflector is tracked by the ship's radars, or by RABAL (radio balloon sounding), a standard radiosonde with a large balloon which carries it to a height at which the balloon bursts. The RABAL transmitter operates at about 40 mc, and has been heard as long as three hours before reaching the bursting altitude.

All weather reports, together with temperatures and other meteorological information, are coded and transmitted to Coast Guard receiving stations on one of the high-frequency bands near 8, 12, or 16 mc, depending on the time of day, distance of transmission, atmospheric, and other conditions. Sometimes the messages may be transmitted simultaneously on two frequencies to reduce the effects of selective fading; and when no frequency or combination of frequencies will get them to shore, they are relayed through another OSV.

Station vessels relieve each other every three or four weeks. Upon sighting the relief ship, the ship to be relieved releases a helium-filled balloon which carries a crossed-dipole target reflector. Both ships then engage in a joint RAWIN (radio wind direction and velocity observation) with their air search radar, as a check on the performance of both plotting teams and radars.

When the RAWIN is completed the new ship officially takes over the station and places its automatic high-power aircraft beacon in operation. The beacon, which transmits five out of every fifteen minutes the ship is on station, is primarily useful to transoceanic aircraft, and permits them to get automatic direction finder bearings as a position check. As the aircraft nears the ship it reports departure, destination, altitude, speed, course and other information by radiophone.

The ship's radar picks up the aircraft and can give it an accurate check on its position, course, and actual speed. All information concerning passing flights is recorded and saved, for it might be of vital importance should planes be off course, in trouble, or overdue at destination.

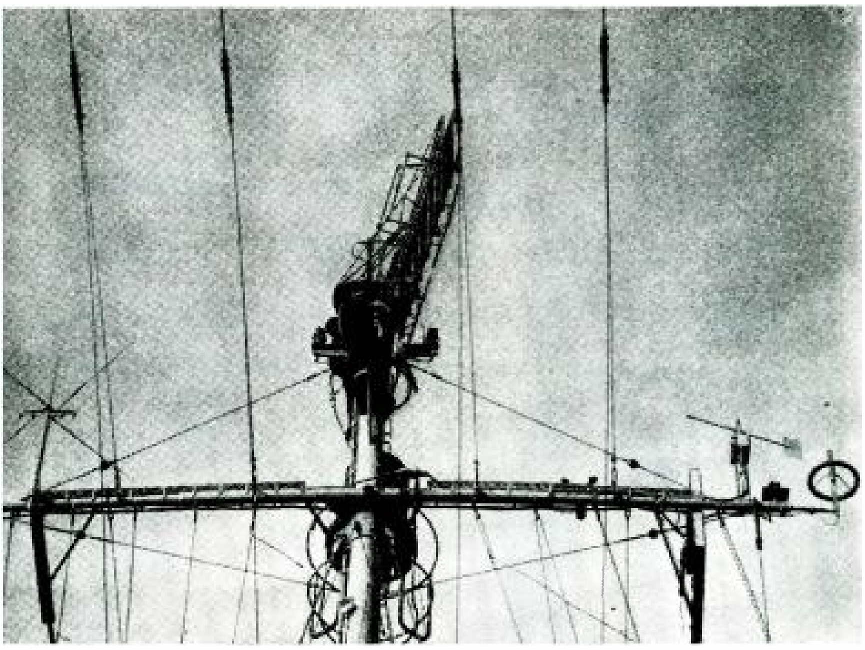
Data on local surface weather and the direction and velocity of winds at different altitudes are transmitted to aircraft. Some station vessels in the North Atlantic handle as many as 350 aircraft on each patrol, and in some cases as many as 15 at the same time. Such cases require the highest degree of teamwork in the plotting room.

Possibly as important as the ships' weather observations is their direct service to air and sea navigation. Continuous watch is maintained on all distress frequencies, both air and marine. Coast Guard OSV's have participated in more than one spectacular rescue, such as that of the Bermuda Sky Queen in October, 1947. The 65 passengers of that plane were picked up over a period of two days by the boats and rafts of OSV *Bibb*, patrolling station C, midway between Newfoundland and Ireland, though 35-foot seas were running. There have been many less dramatic occasions when a plane or surface ship has been assisted in emergencies, ranging from medical treatment to the rescue of the crew of a "ditched" plane.

The electronic personnel of an OSV consists of 15 persons. Of these, twelve are on the operating staff—seven radiomen, four radarmen, and one sonarman. Commissioned deck officers and petty officers are also called upon from time to time to operate direction finders, echo sounders, and radar equipment.

Radio Repairmen

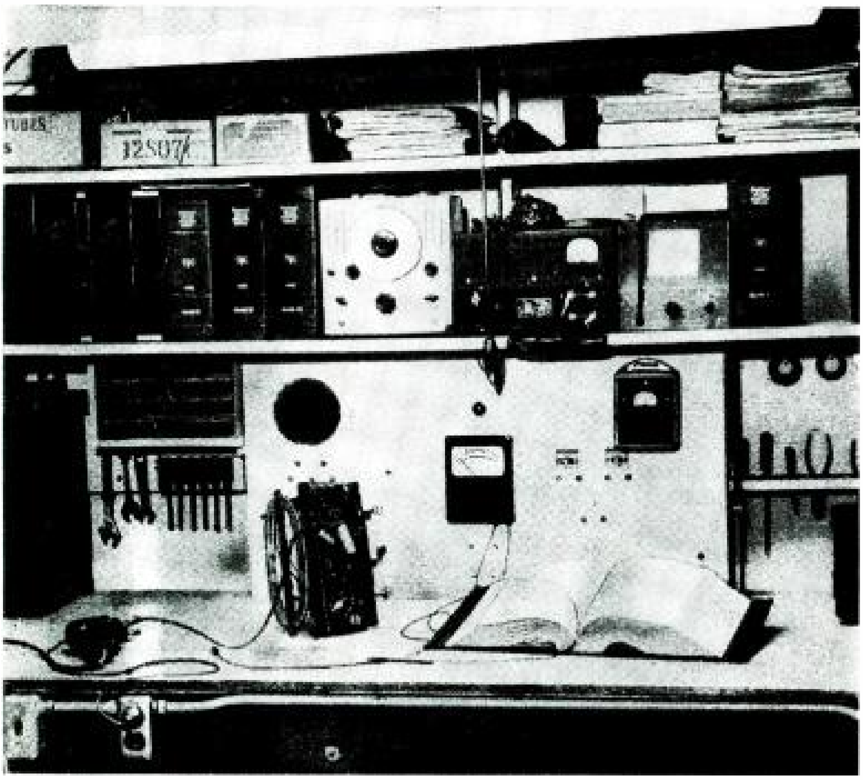
The other three men are classed as electronic technicians. On them devolves the whole task of keeping the equipment in operating condition. A complete complement of test equipment is necessary to maintain the variety of gear on board. There are five frequency meters, two signal generators, a wavemeter, tube checkers, oscilloscopes, v.t.v.m.'s, and special test sets for particular equipment. Since frequencies vary from ultrasonic to u.h.f. and types of transmission from c.w. through phone to pulse, with equipment ranging from kilowatt size down to hand-carried apparatus, an electronic technician on one of these vessels holds down an extremely interesting, if very busy, job. He has to know his stuff, and there is plenty of stuff for him to know. Each man must be extremely versatile and an expert in each line. It is a carefully selected and carefully trained man who holds a technician's position on an OSV.



Official Coast Guard Photos

Masthead of one of the ships, showing assemblage of radio and radar antennas.

In the radar room of one of the OSV's.



Part of typical test bench shows manuals and some essential instruments.

Test Instruments and the Technician

By HERBERT S. BRIER

RADIO-ELECTRONICS for February, 1949, contained an article of mine, "Using Your Ohmmeter," which outlined how the radio experimenter with a good grasp of radio fundamentals could repair an ordinary radio receiver with no equipment other than an ohmmeter, a tube manual, and a small stock of parts. While this is true, more extensive equipment is necessary for anyone who expects to *earn a living* through radio servicing, and this article will attempt to show the reason why.

The greatest value of test equipment on the average service job is that it enables the technician to do a better job *in less time*, although it often spells the difference between success and failure as well. While no two technicians will agree entirely, the following describes, somewhat in the order of their importance, the service instruments the average radio repair shop should have on its bench.

1. Multitester (volt-ohmmeter).
2. Service data.
3. Signal generator (for AM work).
4. Tube tester.
5. Vacuum-tube voltmeter.
6. Signal tracer.
7. Capacitor checker.
8. Wide-range (television) signal generator with built-in variable sweep generator and marker oscillator.
9. Cathode-ray oscilloscope.

Multitesters

Accepted almost universally as the indispensable test instrument, there are two common types of multitesters, one rated at 1,000 and the other at 20,000 ohms per volt. (See RADIO-ELECTRONICS for May, 1949, for complete specifications on 30 different models of multitesters.)

For general measurements on tube circuits, the 20,000-ohm-per-volt models are to be preferred, other things being equal, because they will measure across much higher resistances and will usually give more accurate voltage measurements. Table I records the readings that might be obtained with different meters at the plate and screen terminals of the 6SJ7 resistance-coupled amplifier which is diagrammed in Fig. 1.

Obviously, different ohms-per-volt ratings and different scales can affect voltage readings. The meter resistance shunts the plate or screen resistance, lowering it considerably as far as the B-supply is concerned, and reducing the voltage appearing across it. To be ignored, the meter resistance must exceed the plate or screen resistance by at least 10 times so that its shunt effect is negligible.

The a.c. voltage ranges of most multimeters are 1,000 ohms per volt, and are generally used for measurements only at the power-line frequency or across voice coils. There are more suitable devices, which will be discussed later, for measuring audio and r.f. voltages (signal voltages) in the receiver proper.

Service data

Admittedly, a competent service technician can repair any piece of radio equipment without a service manual; he does so when necessary, but only at the cost of much time. Quoting two technicians on the subject will make further comment unnecessary.

In the November issue, John T. Frye, the well known writer, described the servicing of a radio-phono combination. The complaint was faulty operation of the record changer, and the repair consisted of tightening a setscrew, a 30-second job. But even to see the screw required disassembling the changer and removing the motor from its suspension mounting. The importance of this story is that Mr. Frye commented that his service data saved valuable time by detailing trouble symptoms and by showing how the setscrew could most easily be reached. Every repairman can cite a parallel case.

Another technician, who has been a radio trouble shooter for several airlines and for a large manufacturer, said that he would give up all his test instruments before parting with his manuals. "After all," he said, "if worse comes to worst, I can always substitute good parts for doubtful ones and use the old spark method for checking voltages, but without the service data, not even the designer himself could figure out some of the things they call receivers."

Signal generators

The signal generator runs almost constantly in a busy service shop. Aligning i.f. and r.f. circuits then becomes a simple matter of setting the generator to the proper frequency, coupling it to the various control grids in sequence, and adjusting the appropriate trimmers or slugs.

Service manuals, incidentally, are almost a necessity for getting maximum utility from a signal generator, because they list the various frequencies to which to set the generator, and give special alignment instructions for individual receivers.

Tube testers

With a good stock of tubes to substitute for doubtful ones, the tube tester can be dispensed with temporarily. However, no successful technician would attempt to operate very long without one, if for no other reason than that the customer expects him to have it. Besides, a tube tester is convenient and a potent seller of new tubes.

Unfortunately, practically every tube tester on the market occasionally misjudges a tube, especially oscillator tubes and noisy and intermittent ones. As a result, a good technician never hesitates to substitute another tube for one that tests OK in a checker, but in a receiver where everything is apparently normal still does not operate properly.

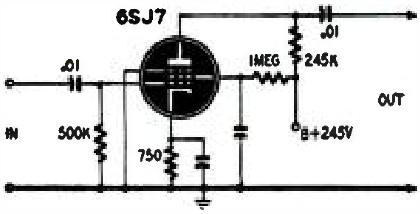


Fig. 1—Table I shows results of measurements on this voltage amplifier.

Vacuum-tube voltmeters

Some technicians prefer a good vacuum-tube voltmeter (v.t.v.m.) above any other single test instrument because of its versatility. A good one may measure resistance between 0.1 ohm and 1,000 megohms; d.c. and a.c. voltages up to low radio frequencies, from a fraction of a volt up, at a resistance measured in tens of megohms; and with a high-frequency probe, it can measure r.f. voltages above 100 mc, just to mention a few of its uses.

Comparing the third column of Table I with the other columns shows the value of the v.t.v.m.'s high input resistance, as does the fact that it offers the only practical method of measuring a.v.c. and similar low d.c. voltages developed across high resistances. Being equally sensitive on the a.c. scales, the v.t.v.m. will also measure signal voltages (using the high-frequency probe for r.f.) right at the tube elements, revealing such things as unbalance in push-pull stages, leaky coupling capacitors, defective i.f. or r.f. coils, and improperly functioning oscillators.

TABLE I

Meter Scale volts	1,000 ohms/v		20,000 ohms/v		V.t.v.m.	
	Plate volts	Screen volts	Plate volts	Screen volts	Plate volts	Screen volts
50	20	7	off scale	20	off scale	25
250	50	15[1]	83	22	90	25
1,000	74[1]	20[2]	89[1]	24[2]	90	25[2]

[1] Difficult to read accurately. [2] Impossible to read accurately.

The v.t.v.m.'s high sensitivity is not obtained at the cost of durability. It is less likely to be damaged through accidental overloads than are less sensitive straight multimeters.

Signal tracers

Although some technicians claim that signal tracers merely duplicate the work done by other test equipment, others like the speed a tracer allows in diagnosing a receiver's ills. The signal tracer is moved, stage by stage, from the antenna terminal toward the speaker, revealing exactly where the signal disappears. The tracer may even tell the experienced user the exact defective part. And it is especially useful in tracing hum, particularly in a.c.-d.c. receivers where individual tubes cannot be removed without disabling the entire receiver.

Capacitor checkers

Here again, there is considerable divergence of opinion. Depending on personal preference and on what other test equipment is available, capacitor checkers are often rated by service technicians on the answers to questions like these: *Is it easier to check a coupling capacitor with a checker or with a v.t.v.m.? Is it faster to bridge another filter capacitor temporarily across one that is suspected of having dried out than to unsolder it and test it on a checker? Why measure the characteristics of a capacitor in a receiver when service manuals give full data on all of them?*

No matter how these questions are answered, almost all technicians will admit the value of a capacitor checker in culling defective and mislabeled replacement units *before* they are placed in a set. Too, most capacitor checkers will measure inductance and resistance as well.

Sweep generators; oscilloscopes

A suitable sweep-frequency signal generator tunes between at least 2 and 216 mc, and can be swept (frequency-modulated) from zero to 10 mc or more. Also, it has provision, preferably built into the same cabinet, for providing accurate, unmodulated marker points.

The requirements for the cathode-ray oscilloscope are not too severe. Any good one, with amplifiers of reasonable gain capable of passing audio frequencies, is adequate. Although the frequencies of the circuits being adjusted are high radio frequencies with bandwidths measured in megacycles, the signal generator is invariably swept at 60 or 120 cycles per second. As it is the *rate of sweep* and not its width that determines the modulation frequency of an FM signal, and the majority of television alignment procedures are based

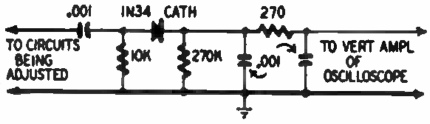


Fig. 2—Simple probe rectifies TV r.f. or i.f. for feeding to scope amplifier.

on connecting the oscilloscope to the output of the video detector, it can be seen that the oscilloscope trace is also 60 or 120 cycles. Those alignment procedures that require the oscilloscope to be coupled to individual tuned circuits are handled by a simple diode in a probe (see Fig. 2) to convert the signal generator output frequency to one that will be passed by the built-in oscilloscope amplifier.

With almost every new test instrument comes an auxiliary piece of equipment that may double or triple its usefulness; yet, oddly enough, many technicians throw it away with the packing. **This gadget is the instruction manual.** Not only does it tell how to use the instrument, but, equally important, it tells what the instrument *cannot* do. More can be learned about the comparative merits of various types of equipment through reading and comparing instruction manuals than in any other way except actually using the equipment or "asking the man who owns one"—and not even he can always be depended on for full information.

The importance of reading the instructions accompanying even familiar, simple types of test instruments is well illustrated by the following incident. Some weeks ago I helped a service technician test several hundred tubes. Following exactly his instructions for using his tube tester, we had tested about half of the tubes when I became certain that there was something amiss. He dug out the instruction sheet, and we discovered that we were using the wrong procedure for testing for shorted elements. Retesting the previously O.K.'d tubes, we found many that had shorts between two or more elements! I hesitate to think of how much extra work this technician made for himself in the year or more he had been using the tester in this manner.

How To Remove The 60-Cycle Buzz From Intercarrier TV Receivers

A known disadvantage of intercarrier receivers is a possible 60-cycle buzz. It can be removed easily.

By L. S. PEARLMAN

INTERCARRIER sound i.f.'s for television receivers have several decided advantages over separate video and sound i.f.'s. There is a saving in the total number of tubes in the set, freedom from drift problems, and ease of tuning. But their use brings up one big problem: a 60-cycle buzz in the sound due to sync and picture modulation. Good design in the set and good service in the field when necessary will eliminate this buzz.

Fig. 1 is a block diagram of a receiver using the intercarrier system, sound and picture carriers being exactly 4.5 mc apart on all channels. If sound and picture carriers are both passed through the i.f. strip, a 4.5 mc beat note appears in the video detector. This beat note is frequency-modulated like the sound carrier and amplitude-modulated like the picture; the amount of each modulation and the strength of the 4.5-mc beat note depends on the strength of each carrier at the detector. Picture carriers are modulated downward as much as 95% for the brightest whites in the picture. So you can be sure of only 5% of the picture carrier being there all the time. The sound carrier in the i.f. stages should be way down on the slope of the over-all response curve, no more than 1/20 (5%) of the flat-top maximum, to keep the beat note as free from picture modulation as possible (see Fig. 2). It should not be too much less than this so that there will be enough 4.5-mc signal to give adequate sound volume. The front end, i.f.'s, traps, and alignment frequencies should be designed with this in mind.

The 4.5-mc beat note is normally trapped out after the video amplifier. In well-designed receivers the video detector and amplifier should pass up to 4 mc and then cut out the higher frequencies. For intercarrier, some 4.5-mc signal should go through the peaking coils and be taken out of the picture by a trap which feeds the 4.5-mc amplifier and ratio detector. A good ratio detector will go far toward cutting down the buzz.

The 4.5-mc beat must pass through the front end, i.f.'s, and video continuously. If any tube, such as the last i.f. stage or the video amplifier, cuts off on peaks of sync signals or picture whites, the beat note will be cut off at the same time. This will cause a buzz in the sound that cannot be removed by any means except changing the bias or other voltages or the signal strength to correct the stage that is cutting off. This should not be necessary in a well designed set unless some component is defective or changed in value.

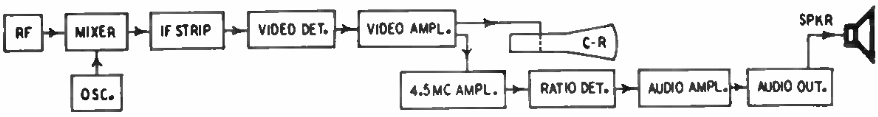


Fig. 1—Block diagram shows how intercarrier works and why it is economical.

Other ways to minimize the buzz are by making the 4.5-mc amplifier a limiter, by using a good ratio detector, and by keeping the sync circuits physically and electrically away from the intercarrier i.f. and audio stages. Decoupling the sync-circuit B-plus supply helps.

In servicing an intercarrier television set to eliminate buzz, touch up the ratio detector first. The primary should be tuned for maximum sound volume and the secondary for minimum buzz, which will also be close to maximum sound volume. Those adjustments should be made on a weak signal first for the maximum volume and a strong signal for minimum buzz. In most cases that alone will cure the trouble.

The primary and secondary tuning adjustments on the ratio detector can be recognized by their effects. Tuning through the primary will gradually increase and then decrease the sound output without too much distortion off tune. Tuning through the secondary from off tune will increase distorted sound to a maximum, clear the sound and reduce noise to a minimum, distort and increase noise, and then drop off the distorted sound volume. Align the sound takeoff coil or transformer and the ratio detector primary for maximum on a weak signal and the ratio detector secondary for maximum undistorted quiet sound. If the set is badly off alignment, a signal generator will have to be used. This should be fed into the video amplifier grid. Carefully retouch the ratio detector secondary on a strong signal for minimum buzz and distortion, and then touch up the primary and the sound takeoff coil.

If the buzz persists, front end and i.f.'s should be tried. The aim here is to get the sound carrier on the right portion of the over-all bandpass curve. Set the fine tuning control in the middle of its range. Adjust the oscillator on a station, tuning until sound in the picture wipes out the picture. The sound will be loud and clear. Back off on the oscillator adjustment until the picture is clear and sharp without sound or 4.5-mc interference. The interference in the picture looks like about 300 fine vertical lines, causing the picture to appear out of focus. Tune the oscillator back and forth slightly from this point for minimum buzz. If the adjustment for minimum buzz is

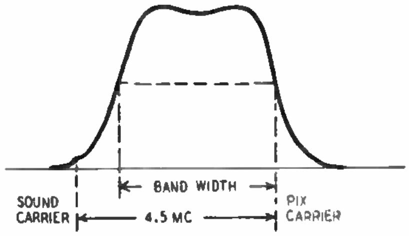


Fig. 2—Desired receiver i.f. response.

not at or near the point that gives a clear picture, the i.f.'s and front end will have to be realigned.

For realignment, connect an r.f. sweep generator to the antenna terminals and a 'scope to the video detector output. Set the output of the sweep generator to give about the same a.g.c. voltage or d.c. voltage at the video detector as the average station would in the particular area. This is important, because in many sets the bandwidth changes with a.g.c. Getting the right curve with a standard value of fixed or a.g.c. bias might not mean much as far as actual operating conditions are concerned. Align the i.f.'s and front end to get the desired curve and bandwidth, as described in instruction sheets on the set. In general, 2.5–3-mc bandwidth half way down the curve is average for 7-inch television receivers and 3 to 3.8 mc for 10-inch receivers.

Don't try to obtain full 4-mc bandwidth on a receiver unless there is a trap to attenuate the sound carrier. Otherwise it will not be possible to get the sound carrier far enough down on the curve. After alignment, check the sound and picture carriers. When the picture carrier is set half way up one side of the bandpass curve, the sound carrier should be far down the slope of the other side, less than 1/20 of the flat top height. After the i.f.'s and r.f. have been aligned and checked on all used channels, the oscillator should be adjusted, as mentioned above, on the air.

In strong-signal areas the buzz may persist because of overload. Check the components and voltages in the last i.f. stage and the video amplifier. Then attenuate the signal by using a pad in the antenna, reducing it to give less than a good picture at full contrast. If this clears up the buzz, it indicates overload. This can be corrected by padding the antenna, if the net picture signal strength is adequate. Or else the a.g.c. voltage could be increased by increasing the value of the a.g.c. bleeder resistor if one is used.

The cathode-bias resistor in the video amplifier can be adjusted up and down, depending upon whether the overload is driving this stage to cutoff or toward saturation. The determination of this point is more difficult. A simpler correction is to reduce the gain of the i.f. strip below overload by increasing the cathode-bias resistor in an i.f. stage that does not have a.g.c. applied, usually the last i.f. stage. This resistor can be increased to several times its normal value as long as the tube is not biased close to cutoff.

Another cause for buzz is electrical coupling through the power supply. Usually not encountered in well designed receivers, this is not peculiar to intercarrier sound but might be present in any television receiver. To test for this, connect an oscilloscope to the B-supply of the audio and 4.5-mc stages. Examine the waveform for vertical sync pulses or vertical sweep. If more than 1 volt peak-to-peak of these waveforms is present, decouple the supply of the sync amplifier, the vertical blocking oscillator, or the vertical output tube, depending upon the waveform found in the power supply. When this is too difficult, the decoupling could be applied to the 4.5-mc stages and the audio. It is best to decouple the source, however.

We've been talking only about elimination of 60-cycle buzz. The same factors covered in this article will also cause a 15,750-c.p.s. note. Practically all commercial television receivers have a narrower audio response than that, and the high-frequency noise and note are cut out in the audio stages. This can't be done for the 60-cycle buzz. The 60 cycles can't be eliminated merely by keeping the low-frequency cutoff of the audio system above 60 cycles. The buzz in the sound is due to a sharp pulse with many strong higher harmonics. Raising the low-frequency cutoff of the amplifier above 60 cycles would diminish the fundamental but would still permit the higher harmonics to come through.

This article has covered a large number of causes and cures for intercarrier buzz. Don't be overwhelmed. In a normal, well-designed receiver, touching up the alignment of the ratio detector or oscillator and checking tubes and components will be all the servicing necessary in the vast majority of cases. The rest of the information may be found useful for a more general understanding and in occasional difficult servicing jobs. Remember, there shouldn't be any annoying buzz in an intercarrier set; all causes for it have their cures.

Reports on Television DX

Long distance (several-hundred-mile) reception of television signals is very undesirable from the standpoint of the FCC allocation engineers, since it means that interference from a distant station may suddenly wash out a local one. When the dx does not create interference, it, like any other freak phenomenon, is of great interest to some television fans. Many set owners —especially in areas where there is little local reception—spend a good deal of time seeking out TV dx. For the benefit of dx'ers. we ran in the November issue a list of U. S. television stations as well as a call for reports.

The November issue is not yet off the press as this is written, but even the few letters on hand show what can be done. J. R. Pewitt of Nashville, Tenn., for instance, reports reception from several distant stations, the farthest of which was WBZ-TV, Boston, Mass., 950 airline miles away. He used a Garod model 900 receiver and a Radiart stacked-dipole antenna. Other stations Mr. Pewitt has received include WMAR-TV, Baltimore, Md.; WBEN-TV, Buffalo, N. Y.; WRGB, Schenectady, N. Y.; and WPTZ, Philadelphia, Pa.—and there are more.

William A. Riaski of Guthrie Center, Iowa, experimented with a number of antennas atop a 60-foot pole and found that the circular loop described by Noll and Mandl in the June, 1949, issue of Radio-Electronics (page 26) gave the best results of them all. His farthest dx was Los Angeles. He gets good results about five nights out of seven with Omaha, Nebr., stations, about 85 miles away, which are the nearest ones to him. Mr. Riaski's report on the loop should be of interest to others looking around for an antenna that will really pull in a picture from a distance.

A. B. Cooper of Rochester, Minn., reports receiving KOB, Albuquerque, N. M. His receiver was an Emerson 611 and the antenna a Ward TVS-6 low-band, stacked array.

We hope to receive many letters from dx'ers all over the country and to report on them in the January issue. When you write, don't forget to give us all the information on receiver, antenna, times, distances, channel numbers, and so on.

Two-Week Course Teaches TV

By DAVE GNESSIN

IT is not unusual for a young man about to enter the radio field to register at one of the many good radio service schools, buckle down to a regimen of study, and remain in residence at the school for several months—or even years if need be—to learn the trade properly.

On the other hand, a settled family man no longer young in years, with 10 or 20 years of practical radio servicing behind him and a steady business taking his full time, views with alarm the onset of television in his community. The dim rumors of only a few months before now become stark reality. Showers of Sunday advertising herald the opening of a TV relay outlet. The chain department store has a hastily prepared window set up with the first TV receivers ever seen in town. Our small radio dealer studies his first TV schematic.

What strange world of radio is this new field? There are more tubes in the smallest TV set than in the largest combo ever seen before. The C-R tube voltages run from 2,000 to better than 20,000, where 450 volts used to be maximum rating on the power supply. Unfamiliar new terms, such as *raster*, *sync*, *sawtooth*, *sweep*, *scan*, and *restorer*, clog the tongue. Regular test equipment becomes obsolete. Regular methods are inadequate Regular radio information is now insufficient.

Can the corner radio service dealer go back to school?

Armed with pencil and scratch pad, with lunch bag under his arm, the middle-aged radio man *is* going back to school. In the pictures on this page the students are all well over 30 years of age. All are married. All are experienced service technicians. Faced with the positive certainty of television in their community, they realized that the only way to handle the new field properly was to go to school and learn it. So these men took a "vacation" from their work bench and started to study.

Different communities have different setups. This group in Columbus, Ohio, made a cooperative deal with the local Philco outlet, Bennett Distributors. The distributor furnished the factory instructor, school space, test equipment, and TV receivers for study, while the service technicians furnished their full time from 9 to 5 for two weeks. A fair deal? The distributor thinks so. So do the technicians.

Limited to 12 men to a class, the school has a long waiting list At this writing more than 50 radio men from Columbus and surrounding towns have completed the course—*tuition-free*.

Can the average service technician learn TV in two weeks' *full time?* Bennett thinks so. The graduating *students* confide they never realized how basic the whole idea of TV is until it was slowly and carefully explained in class, followed up by (not laboratory, mind you—but) work-bench practice. High-voltage is *respected*, but no longer feared, for these men have now handled it. *Sweep*, *scan*, and *raster* are permanent additions to the radio man's working jargon, for he can now use the terms meaningfully, having adjusted and observed the action of each of these elements. Having *touched*, *felt*, and *seen* at first hand the TV chassis on the bench, the technician now recognizes it well, and welcomes it.

Gentlemen, this TV is *good business*.

The distributor, it may be noted, has bought himself a fistful of good-will. He has invested in the ultimate salesman, the small radio shop owner. He has built up a crew of *TV men* who can now take care of their own. These men will push TV *with confidence*.

Class works on actual receivers. Author (left, hand in pocket) checks voltage.

Gnessin, himself a student, shows friend alignment method as instructor watches.

Speaker Baffling Simplified

The best speaker needs good baffling to realize its full range and output efficiency

By A. G. SANDERS

RCA Photograph

High-fidelity, low-cost speakers, like the one held by Dr. H. F. Olson, are now available to the baffle builder to form complete units.

A SPEAKER is an instrument by means of which the electrical signals picked up by the radio or phonograph are made understandable to the human ear. It acts as an interpreter, converting pulsating audio-frequency currents into air vibrations, or sound waves.

Despite the importance attached to its operation, the speaker is not yet anywhere near as efficient as other radio components. While the cone or diaphragm can be so designed that it follows the changing audio currents, more or less faithfully, it is incapable of forcing the relatively heavy mass of air to do likewise. Consequently, the resulting sound wave is more or less a compromise, or distortion, of the original sound wave, the distortion varying in degree with the quality of the speaker.

Losses occur at all frequencies of the audio spectrum but are more pronounced in the upper and lower regions than in the middle. High-frequency losses can be minimized somewhat with electrical networks and a properly designed speaker. Low-frequency losses can be compensated only by using that auxiliary structure known as a loudspeaker baffle.

When a speaker is operated in the open and unattached to a baffle of any kind, sound waves generated at the front and rear of the cone cancel each other because they are out of phase; that is, their direction of travel is opposite and each one is bucking the other, or rather, the pressure wave at the front flows around and cancels the rarefaction wave at the rear of the cone. With the speaker bolted to a circular board, or flat baffle, with an opening in the center for radiation of sound waves, those waves generated at either side (front or rear) do not immediately reach the other side, but are retarded by having to travel around the baffle. It is possible to control the travel time of sound from one side of the cone to the other by variation in the size of baffle.

If the dimensions of the baffle are correct for reinforcement of any given frequency, a sound wave from the front of the speaker will arrive at the rear of the cone at the exact moment the next outward thrust begins. The moving wave will then push against the cone in the same direction as the voice coil is pulling, resulting in assistance

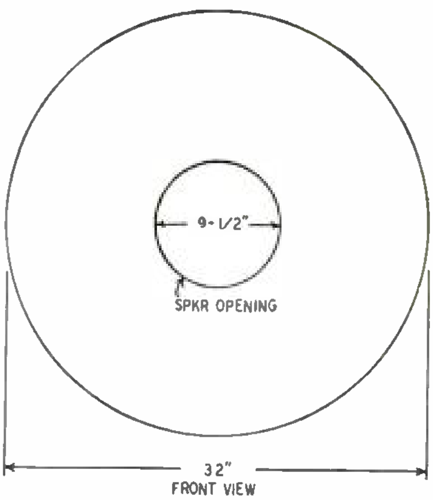


Fig. 1—Flat baffle is simplest. Round types are not as common as the rectangular ones.

to the voice coil instead of resistance to its action. The two forces are working together in series, or in phase.

The diameter of flat baffles is calculated by dividing the time of one-half cycle into the distance in inches that sound travels per second. (Velocity of sound in air at 68 degrees F. is about 1,127 feet per second, or 13,524 inches.) The diameter of the speaker opening is then added to the sum, giving the over-all diameter of the baffle.

From the foregoing it can be seen that the speaker can be *acoustically loaded* at any given frequencies. Since we are chiefly concerned with low-frequency losses and the baffle is the only means of correcting them, the acoustic load of the speaker should be at, or very near, the lowest frequency to be reproduced.

For reproduction of speech only, the low frequency may be 300 cycles per second (350 cycles for limited speech), making possible the use of a flat baffle with an over-all diameter of 32 inches, as in Fig. 1. However, music extends the lower range downward to 100 cycles and less. If we are to change the acoustic load of the speaker to 100 cycles per second, the diameter of the baffle must be increased to 77 inches. The larger size is impractical; therefore, we must look around for designs that will replace flat baffles.

Since sound waves from either side of the speaker tend to cancel each other, it would appear that a simple solution of the problem would be to enclose tightly the rear of the speaker in a sound-proofed cabinet. Theoretically this is an infinite baffle.

Actual tests have shown, however, that the behavior of the speaker does not conform to the theory of infinite baffles under these conditions and operation becomes erratic and highly variable. The reason is that the air within the closed compartment is not free. Each movement of the cone raises or

(*Continued on page* 32)▶

Audio Squelch Circuits

By JOHN L. GERGEN

IN installations where a receiver must remain on for long periods of time even though no signal is present at the antenna, noise and background hiss (present in any receiver no matter how well designed) are amplified through the i.f. and audio stages and cause annoying noises at the loudspeaker. A squelch circuit is a control arrangement, usually operating from the a.v.c. voltage, that silences the receiver when no usable signal is being received.

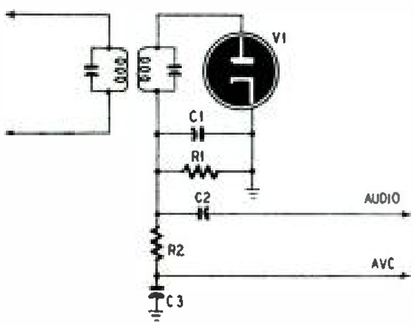


Fig. 1—The sources of a.f. and a.v.c.

Squelch circuits are used frequently in military and police receivers; such equipment must remain on to receive unscheduled broadcasts. However, designers of high-quality receiving equipment can use the squelch circuit to good advantage to silence between-station noises while tuning. A squelch circuit would be impractical for this purpose in a communications receiver when listening to signals which fluctuate rapidly at random due to atmospheric conditions, but it offers improved performance for FM and broadcast reception.

The diode detector V1 of a conventional AM receiver, such as that in Fig. 1, furnishes two output voltages. An a.f. signal, from which r.f. has been removed by C1, appears across R1. This is applied through C2, which blocks the d.c. component, to the volume control (not shown), the arm of which is connected to the grid of the first audio amplifier. The rectified d.c., filtered by R2 and C3, is negative with respect to ground. It is brought back to one or more r.f. and i.f. stages as a.v.c.

Since the a.v.c. voltage is the result of rectifying the r.f. signal, its magnitude depends solely on the signal strength, not at all upon the modulation.

The a.v.c. voltage may also be used to control a squelch circuit, as shown in Fig. 2. Only two additional tubes are required, the most convenient arrangement being to use a dual-triode. The 6SL7-GT was chosen because it has a sharp change in plate current for a change in grid voltage of from 2 to 4 when the plate voltage is 250.

How the squelch works

The circuit of the squelch is very much like that of a direct-coupled amplifier: a voltage divider is placed across the power supply, and the two stages—plates, cathodes, and grids—are placed at various points along it. Fig. 2 is drawn so as to show clearly the voltage-divider effect provided by the three resistors R4, R5, and R9 across the power supply.

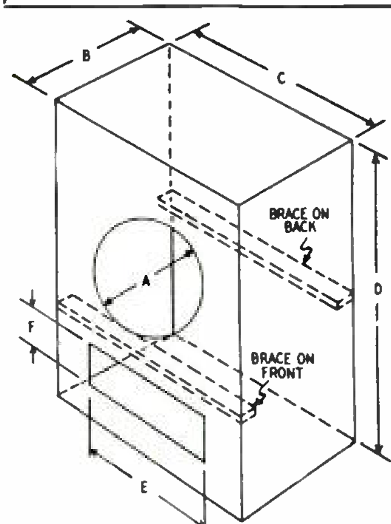
The voltage appearing across R9 is applied as plate voltage to V2-b, an ordinary cathode-follower amplifier. The a.f. signal from the detector is applied between grid and ground. Output is taken from across the cathode resistor.

The bias on V2-b, however, is controlled by V2-a, which, in turn, is controlled by the a.v.c. voltage.

When no signal is being received, there is no a.v.c. voltage; therefore there is no voltage between grid and

SPEAKER BAFFLING SIMPLIFIED

(*Continued from page 31*)



Courtesy Jensen Mfg. Co.

Fig. 2—A typical bass-reflex speaker.

Spkr. diam. (in.)	Volume (in³)	Port area (in²)	A	B	C	D	E	F
18	12,600	87	15 3/4	14 3/4	26	33	15 3/4	5 1/2
15	9,080	85	13 1/2	12	23 3/4	31 7/8	13 1/2	4 13/16
12	6,990	60	10 7/8	11	22	28 7/8	10 1/2	5 3/4
10	5,440	37	8 7/8	10 1/2	19 3/4	26 1/4	8 7/8	4 1/4
8	3,210	25	6 7/8	9 1/2	16	22 1/8	6 7/8	3 5/8
6	2,100	19	5 1/2	7 3/4	14	19 7/8	5 1/2	3 7/16

lowers the pressure of air within the cabinet, which in turn stiffens the cone. The more rigid cone is unable to follow the pulsating current in the voice coil with any degree of accuracy, especially on transients and at the higher audio frequencies.

Many designs have been created in the attempt to find suitable means of baffling the speaker and not have excessive bulk or size. One of these is the Jensen *Bass-Reflex* speaker housing shown in Fig. 2. This is essentially a sound chamber of several cubic feet, having a second radiation vent near the speaker opening. A limited amount of sound insulation used on the inside walls absorbs high frequencies, but has little effect on low frequencies. This type shows a marked improvement over the average baffle, particularly radio cabinets.

Another type recently introduced is a corner baffle utilizing adjacent wall surfaces as part of the sound channel. Fig. 3 shows how the sound channel within the cabinet is "folded" as in a re-entrant horn, eliminating much of the objectional size. Location of the cabinet is also an advantage. The efficiency of the speaker is maximum directly in front, or along the axis, decreasing as the angle of distribution becomes greater, until a point of minimum efficiency is reached along the plane of the cone.

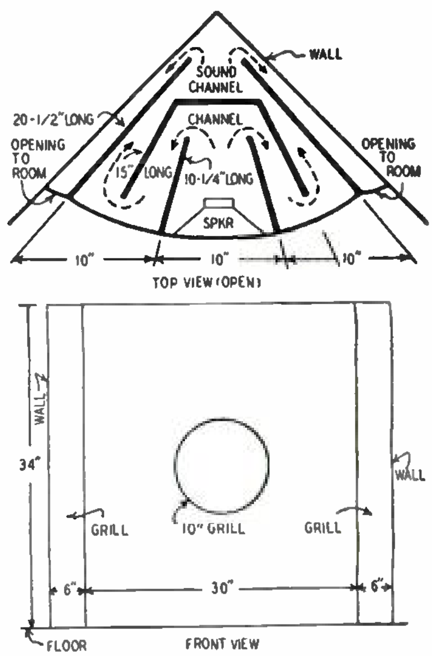


Fig. 3—Corner-type speakers like this one are becoming increasingly popular.

cathode of V2-a, except a small bias furnished by R4. The grid is connected to the negative end of the power supply (through R3, in which there is no current flow and therefore no voltage drop), while the cathode is connected to the top of R4, which is a more positive point on the voltage divider. The grid is slightly negative for that reason, but plate current flows.

The plate current of V2-a flows through its plate-load resistor R6, which has a high resistance. The current flows through R6 from plate to supply, which means that the plate end is negative with respect to the other end. The negative (plate) end of R6 is connected (through R7, in which there is no voltage drop) to the grid of V2-b, and the positive end (through R8, in which there is no drop when V2-b is not conducting) to the cathode of V2-b.

When V2-a is conducting (when there is no a.v.c.), V2-b is biased by the voltage drop across V2-a. This is sufficient to cut V2-b off completely. Therefore, it cannot amplify the audio signal impressed on its grid by the detector, and the loudspeaker is silent.

When a signal appears, it creates a

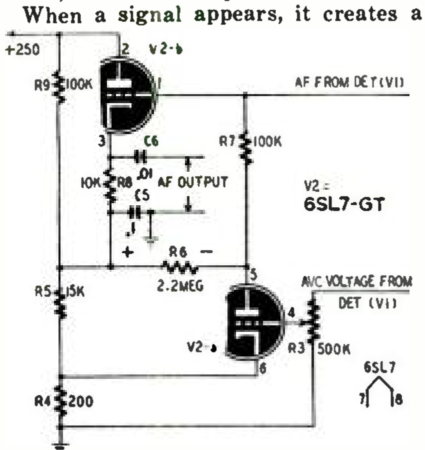


Fig. 2—Where squelch tube is inserted.

certain amount of negative a.v.c. voltage, which appears across R3. Enough of this is tapped off R3, by the setting of the movable arm, to cut off V2-a. Since there is now no V2-a plate current passing through R6, there is no voltage across it and the cutoff bias it had applied to V2-b is removed. Because the only resistors between the grid of V2-b and the bottom of its cathode resistor are now carrying no current, these two points are at the same potential. The only d.c. voltage appearing between the grid and cathode of V2-b is that caused by the usual voltage drop across the cathode resistor R8, which gives the correct bias for normal operation.

The a.f. plate current of V2-b causes a.f. voltage variations across R8. The a.f. voltage is fed out to the following audio stage through C6, which blocks the d.c. component of the cathode voltage. The lower end of R8 is bypassed to ground for a.f. by C5, so that the audio output is effectively 10,000 ohms above ground, while the entire tube is actually far above ground for d.c., a condition necessary for operation of the d.c. circuits just described.

Construction

The squelch circuit can be installed in any receiver which has a.v.c.; the detector need not be a diode. The 6SL7-GT and its resistors and capacitors can usually be installed right on the chassis. Connections are made to the receiver's B-supply, filament supply, and to the detector's audio and a.v.c. outputs.

The only actual change necessary in the receiver circuit is to disconnect the audio output of the detector from the top of the volume control and lead it instead to the grid of V2-b. The a.f. output from the cathode end of R8 is then connected to the top of the volume control. Because V2-b is a cathode follower, it has no gain and the output volume of the receiver will be about the same as before. It may be slightly less because the cathode-follower gain may be slightly less than 1, but there is not enough loss to cause trouble.

Only one adjustment is needed. The magnitude of the a.v.c. voltage developed in the receiver depends on the proximity and power of the stations listened to. The weakest of these should be tuned in and R3 adjusted until V2-a just cuts off—that is, until normal audio is heard. Tuning off the station should silence the speaker. When any other station is tuned in correctly, it should be heard; but, when tuning between stations, all noise, hiss, interference, and so on should be inaudible.

Though the diagrams show the squelch circuit used with an AM receiver, it can be especially valuable with an FM set, particularly to silence the loud hiss heard between stations on sets which use limiter-discriminator combinations. All that is necessary is a negative d.c. voltage which is present when there is a signal and absent when there is none. The grid voltage of the limiter satisfies this requirement and may be connected to the top of R3 to control the squelch. With other types of detectors which do not need limiters there is generally a way of obtaining a d.c. voltage. Sets which have a.v.c. will, of course, present no problem, as R3 is simply connected to the a.v.c. line.

MATERIALS FOR SQUELCH

Resistors: 1—200, 1—10,000, 1—15,000, 1—100,000 ohms, 1—2.2 megohms, ½ watt; 1—100,000 ohms, 1 watt; 1—500,000-ohm potentiometer.

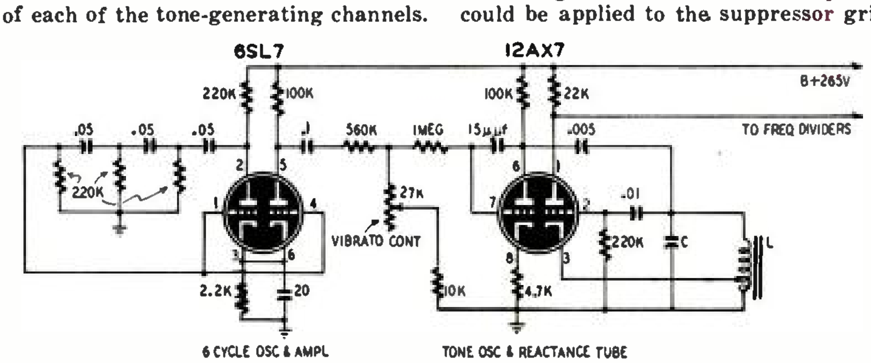
Capacitors: 1—.01, 2—0.1 µf, 600 volts, paper.

Miscellaneous: 1—6SL7-GT; 1—octal tube socket; necessary hardware.

New Electronic Music Vibrato Circuit

A novel electronic musical instrument was described in a recent issue of *Electronics*. The instrument consists of 12 tone-generator channels and an audio amplifier. A switch frame is fastened across the keyboard of a standard piano so its keys close appropriate circuits in the electronic-organ tone generators and both instruments are played at once.

Each tone-generator channel consists of an electron-coupled sawtooth oscillator and a series of four cascade frequency-halving multivibrators. Each of the oscillators can be frequency-modulated to produce a vibrato effect. Frequency modulation is produced by applying a 6-cycle signal to the grid of a reactance tube across the oscillator of each of the tone-generating channels.



The low-frequency oscillator and a single tone-generating oscillator and reactance tube are shown in the diagram.

The vibrato signal is generated in one triode of the 6SL7, which is connected as a phase-shift oscillator whose frequency is controlled by the 220,000-ohm resistors and the .05-uf capacitors. The other section of the 6SL7 is a buffer amplifier.

One section of the 12AX7 is an electron-coupled oscillator whose frequency is controlled by the values of the iron-cored inductor L and the capacitor C shunting it. The signal from the buffer amplifier is applied to the grid of the remaining triode of the 12AX7. The strength of the vibrato signal is controlled by varying the 27,000-ohm resistor. The value of this resistor is altered by switching in parallel resistors in the original circuit.

The signal from the buffer-amplifier could be applied to the suppressor grid of a voltage amplifier in an audio amplifier used with electric guitars and similar instruments to produce a vibrato or tremolo effect.

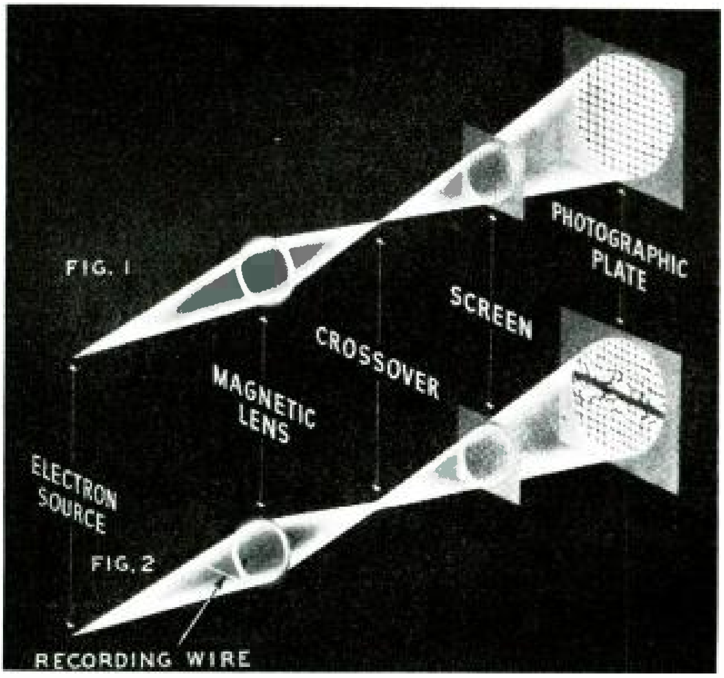


Fig. 1—Untouched beam throws mesh pattern on photo plate.
Fig. 2—Magnetized wire in path of beam distorts grid lines.

Electron Shadows Map Force Fields

★ ★ ★ ★

New technique makes magnetic and electrostatic fields visible to the eye

NEXT time you see a light shining against a wall and decide to improve the opportunity by making hand shadows resembling ducks and rabbits, you may feel a little kinship to serious-minded scientists of the National Bureau of Standards. These men are using shadow pictures too, though for a purpose far removed from innocent enjoyment. Their shadow-casting rays are not light, but electron streams projected on a fluorescent screen or photographic plate. And the shadows, cast by electric and magnetic fields in a technique developed by the Bureau's Dr. L. L. Marton, are yielding important information on hitherto invisible phenomena.

Figs. 1 and 2 show how one typical experiment was conducted. In Fig. 1 a stream of electrons emitted at the left is focused by a magnetic lens, much as a glass lens would focus light. The beam then converges at the focal point: the electrons deflected downward by the lens continue to travel downward and those deflected upward continue upward. The focus at this "crossover" point is very sharp. Thus the crossover is a virtual electron source.

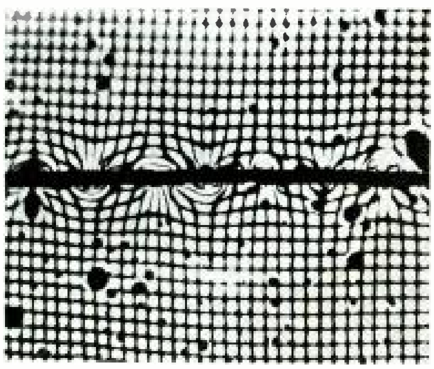


Fig. 3—Pattern of the magnetized wire.

Between the crossover and the photographic plate or fluorescent screen is a mesh of fine wires, so that the plate shows an enlarged gridiron pattern.

The field to be analyzed is placed between the point electron source and the magnetic lens. Fig. 2 illustrates what happens when a piece of recording wire which has been magnetized by a series of evenly spaced short pulses is examined. The magnetic field around the wire distorts the rays from the source before they reach the lens, the amount of distortion at any point depending on the intensity of the magnetic field at that point.

Because electron rays have been displaced, the focus at the crossover is disturbed. It becomes larger, and the virtual source of electrons which it forms is no longer simple. When the diverging beam reaches the wire mesh and casts its shadow on the screen, the even pattern of the mesh no longer appears. The disturbed rays of the source make curves and aberrations in the gridiron, vary the sharpness of focus, and make strange-looking whorls.

An enlarged photograph of the screen of Fig. 2 is shown in Fig. 3. Another picture, the pattern distorted this time by an ordinary horseshoe magnet (you can see the magnet's shadow), is Fig. 4. With the aid of complex mathematical formulas. researchers can measure and evaluate the distortion of the mesh pattern and determine exactly the strength and nature of the magnetic field set up. Even without a scientific background, however, it is easy to see the bulges above and below the shadow of the wire in Fig. 3, indicating the alternating magnetic field induced by the recorded pulses.

The electronic "shadowgraph" is expected to allow exploration of complex electric and magnetic fields of very small size, its special value being that field strength at any point can be measured. Many of these fields could never before be evaluated because a probe any larger than an electron disturbs the field. Investigation of the

Fig. 4—Pattern of a horseshoe magnet.

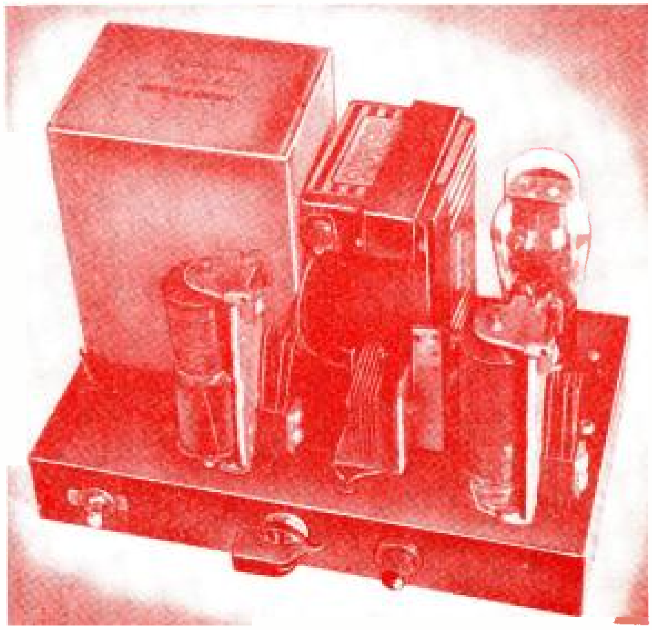
fundamental nature of ferromagnetism, for instance, is now under way at the Bureau of Standards. Space-charge fields, fields produced by contact potentials, charge distribution in gaseous plasma, waveguide problems—all these and more will yield their secrets to the probing electron ray.

One of the important fields the technique may be applied to is waveguides. Often the shapes of waveguides are too complex to allow mathematical analysis and the engineer depends on experiment. By measuring the fields in waveguides of various sizes and shapes with electron shadows, it may be possible to set up formulas to predict performance accurately and eliminate much guess work.

Lead-Pencil Mark Sets Off Relay

Thyratron and two delay relays make simple responder

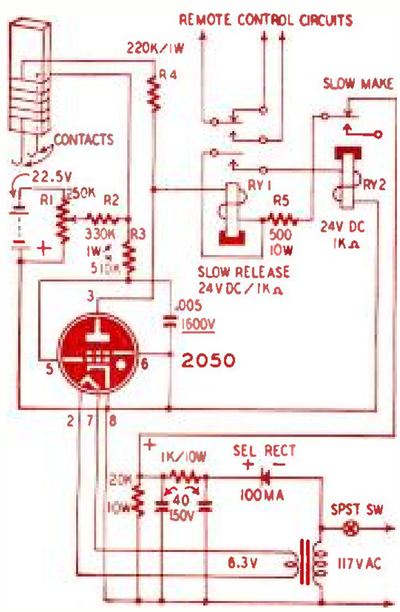
By VICTOR H. LAUGHTER



Responder chassis. The large filament transformer is not necessary.

THE pencil-mark responder is a device that operates a relay when a pair of contacts passes over a pencil mark. Because the resistance of pencil marks is not only high but very variable, the current through the marks is neither great nor constant enough to operate a relay directly; and if the pencil marks travel under the contacts at any but the very slowest speed, the contact does not last long enough to operate a relay even through a vacuum tube.

The model described here was used with a traveling tape in which holes had been punched to record store purchases. The name of each item purchased was printed on the tape and the following holes worked in conjunction with mechano-electric selectors to indicate and add up prices. When a purchase for which holes had been punched had to be canceled, a line was drawn through the printed name. When the contacts passed over the pencil mark, the responder relay opened long enough to make the price-calculating mechanism blank out until the next item was reached. Other possible applications include computing devices and grading machines for school examination papers. In either case, combinations of contacts connected to separate relays would be needed.



Schematic of the pencil-mark responder.

The diagram and photographs show the basic unit. The U-shaped contacts were quickly made for experiment but should be much improved for continuous duty. The 2050 is a thyratron.

The potentiometer R1 across the bias battery is normally set so that the gas in the 2050 does not ionize and the tube is cut off. Plate voltage is supplied to the tube through the coil of RY1 and R5. Positive voltage is also supplied to the contacts through R4, an isolating resistor.

When the contacts hit the pencil mark, positive voltage is applied through R4, the pencil mark, and R3 (another isolating resistor) to the 2050 grid. Because the resistance of R2 and R1 is fairly high (330,000 ohms minimum, actually much more because the potentiometer arm is some distance from the positive battery terminal), very little current is drawn from the plate supply through the contact network. The positive voltage, even when there is considerable resistance in the pencil mark, is high enough to raise the grid above the triggering point. The gas then ionizes, and the tube conducts.

As soon as the tube conducts, or fires, plate current is maximum and the grid loses control. RY1, in series with the plate and the B-supply, closes immediately. Its s.p.d.t. contacts actuate the remote control circuit, whatever it may be. Its s.p.s.t. contacts close, sending B-current through RY2.

RY2, however, is a slow-make relay. (The model used a surplus Clare time-delay type with a copper slug on the armature end of the coil.) Closing delay for RY2 may be adjusted up to about 0.1 second.

When RY2 closes, the current supply to it, to RY1, and to the 2050 plate is interrupted. RY2 opens immediately but by this time the tube has deionized, the negative grid has resumed control, and the tube is again at cutoff.

RY1 is a slow-release relay (another surplus Clare unit). After a time adjustable up to about 0.4 second its contacts release. The control circuit is returned to its original condition, and the circuit is ready for another contact.

The speeds to which the relays should be adjusted depend on the maximum speed at which pencil marks are expected to hit the contacts. The combined relay delay times should be slightly less than the time between marks.

Contacts have been placed as far apart as 4 inches with stable operation, but probably the ideal distance is around 1/16 inch. The selenium-rectifier supply shown in the diagram was selected for simplicity, and is thoroughly satisfactory. The contacts shown are a pair of bent wires lashed to a piece of polystyrene with Scotch tape. Adjustment of the unit merely requires setting R1 at a point just negative enough to keep the tube from firing.

MICROWAVES

Part VIII—Receiving and transmitting antennas for microwave communication

By C. W. PALMER

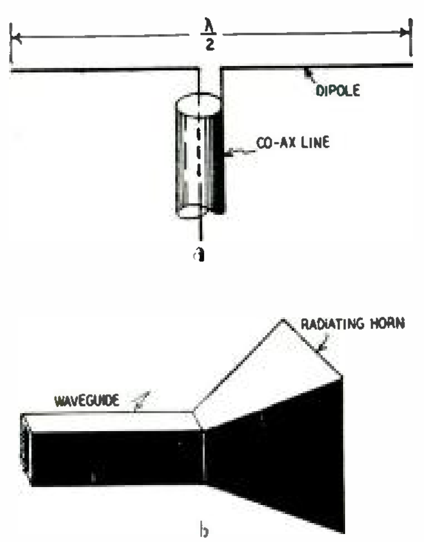


Fig. 1—U.h.f. dipole and horn antennas.

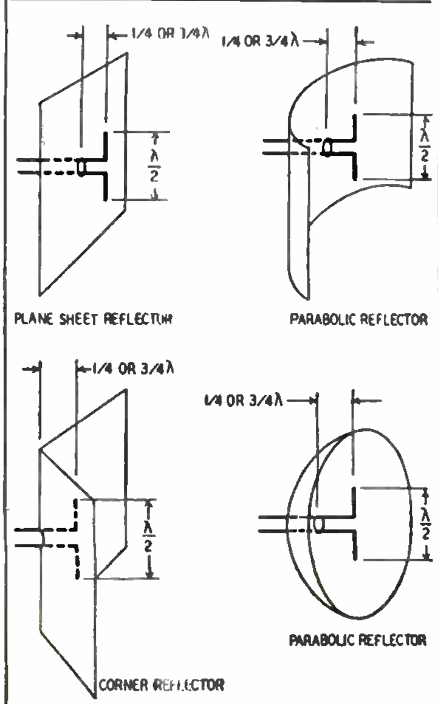


Fig. 2—Reflectors concentrate the beam.

OUR study of microwave components cannot be called complete until the subject of antennas, both for transmitting and receiving, has been thoroughly explored.

The usual considerations for antenna design at lower frequencies must be modified for microwaves. First, transmission distances are usually limited to the line-of-sight, which means about 20 to 50 miles, depending on the antenna height and the terrain over which the signals are to be sent. Second, microwave transmission usually is point-to-point rather than broadcast, so that it is desirable to use some form of beaming for the transmitting and receiving antennas. Third, the physical sizes of the antennas for microwaves lend themselves to efficient use of reflectors, directors, and multiple-unit radiators. And fourth, the extremely short lengths of microwaves permit the use of electronic lenses, which simulate in action the lenses used in optics to focus and concentrate light.

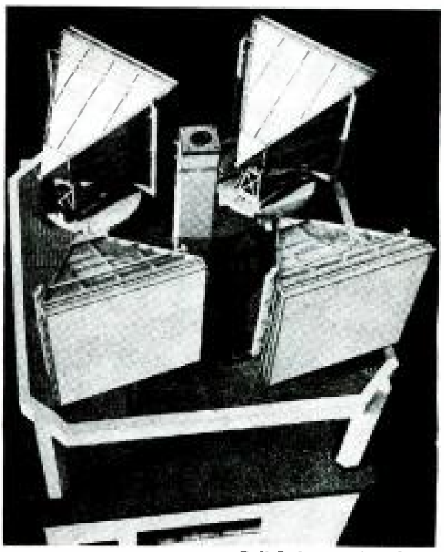
Transmitting Antennas

The simplest forms of microwave antennas are the dipole and expanded waveguide (horn) shown in Fig. 1. Both of these have a certain amount of directivity. The dipole has the usual bidirectional figure-eight pattern, while the horn has a unidirectional field-strength pattern.

The dipole can be made unidirectional by placing a reflector behind it. A flat metal plate, a plate shaped into a parabola, a series of parallel rods about 0.1 to 0.25 wavelength apart, and other types of reflectors serve to focus the radiation from a dipole antenna into a beam that gives antenna power gain of several decibels. Fig. 2 shows a few of the reflector shapes commonly used.

A group of stacked dipoles and a large reflecting sheet or series of deflecting rods provide still greater antenna gain than does the single dipole and reflector. These are stacked arrays.

The increased efficiency of narrow-beam transmission permits the use of very low-power transmitters, because the power is concentrated rather than being spread over a large area. This is fortunate because it is difficult to generate high power in the microwave range. With the concentrated beam, the effective power sent out is very high compared to the actual transmitter out-



Bell Laboratories photo

Fig. 3—Four typical microwave lenses.

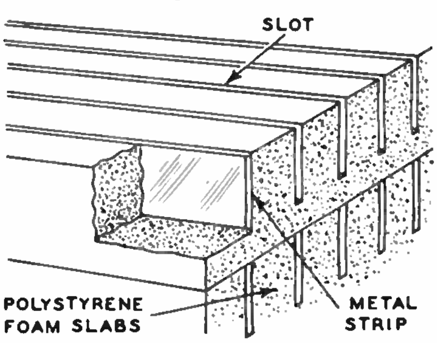


Fig. 4—Cross section of magnetic lens.

Bell Laboratories photo

Fig. 5—Putting together a metal lens.

put power, which in most cases is well under 100 watts. Using higher power is unnecessary because receiver gain—especially in the i.f. and a.f. sections—can be upped as needed, provided the signal at the receiving antenna exceeds the noise by a reasonable ratio. Atmospheric noise is a very minor problem at microwaves.

Microwave Lenses

While the reflector plates and rods described above follow to some extent the principles of optics in focusing a radio beam (somewhat as do the reflectors used in auto headlights and in searchlights), an even more striking similarity was recently demonstrated by the Bell Telephone Laboratories in disclosing their new microwave lens. Microwaves are focused in beams by being bent through sheets of insulating material and metal strips of the correct dimensions and shapes. Just as light waves can be bent in a glass lens to focus on a small spot, the microwaves are bent in this easily controlled focusing device, which produces efficiencies even higher than the reflectors and which is capable of handling a much greater bandwidth.

This is not to be confused with the earlier Bell electromagnetic lens, pictures of which have been published in this magazine and in many Bell advertisements, especially around 1946. That lens worked on a waveguide principle and its frequency range was limited. The new lens might be called a true optical type, and the strips (or beads in some models) of metal in the lens look to the radio wave much the same as the molecules of glass in a standard optical lens look to the much shorter waves of light.

Fig. 3 shows four of these lens antennas installed at a television relay station. At the base of the horn-shaped shield is the waveguide feed which supplies the r.f. power. The shield allows the waves to spread out over the entire surface of the lens which then focuses them into the narrow beam (vertically polarized) needed for the transmission path.

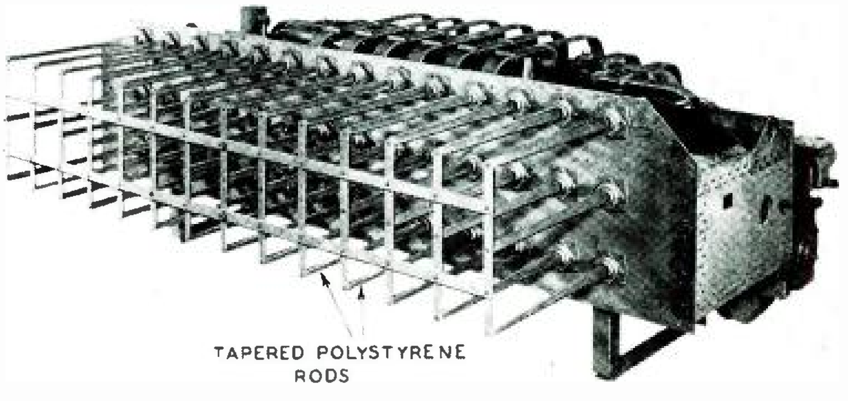
As shown in Fig. 4, the lens consists of slabs or sheets of polystyrene foam (somewhat like sponge rubber in appearance). Thin strips of metal are inserted into slots cut into the foam in a predetermined pattern. The lengths and positions of the metal strips determine the sharpness and other characteristics of the beam.

The construction of the lens is shown in Fig. 5.

End-Fire Antennas

Microwaves follow a plastic rod just as light waves follow a lucite or fused-quartz rod. This phenomenon has been used to demonstrate the action of the waveguide many times, but has found little application in practical microwave work.

However, one radar device developed during the war and used commercially for point-to-point microwave communication is the end-fire antenna, which makes use of this ability of plastic materials to guide waves.



Bell Laboratories photo

Fig. 6—In this wartime end-fire array, the microwaves follow plastic rods.

Fig. 6 shows a wartime version of the end-fire antenna. It contains three rows of polystyrene rods, 42 in all, each of which is fed by a waveguide from the transmitter.

Such an antenna displays a remarkable ability to beam microwave signals and is easily controlled by correctly dimensioning the plastic rods. The number of rods, their length, and spacing depend on the width of the beam required and the power to be transmitted. These antennas have gains up to 17 db.

Receiving Antennas

The subject of receiving antennas can be covered very quickly: in most microwave installations the transmitter antenna is also the receiving antenna. Thus all the factors mentioned above except power-handling ability apply also to receiving.

When separate receiving antennas are used, they usually take the form of a dipole backed up by some form of reflector. Where extremely sharp beaming is needed, the parabolic reflector or "dish" is generally employed while in the case of extremely wide-band work, such as television link receivers, the lens—used with either a waveguide or a dipole—is preferable.

For the amateur radio experimenter, a dipole receiving antenna with either a flat or bent plate or rod reflector is probably the best. It is simple and fairly efficient.

Antenna Matching

For both receiving and transmitting it is necessary to match the impedance of a microwave antenna to the feed line for efficient operation. Let us consider a typical antenna consisting of a dipole mounted in a parabolic dish reflector.

The position of the antenna in the dish is set for maximum gain and minimum side lobes. The side lobes are secondary responses which are always present in this type of antenna and, if large enough, will destroy its directional characteristics as well as reduce its efficiency. Fig. 7 shows a typical antenna field pattern for a highly directional beam with the main lobe and the side lobes marked.

The antenna is matched to the feeder with impedance-matching transformers which were discussed earlier in this series. For co-axial type feeds a quarter-wave transformer on the inner conductor is ordinarily used. Waveguides are matched by inserting a matching "window" at the proper place. A properly matched antenna feeder should have a standing-wave ratio of less than 1.2 after final adjustments.

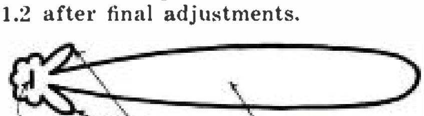
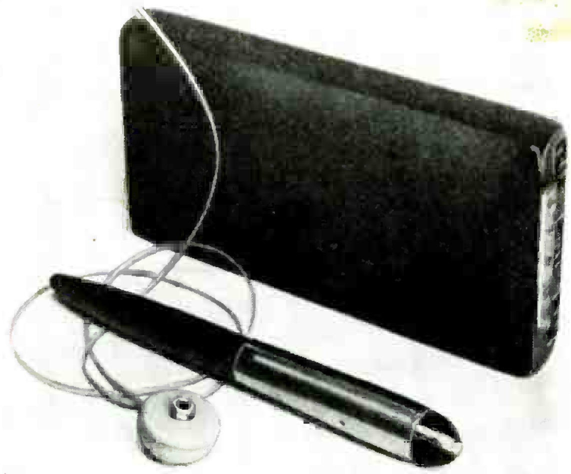


Fig. 7—Ideal result is a narrow beam.

It is desirable to keep the r.f. feeder as short as possible to avoid losses. In many microwave installations, notably radar systems, the r.f. generator or transmitter is located very close to the antenna, with cables carrying d.c. power and modulation (voice, keying, or pulses) to the r.f. tubes. While this may seem troublesome to the amateur experimenter, the results pay many times over for the increased construction difficulties. Care taken in building the r.f. generator will keep it small and light enough to mount right on the antenna mast or in a container at its base.

Receiver Fits Shirt Pocket



Whole receiver is no taller than a standard fountain pen.

Subminiature tubes in a standard regenerator

By THOMAS J. JUDGE

THE set described here was built around three subminiature tubes, using an orthodox circuit consisting of a regenerative detector followed by two stages of audio amplification. Permeability tuning, used with a built-in loop antenna, covers the entire broadcast range from 550 to 1,500 kc. A small 22½-volt B-battery and two standard penlight cells (used in parallel) provide the power supply. All parts are mounted on a 1/16-inch phenolic plate and enclosed in a case of 1/16-inch black Plexiglas. A slide-rule-type dial is mounted on the top end of the chassis, adjacent to the three control knobs. The over-all size of the unit is only ¾ x 2⅞ x 5⅝ inches.

To keep the size of the unit to a minimum and also to provide a simple and neat-looking job, no wiring was used to make connections. Instead, all connections were cut from a piece of .012 phosphor bronze, after which each piece was tin-plated. Small silver-plated eyelets and small turret-type lugs were used to fasten the various pieces to the chassis and also to provide means of anchoring the resistors and capacitors.

Subminiature sockets were cemented to the chassis to provide a ready means of replacing the tubes. In addition, fixed clips are provided for the batteries, simplifying replacement. All components are so arranged that replacement can be made with the utmost ease.

The circuit used in this set is quite orthodox with the exception of the method employed for regeneration. Referring to the circuit diagram, note that one winding of the feedback coil is in series with the plate of the detector tube. The other winding is in series with the loop antenna. This arrangement provides very good gain and at the same time reduces to a minimum the effects of detuning caused by body capacitance.

The smallness of the receiver can be readily seen in the photograph of the assembled set and a standard fountain pen. The other photos show the chassis, both front and back views, when removed from the case. Note that the bottom portion of the case is cemented to the chassis.

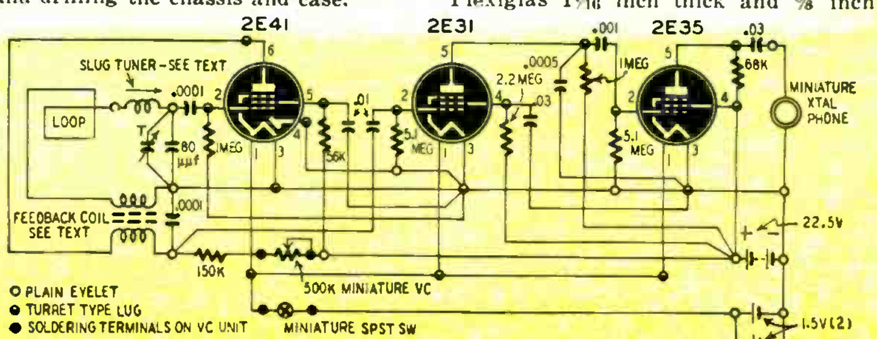
Construction of a really small receiver such as this presents a number of problems not usually encountered. Because of the small working space each part must be added with great care.

Anyone interested in building such a receiver should first acquaint himself with each component to be used. With patience and care, a scale drawing should then be made showing the exact location of each component. This drawing can be used as a guide in forming and drilling the chassis and case.

A certain amount of time should be spent learning how to bend and cement plastics, which, with a little practice, are very easy to work with.

The complete circuit is shown in the drawing. The photographs reveal how most of the connections are made. The loop consists of 14 turns of No. 34 enameled wire wound on the 1/16 x ½-inch strip cemented around the outer edge of the chassis. The regeneration transformer consists of a drilled and tapped powered-iron core ⅜ inch in diameter and 5/16 inch long. A single layer of Scotch tape was first wrapped around the core, and the plate winding, 60 turns of No. 40 enameled wire, was then wound. Coil dope was painted on, and, after it dried, grid winding, of 25 turns of the same size wire, was added. All leads were left fairly long until after assembly to the chassis and until after all the necessary operating tests were made.

The permeability tuner consists of a phenolic tube of ¼ inch outer diameter and 1 11/16 inches long. Small pieces of Plexiglas 1/16 inch thick and ⅜ inch



Circuit is almost standard regenerative set. Tubes are Raytheon subminiatures.

square were drilled and cemented to both ends of the tubing for mounting. The space between the two end pieces was covered with a single layer of No. 43 enameled wire. A powdered-iron slug 1½ inches long and 15/64 inch in diameter provided with wire hooks on both ends completed the unit. For good efficiency the slug must fit snugly within the tubing. Start with an oversized slug and carefully turn it dowr until a snug fit is provided. Small grooves 1/16 inch wide, ⅝ inch long, and 1/32 inch deep are cut in the chassis, after which the ends of the tuning unit are placed and cemented to the chassis.

The driving element of the tuner consists of standard dial cord, tension spring, a small piece of black Plexiglas, and a drive pulley. Turret-type lugs are used to guide as well as to retain in place the dial cord. The pointer is made from black Plexiglas cut in a U shape. The upper side of the piece acts as the pointer, while the lower half connects to the dial cord. The drive pulley was turned down from a piece of ¼ x ½-inch brass rod. It is ¼ inch outside diameter and ⅛ inch wide, with a groove approximately 7/32 inch wide and 1/32 inch deep. The balance of the rod is turned down to ⅛ inch and the tuning knob is mounted on it. In mounting the drive pulley, a 1/16-inch piece of Plexiglas was riveted to the chassis to provide sufficient bearing surfaces. This can readily be seen in the lower photograph at right.

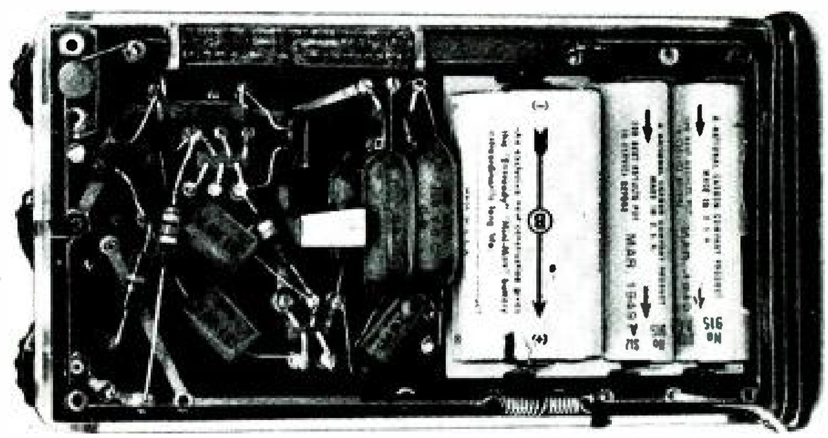
The tuning knob was made by using the outer part of a standard IRC miniature volume control with a piece of phenolic plate cemented on the inside. A hole approximately ⅛ inch in diameter was then drilled through the center. A small drilled and tapped hole provided a way of securing the knob to the tuning shaft.

The trimmer capacitor was made from a 1/16 x ¼ x 13/16-inch phenolic plate, two pieces of .012 phosphor bronze, and a thin piece of mica taken from a small standard trimmer. After cutting and forming the various pieces, a hole was drilled and tapped in the chassis as well as in the additional piece of phenolic plate. The pieces were fastened to the chassis with small eyelets, a small brass screw providing means for tuning.

The photographs show the method of completing the various connections with the phosphor bronze strips. These connections are cut and drilled in accordance with the scaled drawing. They should then be tin-plated to prevent corrosion.

Referring to the photos, you will note that the bottom portion of the case, a piece of ⅛-inch black Plexiglas, is fastened to the chassis. A groove 1/16 inch wide, 1/16 inch deep, and 2⅝ inches long was cut in this piece. The chassis is made long enough so that its bottom end can be inserted in the groove and cemented in place. After the body of the case was formed and cemented together a section 1/16 inch wide and 1/16 inch deep was cut off the inner edges of the bottom piece to provide a satisfactory fitting between the case and the bottom piece.

This side of chassis shows how the tube "pins" are bent and pushed in sockets.



Chassis is flat piece of phenol plate. Note metal strips used for connection.

The upper portion of the case is also made from ⅛-inch black Plexiglas. After cutting the necessary openings for the three knobs, an opening ⅛ inch wide and 1⅝ inches long was provided for the tuning dial. A piece of clear Plexiglas 1/16 x ¼ x 1¾ inches was used for the face of the dial, with the numbers 5, 7, 9, 13, and 15, properly spaced, engraved on it. This piece was cemented over the opening mentioned above. To provide sufficient space for the dial pointer, it was necessary to remove a small portion from the underside of the top piece adjacent to the opening provided for the tuning dial. After this, the top piece was cemented to the main body of the case.

The chassis slides into the case from the bottom and they are locked together with a small phosphor bronze spring attached to the chassis. This spring engages a slot cut on the inside of the case. A small hole, large enough to accommodate the point of a pencil, is drilled through the case opposite the spring. To remove the chassis from the case it is necessary only to insert the point of a pencil in the hole, pushing the spring away from the chassis and releasing the lock.

Parts List for Three-tube Radio

Resistors: 2—5.1, 1—2.2, 2—1 megohm; 1—150,000, 1—68,000, 1—56,000 ohm, 1/3-watt. 1—500,000-ohm control, IRC type H.

Capacitors: 2—.03, 2—.01, 1—.001, 1—.0005 μf, 100-volt, paper, hearing-aid type; 1—80 μμf, 2—.001 μf, ceramic.

Miscellaneous: 1—IRC type SH fingertip switch, 1—hearing-aid-type crystal phone; 1—Raytheon 2E31, 1—2E35, 1—2E41 subminiature tubes, 1—Eveready type 412, 22.5-volt hearing-aid battery or equivalent, 2—type 915 or equivalent penlight cell, assorted eyelets and turret-type lugs.

SLUG-TUNED PUSH-BUTTONS

A number of receivers use slug-tuned push-button tuning assemblies consisting of a number of coils, each tunable over a narrow sector of the broadcast band. Frequently it is desirable to increase the resonant frequency of one or more of these coils.

To do this, cut a small brass slug from a volume control shaft or other round stock and insert it into the coil form. Locate the best position for the slug, tape it for a snug fit, and cement it in place. Use the powdered-iron core for precise tuning.

—*B. F. LaDue*

How to Become a Ham

PART III—Study and application will supply the required knowledge of amateur regulations and radio theory

By GEORGE W. SHUART, W4AMN

THE most urgent problem once you have decided to be an amateur is how to persuade the government to give you station and operator licenses. The accepted method is to go to the nearest Federal Communications Commission field office on a day when amateur examinations are scheduled, and prove your fitness to hold an amateur call by sending and receiving code at 13 words per minute and by taking a written examination. If you practice code long enough, remembering the hints given last month, you'll have little trouble sending and receiving at that speed.

The written examination covers two main subjects, the first of which is rules and regulations—when, how, and on what frequencies amateurs may transmit, technical standards, traffic rules, and the many other restrictions and procedures which govern all stations and ham stations in particular. Entirely aside from the immediate problem of passing the examination, a thorough knowledge of regulations will do as much for you as knowledge of traffic regulations does for an automobile driver; it may prevent loss of your license.

A "pink ticket" in a ham's mail any morning will probably spoil his whole day, for it tells him he has been disobeying the rules. Usually, if the offense is not very serious, he is given several days to clear up the violation if it is a technical one. He must then reply to the FCC's notice, detailing all the steps he has taken to prevent further violation. Serious or repeated offenses mean permanent loss of license and no more hamming!

Amateur regulations may be found in various amateur publications, but the safest procedure is to get the information right from the horse's mouth. That means putting 15 cents (in coin) in an envelope addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D. C., and asking for *FCC Regulations, Part XII: Rules Governing the Amateur Radio Service*. You will receive a copy of the basic rules plus any recent amendments, which will bring you right up to date.

Technical questions

The second and major portion of the written examination will tell the Commission whether you know enough about the technical side of amateur radio to operate a transmitter and receiver without transgressing the regulations. To pass this section you must know basic electricity and electronics, and be familiar with antennas and common transmitting, receiving, and amplifying circuits, as well as being able to make simple calculations involving nothing more complex than basic algebra. You must, of course, know the important radio formulas on which the calculations are based.

The FCC's use of multiple-choice questions (instead of writing down an answer, you indicate which of several printed answers is correct) simplifies the task to some extent. If you arrive at an answer that differs from all of those given, you know it is wrong and can try again. In many cases, you can make an "educated guess" if you are fairly familiar with the subject but don't know the exact facts. *The Radio Amateur's License Manual* (available from ARRL) contains many pages of typical questions and answers, and is the ideal text for this examination.

Some people say you don't have to know much about radio to be a successful amateur. These people (who usually have lots of money) go to a store and buy all their equipment, and then persuade another amateur to set it up and show them how to turn it on and off. When they get on the air, they find that just about every other amateur wants to talk about equipment and technical matters. There is little room in hamdom for those who don't care to learn at least as much about technical matters as the average radio receiver technician.

Where to find the answers

Learning radio is not hard. If it isn't a pleasure, you have no business trying to get an amateur license. You can get all needed knowledge at the experimenter's workbench, and you can get most of it from reading. The best way is a combination of the two—read about it, then try it.

One book every amateur and prospective ham should own is *The Radio Amateur's Handbook*, published yearly by the American Radio Relay League and available (like all League books) either directly from ARRL in West Hartford, Conn., or from your local or mail-order parts dealer. A basic text on amateur radio, it contains instructions for building every item of amateur equipment. Another book, similar to it, but different enough to give additional help, is the *Radio Handbook*, published by Editors & Engineers, Ltd., Santa Barbara, Calif. These two texts are most helpful if you already have some knowledge of radio in general.

For the real beginner, there are many elementary books as well as magazine articles. John T. Frye's series, "Fundamentals of Radio Servicing," currently running in RADIO-ELECTRONICS, is excellent. The series started in the February, 1949, issue. Additional texts and references are given in the table below.

Whether or not you do much reading, you will be unable to get the "feel" of radio without doing some practical work. Any issue of this magazine will give you material to work with. Try building a simple receiver or a photo-tube relay or any one- or two-tube gadget. When you have made it work, try something a little more complicated. Each time you build something, try to find out why it works as it does. Use both your books and your brains. To illustrate how much experimenting is necessary for an understanding of radio, notice typical magazine articles that direct the reader to use some component or other from the "junk box." It's a rare radioman who doesn't have a pile of parts left over from past experiments. Before you can consider yourself qualified, you'll have one too!

A very great part of radio—the most important part—is concerned with tubes. Every handbook covers tube operation, of course, but you will need a tube manual as well. A "best buy" is the 35-cent *RCA Receiving Tube Manual*, which lists the characteristics of all receiving tubes and also contains many pages of general information about tubes and their use. This information should be read thoroughly—it is one of the best and simplest texts on the all-important radio tube.

Radio mathematics

Some experimenters have played with radio for many years without ever learning Ohm's law—but no amateur ever went on the air so sadly ignorant, if for no other reason than that he had to know it to pass the examination.

The necessary math is not hard. The basic formula that deals with current, resistance, and voltage, for example (these factors are dependent on each other) is $E = IR$, which means that the voltage across a resistance (symbolized by the letter E) is the product of current (I) times resistance (R). Note that we could have written this $E = I \times R$, but, as in any algebra, the "times" sign may be omitted between symbols.

If we know the values of E and I and want to find R, rearrange the formula by dividing both sides by I:

$$\frac{E}{I} = \frac{IR}{I} \text{ or } R = \frac{E}{I}$$

Another rearrangement

$$I = \frac{E}{R}$$

serves for finding current when you know the voltage and resistance in the circuit.

If you don't remember your high-school algebra—at least the simpler parts of it—or if you never took the subject, dig into a good elementary textbook.

A more complex formula, the basic one for resonance in a tuned circuit, is

$$f = \frac{1}{2\pi \sqrt{LC}}$$

The symbol f represents resonant frequency, L the inductance of the coil, C the capacitance of the tuning capacitor, and $\pi = 3.14$. By the same algebraic rearrangement process, we can find L or C if the other two factors are known. In this case, the squares and square roots dealt with require a little more experience and knowledge than the simple Ohm's law formulas.

Believe it or not, these calculations are really necessary in ham work as well as in the license exam; it will pay you well to brush up on your figuring.

When you consider yourself fairly well along the road to the necessary knowledge, get really interested in the ARRL *License Manual*. You will find in it questions similar to those on the FCC examination. Each question is followed by the correct answer. Go through the book covering the answer to each question with a 3 x 5-inch index card while you try to figure it out yourself. The ones you do well on, leave alone. The ones you miss, mark in the margin and use as a study guide. When you can answer every question in the *License Manual*, you can pass the examination.

Good luck!

USEFUL TEXTS AND REFERENCES

Radio Physics Course	Alfred A. Ghirardi
Fundamentals of Radio	Frederick E. Terman
Radio Fundamentals	W. L. Everitt
How to Become a Radio Amateur	A. R. R. L.
Radio Amateur's License Manual	A. R. R. L.
Learning the Radiotelegraph Code	A. R. R. L.
The Radio Handbook	Editors and Engineers
The Radio Amateur's Handbook	A. R. R. L.
Mathematics for Radiomen	Nelson M. Cooke
The Radio Amateur Newcomer	Editors and Engineers

CAVITY RESONATORS

SINCE the war, with information being released gradually by the authorities, large numbers of radio men apparently have been catching up on their reading. Believe it or not, many who were not in the armed radio services or in secret civilian war work are just hearing about cavity resonators and think these are swell gadgets. Highly technical radio treatises explained these devices (and waveguides too) several years ago, but in mathematical language that frightened away the practical boys.

For some unexplained reason, the author's mail lately has included a respectable number of requests for the dimensions of cavity resonators for use in transmitters and frequency-measuring gear in the amateur 1-, 2-, and 6-meter bands! We advised the inquirers that a cavity for even the 1-meter band is a cumbersome thing, that you just can't do the job with a beer can or lunch bucket, and that there are simpler ways to tune up in those bands. But the reply keeps coming back, "So it *is* as big as an ash can. All right—tell me the exact size. I still want to know."

Maybe somebody has an explanation for this sudden interest and this surprising disregard of physical size. We haven't. At any rate, in an effort to be of service, the accompanying table has been prepared to show the sizes cavities would have to be for the 1-, 2-, and 6-meter bands. The reader can see from that just how big the things must be and can draw his own conclusions.

In each case, the center frequency of

CAVITY-RESONATOR TABLE

Frequency (mc)	Cylinder (diameter—height immaterial)	Cube (box with equal sides, each side in inches)	Sphere (diameter perfect ball)
220-225	40 6"	37.3"	46.59"
235-240	38 2"	35.2"	43.7"
144-148	62"	57 2"	71"
50-54	14'6"	13'5"	16'7"

the band has been selected for calculating the cavity size. We do not believe amateurs are interested in any but the simplest shapes—cylinder (can), cube (box), and sphere (ball). We also doubt that anyone will be honestly interested in a 6-meter cavity, since it would have to be as big as a room. (But a few years ago, we did not think amateurs would be interested in ranch-sized rhombics!) — *Rufus P. Turner, K6AI*

The S-72 is a portable 4-band receiver.

Radio Set and Service Review

Hallicrafters Model S-72

HALLICRAFTERS model S-72 is an eight-tube, four-band, three-way portable receiver of AM and c.w. signals between 550 kc and 30 mc. Housed in a brown leatherette-covered case 12¼ inches high, 14 inches wide, and 7¼ inches deep, it can be operated from 117-volt a.c. or d.c. lines or from its pack-type battery. This set has such features as electrical bandspread, automatic noise limiter, b.f.o., and phone jack, but it is definitely not a full-fledged communications receiver as were the Sky Traveler and Sky Ranger.

The tube line-up consists of a 1T4 r.f. amplifier, 1U4 mixer, 1R5 oscillator, two 1U4 i.f. amplifiers, 1U5 second detector, first a.f. amplifier, and a.v.c., 3V4 power amplifier, and 1U5 b.f.o. The r.f. amplifier is wired to use a loop antenna for broadcast reception and standard antenna coils and a telescoping rod for shortwave.

The oscillator is connected as a triode with grids Nos. 2, 3, and 4 connected to the plate. A 7-$\mu\mu$f capacitor and 47-ohm resistor connect the oscillator plate to the mixer grid to provide local oscillator injection voltage. Resistance coupling being used between the i.f. stages, there are only two i.f. transformers in the set. The second detector and audio sections of the set are conventional. The phone jack disconnects the speaker when the phones are plugged in. Phones of 500 ohms or higher impedance can be used.

The b.f.o. is a triode-connected 1U5. Stray capacitance (and possibly feedback through the power supply) provides coupling between the second detector and b.f.o.

The automatic noise limiter is a shunt-diode type using the diode of the 1U5 b.f.o. tube.

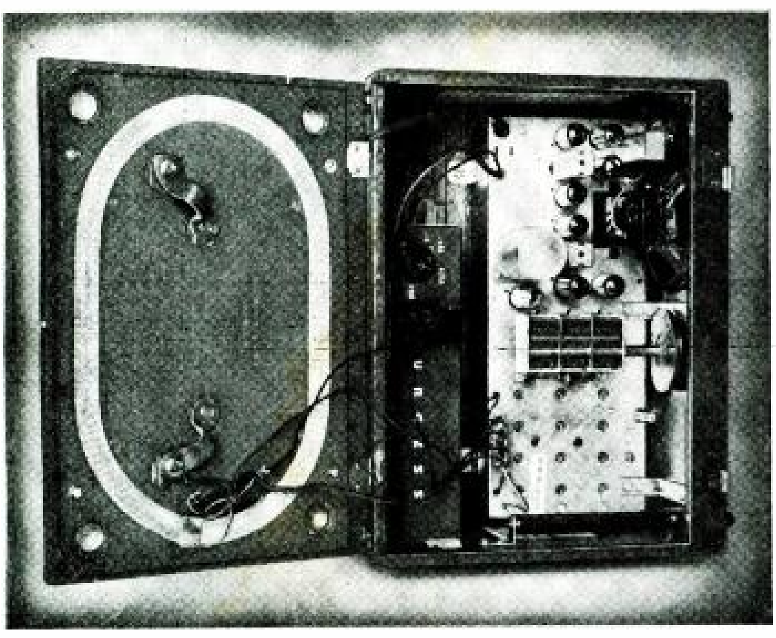
The controls are TUNING, BANDSPREAD TONE, BAND SELECTOR, VOICE-CODE, ON-OFF-VOLUME, and A.N.L. (automatic noise limiter). In the model examined, one of the first off the production line, the bandspread capacitor is a compression-type mica trimmer (C37 in the diagram) shunting the oscillator section of the tuning capacitor. The shaft of this control has a metal projection which opens the tone switch S3 when the bandspread control is set at zero for normal broadcast reception. Moving this control through six divisions on the dial closes S3 and connects a 470-$\mu\mu$f capacitor between the plate of the first a.f. amplifier and ground. The manufacturer states that the tone switch has been eliminated and a three-section bandspread capacitor installed on models now in production.

The VOICE-CODE control is a combination r.f. gain control and a.v.c.-b.f.o. switch. When it is turned clockwise as far as it will go, the set operates at maximum sensitivity because the r.f. and first i.f. screens are operated at the full voltage developed across R8, the r.f. gain control. Switches S2-b (a.v.c.) and S2-c (b.f.o.) are open. Turning the control counterclockwise applies B-voltage to the b.f.o. and grounds the a.v.c. line.

Although the S-72 is primarily designed as a general-purpose portable, its electrical bandspread and b.f.o. put it several jumps ahead of others in the same class. It was compared with several a.c.-operated communications receivers and was able to hold its own on almost any signal which did not require a Q-5'er or crystal to pull it in. A good long-wire antenna increases the average signal level about four S-points over the whip antenna and brings weak signals well above the noise.

The model tested has a tendency to be microphonic when the speaker is used while receiving signals in the 11 to 30 mc range. This is caused by acoustic feedback between the speaker, the oscillator tube, and its section of the tuning capacitor.

This set could be adapted for amateur service by taking the b.f.o. and a.v.c. switches off the r.f. gain control and replacing them with a d.p.s.t. switch. The addition of a standby switch and provisions for a doublet-type antenna would make this receiver ideal for field-day operations.

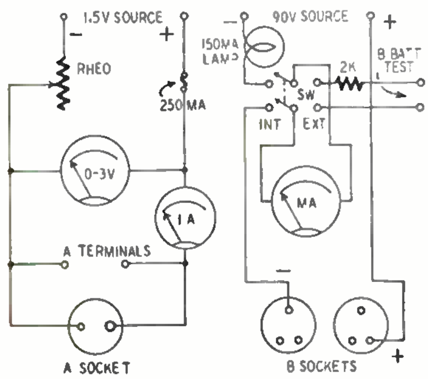


A single pack supplies A- and B-power. A broadcast loop is inside back cover.

Turn dial across local stations. A dip in the total B-current indicates normal a.v.c. action. (This is some help in alignment.)

With class-B-output sets, tune in a local station, and increase volume. One look at the heavy peaks of B-current will show your customer how to conserve B-batteries by holding volume down when not required.

To check for open filaments in individual tubes, turn A-voltage to about 1 volt. Remove tubes one at a time. A slight increase in A-voltage each time indicates a closed filament.



Figs. 1 (left) and 2—A and B circuits of the battery receiver testing panel.

Testing batteries

One-and-one-half-volt cells of all kinds may be tested across the A-terminals (Fig. 1). The rheostat must be in the off position. B-batteries may be tested by throwing the switch in Fig. 2 to EXT and connecting the B-bat test terminals to the battery. One thousand ohms in series with any milliammeter converts the latter to a voltmeter of the same scale. Hence, a 50-ma meter, for instance, becomes a 50-volt meter, and draws sufficient current to throw a good test load on the suspected battery. A 2,000-ohm, 5-watt resistor may be used to measure to 100 volts.

Two-volt sets

If 2-volt sets are commonly serviced, a 2-volt storage cell should be used for A-supply. This will also serve for 1½-volt tubes. For really old models, an extra B-socket may be necessary (there is one on the panel in the photo), and voltage taps at 22½ and 67½ volts.

For car radios and 6-volt vibrator sets, a 6-volt supply may be connected to terminals on the panel, in series with an old-style automobile ammeter. Shorted or open A-connections, sticky vibrator points, and bad buffer or filter capacitors may be detected by observing the current drain.

Modifications or improvements of this arrangement will suggest themselves to the individual technician. Circuits could be installed for other types of sets using 4½- or 9-volt A-batteries. An alternative is to install a switch to open the voltmeter circuit, or to put a multiplier resistor in series with it.

AF-Ultrasonic Frequency Meter

DESCRIBED in *The Review of Scientific Instruments*, this electronic frequency meter measures frequencies between 20 cycles and 160 kc, independently of amplitude and waveform.

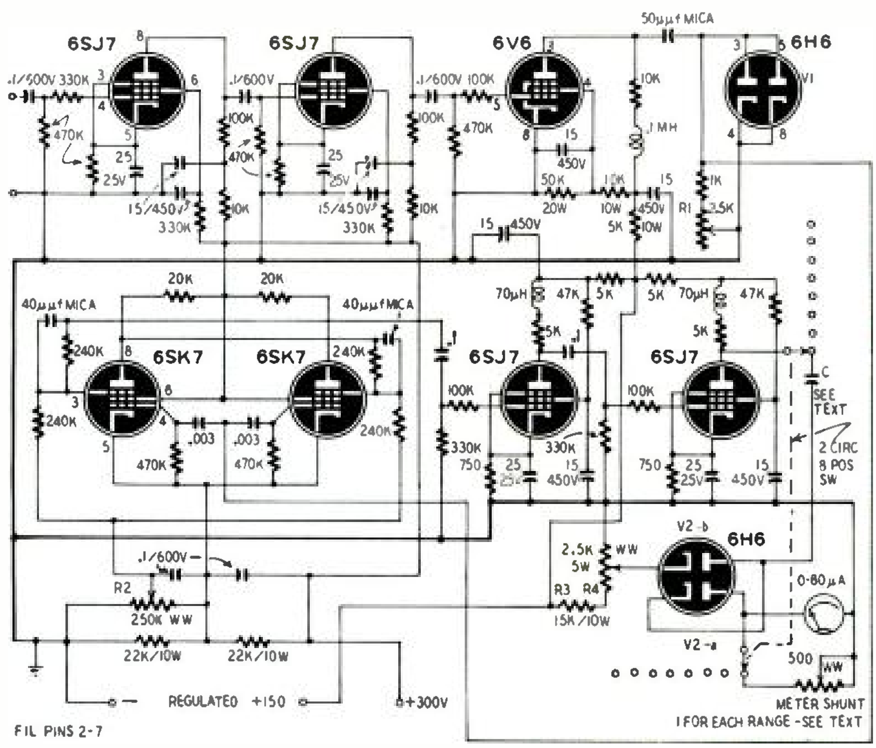
The signal is applied to the input terminals and amplified by two 6SJ7 high-gain amplifiers. A 6V6 is driven beyond cutoff and to saturation so it clips the positive and negative halves of the signal and produces square waves of the same frequency as the input signal. The square waves are differentiated and applied to a diode clipper V1 which removes the positive pulses. The negative pulses are applied to the control grids of a pair of 6SK7's in a modified Eccles-Jordan multivibrator circuit. This circuit is so connected that one tube is cut off and the other conducting at all times. The multivibrator "flips" when a negative pulse is applied to the grid of the nonconducting tube. A positive pulse has no effect on the circuit. The first negative pulse "flips" the multivibrator and the next makes it "flop;" thus, two negative triggers are required to make the multivibrator go through one complete cycle.

The output of the multivibrator is a square wave one-half the frequency of the input signal, thus simplifying high-frequency compensation and increasing the useful range of the meter. Because the multivibrator output is distorted at high frequencies, it is fed to cascade-connected 6SJ7's working as clippers. These produce square waves whose amplitude is constant, regardless of the input frequency and amplitude.

The square waves are applied to a 6H6 discriminator through capacitor C, which is charged through diode V2-a, resistors R3, R4, and the output impedance of the second 6SJ7 clipper during the positive half of the square wave. During the negative half of the cycle, C discharges through V2-b, the meter, and the clipper impedance. If the time constants of the charge and discharge circuits are equal, the meter current is determined by the size of C and the frequency of the square wave. Therefore, the meter can be calibrated to read directly in cycles per second.

Ranges are switched with a 2-circuit, eight-position rotary switch that changes the value of the charging capacitor C and the meter shunts. The high-frequency ends of the ranges are 160, 800, 1,600 cycles and 8, 16, 40, 80, and 160 kc when C equals .05, .01, .005, .0019, .0005, .00025, .00018, and .00009 μf. All meter shunts are 500-ohm potentiometers.

To adjust the instrument, apply an audio signal to the input terminals. Use a scope to check the triggering pulses at the grids of the 6SK7 multivibrators. A sharp negative pulse should be observed. Adjust R2 for a square wave when the scope is connected between ground and either plate of the multivibrator. Adjust R1 for reliable triggering action. Adjust R4 until the meter reads off scale (about 100 μa) at the full-scale frequency of one of the ranges. Bring the meter back to full scale with the appropriate shunt. Calibrate the scales with a wide-range a.f. signal generator.



This instrument indicates the frequency of signals of any waveform or amplitude.

Eight AM Detector Systems

These detectors have stood the test of time

Detector stages have been various and numerous, and we print here diagrams of those which have continued in use. Diode detection is almost universally used today; nevertheless, pentode and triode detectors are occasionally employed and have advantages under certain conditions. In all the diagrams the tubes are: diodes, 6H6; diode-triodes, 6Q7 or 6SQ7; diode- pentodes, 6H8; triodes, 6C5 or 6J5; pentodes, 6J7 or 6SJ7.

No. 1—Grid detection

A 6J7 or equivalent tube is used. At the input end is the primary of the last i.f. or r.f. transformer; at the output, the resistance-capacitance coupling elements to the first audio stage. If the following tube is a 6V6, the capacitance may be .03 instead of .01, and the grid resistor 220,000 instead of the 750,000 ohms indicated in the diagram. This modification for the 6V6 is equally useful in the diagrams to follow.

No. 2—Pentode plate detector

The same tube is used. Since the plate resistor is only 100,000 ohms, reproduction of high frequencies is better than in diagram 1.

If the pentode is replaced by a triode, the cathode resistor should be between 15,000 and 30,000 ohms. In diagram 1, however, no modification (other than omitting the screen resistor and capacitor, of course) is required if the pentode is replaced with a triode.

No. 3—Triode with transformer

This type of plate detection gives good results if the transformer is of high quality. The following tube may be a 6V6 or 6F6, with point G connected to its grid. Transformer coupling may be used with the grid detector of diagram 1, but not with pentodes, unless they are used as triodes. In that case, a 6J7 may be used by connecting the suppressor to the cathode and the screen to the plate.

No. 4—Standard diode detector

Either a single element of the 6H6 or its equivalent, or the two elements in parallel, may be used. The point K may be grounded or—if the other diode is to serve for delayed a.v.c.—it may be attached to the cathode of the preceding i.f. or following a.f. tube.

Point G is, of course, the output to the a.f. grid. If there are two following stages of audio, the 510,000-ohm resistor may be replaced with one of only 220,000 ohms. (This rule can be followed in all the diagrams.)

No. 5—Diode push-pull detector

This circuit makes it possible to reduce the values of C1 and C2—or even to eliminate these capacitors altogether, as well as R. Thus reception of high frequencies may be improved. This advantage is not obtained free, for the audio output voltage is only half as great as that obtainable from the standard diode detector.

No. 6—The diode-triode

If the tube is a 6Q7 (or 6SQ7), R1 may be 3,000 ohms and R2 100,000 ohms. The values of C and R are the same as in diagrams 1 and 2.

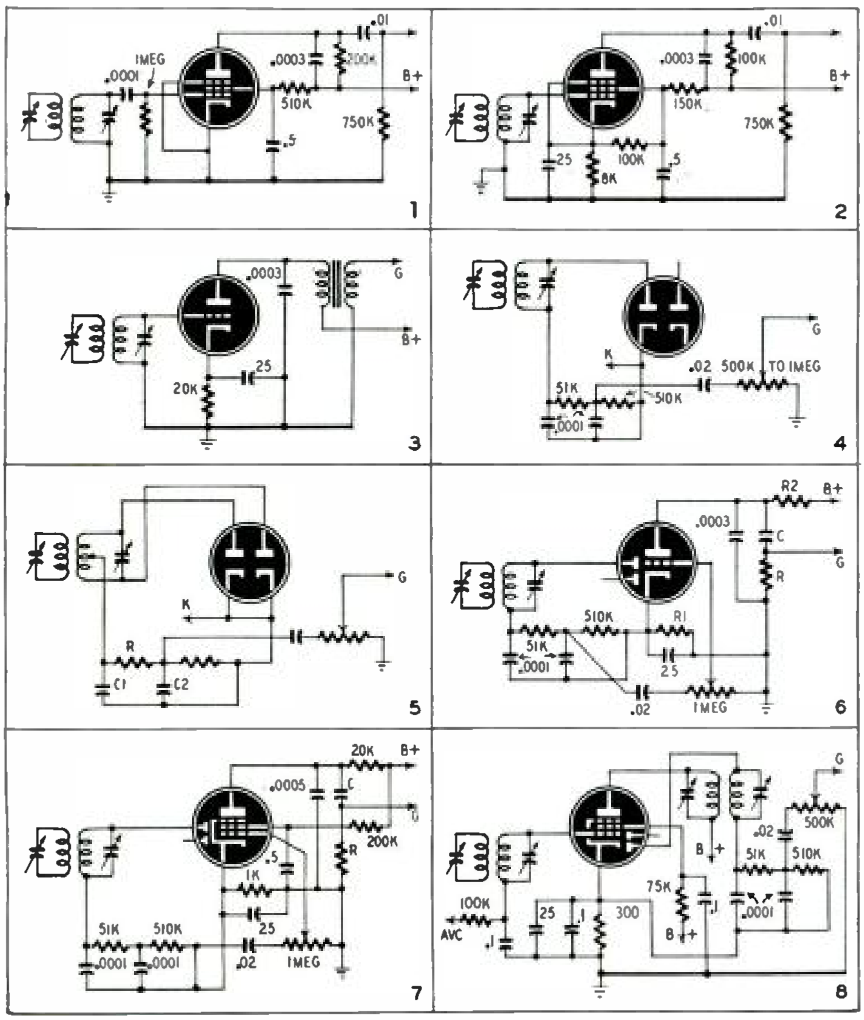
No. 7—Double diode-pentode

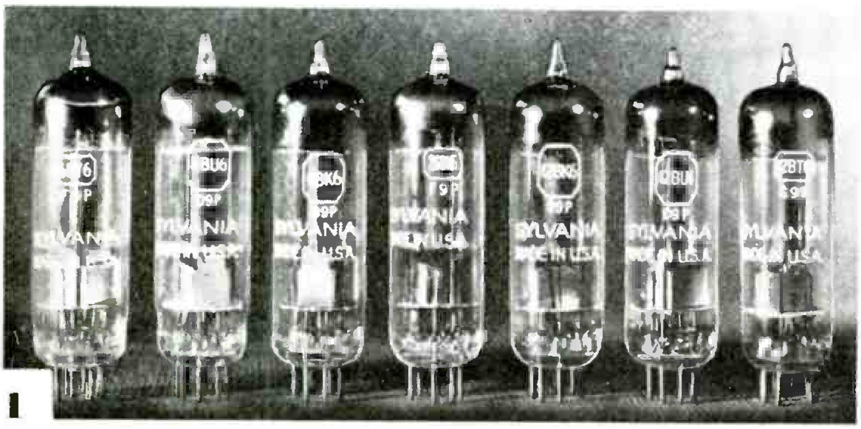
The tube is a 6H8 or similar type.

The low-value plate resistor assures uniform amplification up to approximately 10,000 cycles. The 500-μμf capacitor which shunts the plate resistor may be reduced to a size just large enough to prevent distortion.

No. 8—I.f.-detector stage

In this circuit, the pentode portion of the tube is used as an i.f. amplifier. Point G is connected to the grid of the first a.f. stage, which may be a 6J7 or equivalent. The potentiometer may be 1 megohm instead of the 500,000 ohms indicated. The cathode resistor may be increased or decreased from the 300-ohm value given, depending on tendencies toward oscillation in the i.f. section.—*Toute La Radio* (France)





1

Several New Tubes

TUBE manufacturers have been particularly busy with new types during the last few months, and have issued a number ranging from a 10-stage multiplier phototube to a subminiature ballast.

An array of new Sylvania miniatures appears in Photo 1. They include types 6BT6 and 12BT6, identical with 6AT6 and 12AT6 except for better rectification efficiency of the diodes and lower internal capacitances; 6BU6 and 12BU6, miniature duo-diode triodes like the 6BF6 except for improved diode characteristics; and the 6BK6, 12BK6 and 26BK6, miniature duo-diode high-mu triodes like the 6AV6 but with improved diodes. The 26BK6 has a 26.5-volt. 70-ma filament.

Photo 2 shows two cathode-ray tubes for oscilloscope use. The Du Mont 5XP series has a high-sensitivity deflection system permitting deflection of 1 inch for 24 to 36 volts. The RCA 3KP11 is electrically equivalent to the 3KP1, with a high-intensity bluish glow especially intended for photographing.

The Sylvania 1W4 (at left in Photo 3) is a pentode power amplifier with an output of 35 mw at 45 volts and 200 mw at 90 plate volts. The 1C3 (same photo) is an amplifier or oscillator triode with a μ of 14.5. The center tube is the 5722, a noise-generating diode suitable for measurements at frequencies up to 500 mc.

The RCA 5819 (Photo 4) is a 10-stage multiplier designed especially for use in scintillation counters and other applications involving low-level, large-area light sources. At 90 volts per stage, multiplication of feeble currents produced by weak illumination is about 400,000. The 5823 in the same photo is a miniature glow-discharge, cold-cathode triode designed as a relay tube for on-off control.

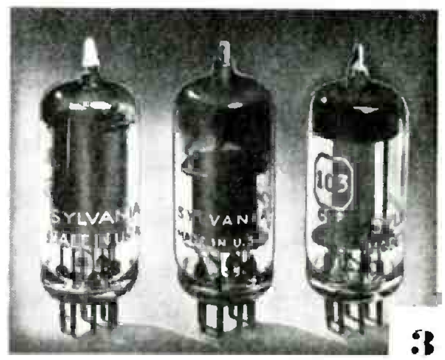
The General Electric GL-5824 (Photo 5) is electrically and physically interchangeable with the 25BG6, but is constructed to give more dependable service.

Raytheon's new 8BP4 (Photo 6, right) is an 8½-inch tube which electrically is a direct replacement for the 7JP4 (left in same photo) but has a considerably larger screen area.

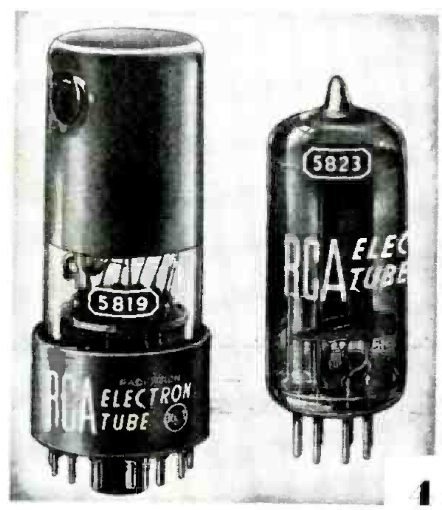
The Amperite subminiature ballast (Photo 7) can be supplied to dissipate power up to 3 watts. Maximum current is 0.9 ampere.

Other new tubes are the Raytheon 1X2, a high-voltage television rectifier, the Sylvania 1L6, a pentagrid converter for portables, the RCA 6AB4, a high-mu triode for grounded-grid service in FM and TV sets, RCA 6AH6, a sharp-cutoff pentode for use in video i.f. and video amplifiers, and the 7X6, a Sylvania rectifier with 150-ma output and separate cathode leads.

2

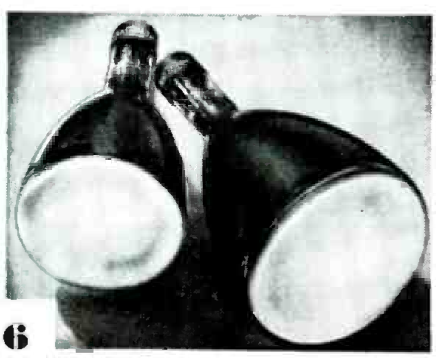


3

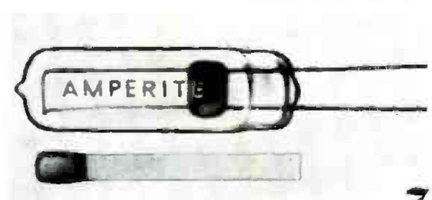


4

5



6



7

Advertising and Selling

A distinctive advertisement that tells a definite story increases sales and profits

By T. W. DRESSER

This advertisement tells a story with pictures. Readers will see and scan it.

WITH few exceptions radio technicians look on advertising as sheer waste of money. They reason that the return is not worth the expenditure, and consider that their reputation for good honest work at a reasonable figure should ensure them their fair share of the neighborhood's radio business. Of course, a sound reputation built up over a period of years will ensure a steadily increasing trade. But it is a slow process and uphill work; and one dissatisfied customer—whether his complaint is justified or not—can do more harm to such a business than the good done by two completely satisfied ones.

The reason advertising is looked at askance by most radio technicians is simple. **Their advertising, as it stands, does not pay.** I have studied thousands, probably tens of thousands, of service-dealers' advertisements. **Not one in a thousand was worth the money spent on it.**

They are stereotyped in their layout and in the style of type used. Interesting facts that could have been brought out are submerged in an unattractive assembly of garden-variety illustrations and wording. That is not advertising; it is philanthropy—giving money away!

Publicity, like anything else worth doing, must be *planned*. Its *only purpose* is to bring together in favorable circumstances the prospective customer and the salesman; **that is the sole aim of advertising**, and it is worth remembering. It is worth remembering because today publicity is high pressure. Hundreds of thousands of firms and people are aware of its value, and your advertisement will be submerged in the flood of mediocre publicity—unless you make it outstanding! Generally, radio technicians' advertisements fall down because they are not attractive enough to warrant reading through, or because they attempt too much in a small space. The inevitable result is that the advertiser gives it up after a period of poor results and thinks that advertising is a much overrated business.

The aim of any well-organized dealer is to "feed" his staff—or himself in the case of a one-man business—with a steady succession of new prospects whose interest has already been aroused. It is the only possible way to run a successful business, and it cannot be done by good will alone. Only good publicity can supply such a flow of new prospects. Figure one is an example of good advertising by a service technician, which stands out by virtue of its distinctiveness; it looks interesting and invites the reader to scan it again. In fact, its attention-compelling angle is comparable with that of the daily comic strips.

Having drawn the reader's attention, this advertisement then forces its point home. The gist of its story is that, if the reader's radio is defective, he should take it for servicing to the dealer whose name appears at the foot of the ad. The other illustrations show what will happen to the radio while in the dealer's hands, and are calculated to inspire confidence in the work done. The appeal is then extended to cover new sales by explaining in the final paragraph that "We take pride in our work; you'll be proud of your radio. You'll say . . . 'Go to Dixon's. I'm glad I did.'"

Another form of publicity with a decided pull is that in Fig. 2. The appeal of this advertisement lies principally in the fact that—superficially at least—it offers "something for nothing." It invites readers to phone and stresses in the most effective manner possible that there is no obligation. In consequence the reader feels that, if he does phone or write, he can ignore, without embarrassment or cost, whatever advice is tendered. In other words, he *feels* he is under no obligation.

Service-dealers' advertisements may be based on this model, although they should not copy its (or anyone else's) format slavishly. Designed to bring inquiries, it ultimately ensures a regular flow of both service and new sales. Once the contact has been made between the "prospect" and the dealer, personal salesmanship and demonstrations should produce that flow of sales and servicing.

Showcards, letterheads, and window lettering can all contribute at a small outlay a substantial quota to the appeal to the prospective customer. Fig. 3 shows the slogan used by a highly successful service-technician-dealer in this city [Bradford, England]. His letterhead and business card carry the same wording and on each repaired radio in his shop stand small cards printed

IS YOUR RADIO IN TROUBLE ? ? ?

I can't get WBZ.
Interference spoils program.
Do I need an antenna?
Why can't I get FM?
We are asked similar questions several times each day. Our advice is given free and without obligation. If you have radio trouble ask our help. It doesn't matter what make or type or where you bought it. Our technical dept. is at the service of all listeners.

TECHNICAL DEPT., DIXON'S RADIO
Whichburg
Call, write or phone 72272

Fig. 2—This ad invites free inquiries.

as in the figure. This reiteration of a theme subconsciously impresses itself on the mind of all who encounter it, and in time they associate automatically any mention of radio with the name of the dealer in question.

The same theme is carried into the window lettering and—in conjunction with a well-arranged window and an attractive colored fluorescent lighting scheme—has brought this technician-dealer the major share of the radio business of a town of 300,000 inhabitants. Yet four years ago he was almost unknown in this city! Such success is an outstanding example of the value of rightly handled publicity.

In advertising new radios far more emphasis should be placed upon the value of demonstrations at the dealer's premises or in the customer's home. Many dealers' advertisements fail to stress how much such demonstrations can help the customer make a wise choice. Others fall down in their appeal

Repaired

by

SHAW

"The Radio Doctor"

Fig. 3—People remember shop's slogan.

to the reader to take some definite action. Most people already know that any modern radio showroom will gladly demonstrate receivers in stock, but there is a vast difference between subconscious awareness and active interest. Good advertising will burgeon this inactive knowledge into real interest. To this end the dealer's publicity should stress the advantages to be derived from demonstrations, while indicating that they imply no obligation whatever on the prospective customer's part.

Whenever and wherever possible manufacturer-dealer campaigns should be used to their fullest. Such publicity —while essentially concerned with the products of one particular manufacturer—does succeed in bringing in potential customers, and the dealer need not refuse a sale if the customer rejects the advertised brand. Sales aids supplied by manufacturers also help greatly in making an attractive window display, an essential in pulling in the casual passerby.

There is no doubt that intelligent, well handled publicity pays handsomely in the radio trade, more so perhaps than in many other industries. The dealer with initiative will use it to the limit to boost his steady trade in sales and servicing, to take advantage of periodic booms such as television is experiencing at the moment, and to buffer the slack periods.

His reward will be an increasingly steady trade, constantly building up, for advertising does not stop when the campaign is over. Satisfied customers—brought in by his publicity—tell others; thus advertising is the most satisfactory "snowball" in the world.

INEXPENSIVE FREQUENCY STANDARD

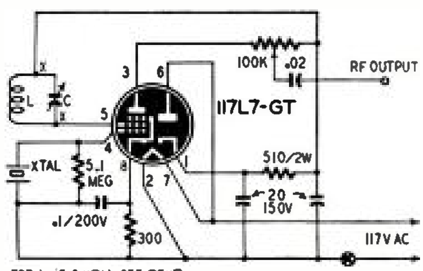
An economical little frequency standard for the experimenter's work-bench, this unit can be used with any crystal whose fundamental frequency is suitable for the purpose. A number of standard-frequency crystals have been available at very low prices on the surplus market.

The parts values are not critical; they can vary approximately 20% from the values shown on the diagram. The tuned circuit is not absolutely necessary and can be omitted if the points X-X are connected together. However, the resonant circuit gives more "kick" to the output, enabling the operator to secure usable harmonics up to 30 mc with a 100-kc crystal and much higher. of course if higher-frequency crystals are used.

Suggested values for L and C for different crystal frequencies are:

Crystal	L (mh)	C (μμf)
100 kc	20	120
200 kc	5	120
500 kc	2.5	40
1 mc	2.5	10
2 mc	1.25	5
5 mc	Omit L and C and short X-X	

Standard r.f. chokes and small variable capacitors are built into plug-in forms. Other combinations of inductance and capacitance can be used if they tune to the frequency of the crys-



FOR L, C & XTAL SEE TEXT

tal they are designed to work with. The 1.25-mh inductor may be half of a 2.5-mh r.f. choke.—*Harry C. Aichner, Jr.*

LRTA INDUCTS OFFICERS

Michael Csigi was installed last month as president of the Lackawanna Radio Technicians Association in Scranton, Pa. Other officers of the Association inducted at the ceremonies were: August Cianchetti, first vice-president; Merrill Greene, second vice-president; James Jerome, treasurer; Howard E. Greene, secretary; Homer Kinback, assisting secretary; and Louis Perna, Stephen Csigi, and John Riegel, trustees of the Association.

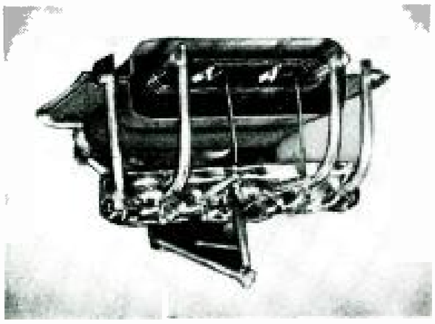
The second semester of LRTA's television school started on October 10. Sessions are held in Scranton Technical High School on Monday and Friday nights under Kenneth Cooke, the instructor in charge. Expenses (including instructor's salary) are paid by the State Board of Public Instruction and the Scranton School District.

Fundamentals of Radio Servicing

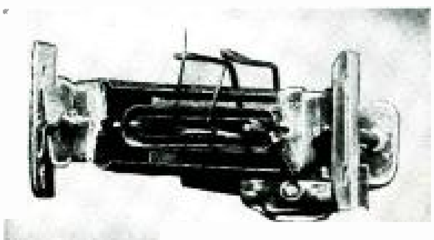
Part X–Triode and tetrode tubes

By JOHN T. FRYE

As POINTED out in a previous chapter of this series, the Father Adam of all electronic tubes is the two-element diode. One of the elements, the plate or anode, is simply a piece of metal without any special fussiness in its makeup. But the other, the cathode (or filament), is the key element in almost every electron tube—no matter how complicated it may be—because the electrons boiled out of it make up the emitted current that goes through the tube. In tube design the cathode material is extremely important, so let us dig a little deeper into the subject of cathodes.



The triode tube has only a single grid.



Note screen grid in this tetrode photo.

In most tubes, the only way to make a cathode emit is to heat it. As with incandescent lamps, tungsten is the only wire that can stay hot enough to emit any practical quantities of electrons without melting. Pure tungsten filaments are used in many large transmitting tubes; they are heated to a dazzling white—to over 2,000 degress C.

Tungsten, while it stands up under heat, is not the best emitting material, and therefore many medium-sized transmitting tubes have tungsten filaments coated with thorium. These *thoriated* filaments liberate plenty of electrons when they are heated to a bright yellow—about 1,700 degrees C.

But the filaments or cathodes of most radio and TV receiving tubes are coated with a mixture of barium and strontium oxides on a nickel-alloy base. They need be heated to only approximately 700 to 750 degrees C to make enough electrons boil out.

There always has to be a villain in the piece though, and the mustache-twirler of electron-tube current flow is the *space charge*. Picture the stage set for plate-current flow: the filament is heated and a positive charge from the B-battery or power supply is connected to the plate. Some of the electrons emitted from the cathode are pulled across to the plate by its positive charge. But other emitted electrons are not reaching the plate because the B-voltage simply isn't high enough; and they are just standing around between the filament (or cathode) and the plate doing nothing. This little cloud of not-so-innocent bystanders is called the space charge; being composed of electrons, it is charged negatively.

Now, as the heat of the cathode boils out more electrons from its surface, the space charge tries to push these electrons back onto the cathode—the negative space charge repels the negative emitted electrons. The positive plate is shouting, "Come on over!" to the electrons, but the space charge is commanding, "Get back on that cathode!" The space charge is nearer the cathode than is the plate, so the newly emitted electrons feel the effects of the space charge much more than those of the plate. Result: fewer electrons get to the plate and plate current is low.

One way to cut down the bad effect of the space charge is simply to cut down the space. In the 25Z6, for instance, the cathode and plate are only .02 inch apart. Another way is to put a little mercury in the tube. When the filament heats, the mercury vaporizes and becomes a gas. When an electron on its way to the plate hits a mercury-vapor atom, it knocks loose one of the mercury atom's electrons, which promptly beats it over to the plate like a little boy at the end of a school day. The mercury atom now is missing one electron. Looking around, it discovers the space charge and snatches an electron from it. The mercury atom is whole again—and electrically neutral—but by gobbling up that electron from the space charge, it has reduced the space charge and aided the hard-working plate to attract a larger current.

Enter the triode

The early radio engineers, viewing this steady flow of electrons from cathode to plate, began to feel like small boys watching the stream coming out of a garden hose: they wanted to stick something into the current and see what would happen. The something they inserted was a *grid*, and that is how the *triode* tube was born.

The grid is a mesh of fine wire wound around supports so that it surrounds the cathode. The photo of a broken-open triode shows the grid wires plainly. The drawing of Fig. 1 shows the element structure of a typical triode vacuum tube.

The *control grid*, as its full name goes, is usually *biased* negative with respect to the cathode; that is, a negative d.c. charge is permanently placed on it. Sometimes a small battery is used, at other times the negative terminal of an a.c.-operated power supply, and in still other cases other methods are brought into play. But the net result is that the grid is more negative than the cathode.

If the grid were positive, it would act somewhat like another plate—it would attract electrons, and there would be a grid current just as there is a plate current. Although the grid *is* positive in a few rare circuits, it is negative in most applications and does not attract any of the emitted electrons to itself.

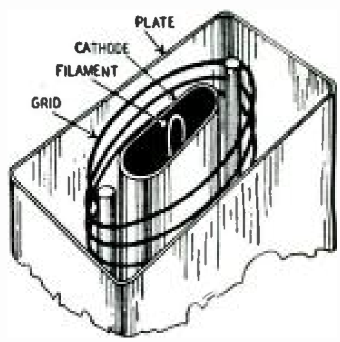


Fig. 1—Arrangements of cathode and filament, grid, and plate in triode tubes.

Like a water-logged life preserver, a negative grid not only is no help, it is

There's Only ONE COMPLETE CATALOG that Brings You EVERYTHING IN RADIO, TELEVISION & ELECTRONICS

IT'S YOUR FREE ALLIED 196-PAGE VALUE-PACKED CATALOG!

SEND FOR IT TODAY

Get Radio's Leading Buying Guide

Here's the Buying Guide to *everything* in radio for *everyone* in radio! It's the *one complete* catalog, preferred in the field because it fills *every* TV, Radio, and Electronic supply need. It's packed with the world's largest selections of quality equipment at lowest money-saving prices. See the latest in TV, AM and FM receivers; radio-phonos; new Sound Systems, P.A. equipment and high-fidelity sound components; recorders and accessories; full selections of newest Amateur receivers and station gear; test instruments; builders' kits; huge listings of parts, tubes, tools, books, diagrams.

ALLIED gives you every buying advantage: speedy delivery, expert personal help, lowest prices, assured satisfaction—plus the most liberal Time Payment plan in radio. Get the 1950 ALLIED Catalog—it will save you time and money. Send today for your FREE copy!

WORLD'S LARGEST STOCKS

Radio Parts Unlimited
Test Instruments—All Makes
Television & Home Radios
P. A. and Hi-Fi Equipment
Amateur Station Gear
Experimenters' Supplies

QUICK, EXPERT SERVICE

ALLIED IS YOUR TELEVISION HEADQUARTERS

TV

You keep up with TV when you depend on ALLIED! Count on us for the latest releases and largest stocks of picture tubes, component parts, antennas and accessories—plus the latest in TV receivers, tuners and kits. If it's *anything* in TV—*we have it in stock!* So remember—for TV—it's ALLIED First!

ALLIED RADIO

THE WORLD'S LARGEST RADIO SUPPLY HOUSE

Everything in Radio, TV and Electronics

Send for Radio's Leading Buying Guide

FREE

ALLIED RADIO CORP.
833 W. Jackson Blvd., Dept. 2-M-9
Chicago 7, Illinois

☐ Send FREE 196-page 1950 ALLIED Catalog.

Name . . . .

Address . . . .

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

a hindrance—it not only does not pull electrons away from the cathode but pushes them back!

So here we have the plate pulling electrons from the cathode and the grid pushing them back on. The question is: who has the most to say in this war of purposes? Answer: the grid. Reason: because it is so much closer to the cathode than is the plate.

When the grid goes negative, it is like a traffic policeman putting up his hand—traffic slows down or stops, as desired. When it goes more positive (or less negative), you can imagine the policeman vigorously motioning all the cars to move on. When the *plate* voltage changes, however, it's as though a policeman 10 blocks away were directing the traffic. There is some effect on the electron traffic around the cathode but not much.

When the grid does become less negative and lets the plate pull electrons away from the cathode, the electrons pass right through the spaces in the

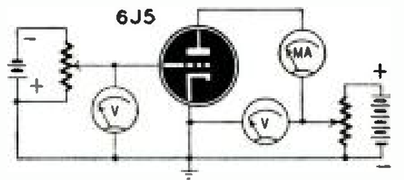


Fig. 2—Test setup shows mu of a triode.

grid mesh, just as the cars in traffic go by the policeman.

With all this in mind it is easy to see why the grid voltage has much more effect on the plate current than the plate voltage has. To state it another way, a small change in grid voltage produces a change in plate current which could only be duplicated by a much larger change in plate voltage.

You can prove this yourself with equipment no more complicated than that shown in Fig. 2. The 6J5 is arranged so that both grid and plate voltages can be varied and plate current read on the milliammeter.

Suppose we start with —8 volts on the grid and +250 volts on the plate. Because of the construction of the tube, the plate current is 9 ma.

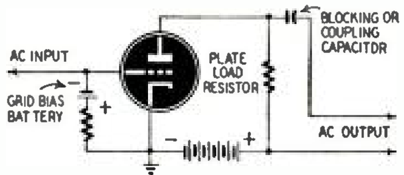


Fig. 3—A plate load resistor is added.

Now we change the grid voltage to —10. The milliammeter reads 5 ma, which agrees with the idea that making the grid more negative pushes more electrons back on the cathode so they can't reach the plate. Remember, then, that to decrease the plate current by 4 ma, we had to make a 2-volt change in grid potential.

Now reset the grid voltage to —8 (so that 9 ma is flowing again). This time the object is to see how much the *plate* voltage must be changed to get plate current down to 5 ma. So we vary the plate-voltage control until the current is 5 ma. A look at the plate voltmeter shows 210 volts. Note that *a 40-volt plate-potential change was necessary to get the same effect on the plate current as was obtained with only a 2-volt grid change!* The ratio of the two, 40/2 or 20, is the *amplification factor* (mu or μ) of the tube.

To make practical use of the tube as an amplifier, however, we must have some way of taking the amplified voltage changes and feeding them to other points in the equipment. The plate load resistor in Fig. 3 is the gimmick that solves the problem. As the plate current changes because of grid-voltage changes, the current rising and falling through the resistor creates a changing voltage drop across it. If the tube is operated correctly, the voltage changes across the load duplicate exactly the voltage changes at the grid, except that they are much larger.

They are *not* 40 times as large, though—there's a fly in the ointment. Every time the plate current rises, the drop across the resistor rises too . . . it must to furnish output. But the voltage on the plate is now less because much less than the full battery voltage reaches the plate. Of course, the lessened plate voltage does not entirely nullify the effect of the more positive grid voltage, because, as you remember, plate voltage is not anywhere near as effective in controlling the tube as is grid voltage. It does cut down the amplification somewhat, however, and, depending on the values of resistance and voltage used, the output voltage is only about 14 times the input.

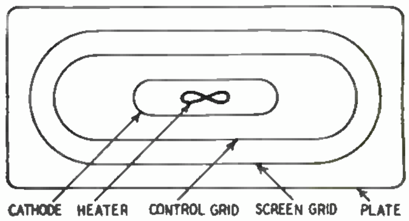


Fig. 4—Screen between grid and plate.

There is one point to get straight: the tube does not take the input voltage and stretch it in some mysterious way to get a bigger output. The tube really does not amplify at all! It is a *control device*. It works similarly to the filling station hoist that sends your car up in the air so the garageman can work underneath it. The attendant works a little valve—and presto! your 3,000-pound automobile rises before your eyes. It isn't the attendant's hand that does the work, of course. It's the compressed air stored in a tank, released in the desired quantity by the little hand valve.

A vacuum tube is just like the little valve and the plate or B-battery like the stored compressed air. The incoming signal on the grid simply releases and dams up the stored electrical energy in accordance with its desires. There is no grid current, so no power is taken by the grid either from the batteries or from the controlling input signal. The output voltage—every bit

MONEY BACK GUARANTEE— We believe units offered for sale by mail order should be sold only on a "Money-Back-If-Not-Satisfied" basis. We carefully check the design, calibration and value of all items advertised by us and unhesitatingly offer all merchandise subject to a return for credit or refund. You, the customer, are the sole judge as to value of the item or items you have purchased.

A COMBINATION

20,000 OHMS PER VOLT MULTI-METER and TELEVISION KILOVOLTMETER

The New Model TV-20

Added Feature: Includes an Ultra High Frequency Voltmeter Probe with a frequency range up to 1,000 MEGACYCLES. When plugged into the Model TV-20, the V. H. Probe converts the unit into a Negative Peak-Reading H. F. Voltmeter.

The Model TV-20 operates on self-contained batteries. Comes housed in beautiful hand-rubbed oak cabinet complete with portable cover. Built-in High Voltage Probe, H. F. Probe, Test Leads and all operating instructions

$39.95 NET

Specifications:

9 D.C. Voltage Ranges: (At 20,000 ohms per Volt)

0-2.5/10/50/100/250/500/1,000/5,000/50,000 Volts)

8 A. C. Voltage Ranges: (At 1,000 ohms per Volt)

0-2.5/10/50/100/250/500/1,000/5,000 Volts

5 D. C. Current Ranges

0-50 Microamperes

0-5/50/500 Milliamperes

0-5 Amperes

4 Resistance Ranges:

0-2,000 / 20,000 ohms. 0-2/20 Megohms

7 D. B. Ranges: (All D. B. ranges based on 0Db=1 Mv. into a 600 ohm line)

— 4 to + 10 db
+ 8 to + 22 db
+ 22 to + 36 db
+ 28 to + 42 db
+ 36 to + 50 db
+ 42 to + 56 db
+ 48 to + 62 db

7 Output Voltage ranges:

0 to 2.5/10/50/100/250/500/1,000 Volts

The New Model TV-10

TUBE TESTER

The Model TV-10 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

$39.50 NET

Specifications:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing-aid, Thyratron, Miniatures, Sub-Miniatures, Novals, etc. Will also test Pilot Lights.

★ Tests by the well-established emission method for tube quality, directly read on the scale of the meter.

★ Tests for "shorts" and "leakages" up to 5 Megohms.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-10 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

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

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

The Model 88—A Combination

SIGNAL GENERATOR and SIGNAL TRACER

Signal Generator Specifications: *Frequency Range: 150 Kilocycles to 50 Megacycles. *The R.F. Signal Frequency is kept completely constant at all output levels. *Modulation is accomplished by Grid-blocking action which is equally effective for alignment of amplitude and frequency modulation as well as for television receivers. *R.F. obtainable separately or modulated by the Audio Frequency.

Signal Tracer Specifications: Uses the new Sylvania 1N34 Germanium crystal Diode which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megacycles.

The Model 88 comes complete with all test leads and operating instructions. ONLY ....

$28.85 NET

The New Model TV-30

TELEVISION SIGNAL GENERATOR

Enables alignment of Television I. F. and front ends without the use of an Oscilloscope

Specifications:

Frequency Range: 4 Bands—No switching. 18—32 Mc. 35—65 Mc. 54—98 Mc. 150—250 Mc. Audio Modulating Frequency: 400 cycles (Sine Wave). Attenuator 4 position, ladder type with constant impedance control for fine adjustment. Tubes Used: 6C4 as Cathode follower and modulated buffer. 6C4 as R.F. Oscilator. 6SN7 as Audio Oscillator and power rectifier.

Model TV-30 comes complete with shielded co-axial lead and all operating instructions.

$29.95 NET

The New Model 670

SUPER METER

A Combination

VOLT - OHM - MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS.

D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/7500. **A.C. VOLTS:** 0 to 15/30/150/300/1500/3000 Volts. **OUTPUT VOLTS:** 0 to 15/30/150/300/1500/3000 **D.C. CURRENT:** 0 to 1.5/15/150 ma., 0 to 1.5 Amps. **RESISTANCE:** 0 to 500/100,000 ohms, 0 to 10 Megohms. **CAPACITY:** .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics.) **REACTANCE:** 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.

INDUCTANCE: 1.75 to 70 Henries: 35 to 8,000 Henries.

DECIBELS: —10 to +18, +10 to +38, +30 to +58.

The model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

$28.40 NET

The New Model 770—An Accurate Pocket-Size

VOLT-OHM MILLIAMMETER

(Sensitivity: 1000 ohms per volt)

Compact-measures 3¼" x 5⅞" x 2¼". Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. Housed in round-cornered, molded case. Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications: 6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 volts.

6 D.C. VOLTAGE RANGES: 0-7½/15/75/150/750/1500 volts.

4 D.C. CURRENT RANGES: 0-1½/15/150 Ma. 0-1½ Amps.

2 RESISTANCE RANGES: 0-500 Ohms. 0-1 Megohm.

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

$13.90 NET

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

GENERAL ELECTRONIC DISTRIBUTING CO.

Dept. RC-12, 98 PARK PLACE
NEW YORK 7, N. Y.

of it—is energy from the B-battery. If there were no grid signal, there would just be a steady d.c. voltage across the load resistor. There would be no output because the capacitor prevents d.c. from passing. But when the grid signal starts alternately repelling and passing electrons, the d.c. across the resistor rises and falls with the plate-current changes. That gives it an a.c. character, and it passes through the capacitor.

The screen grid

You remember that, while the amplification factor of the 6J5 is 20, we could get a real amplification of only 14 times in the practical circuit of Fig. 3 because plate-voltage changes gummed up the works. The cure is to add another grid to the tube. Called the *screen grid* (or simply screen), it is located between the control grid and the plate, as in Fig. 4.

The screen operates at all times with a positive voltage on it, a voltage about half that of the plate (more or less). The hookup appears in Fig. 5. The

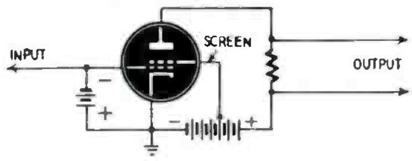


Fig. 5—Circuit of a tetrode amplifier.

screen voltage is fixed and does not vary with the plate current. Because it is positive, it helps the plate attract electrons from the cathode; most of the electrons, however, pass through the screen wires and go to the plate—screen current is very small.

Now the tube works just as before, with this exception: while the plate voltage changes periodically (just as it did before), the screen voltage does not. And because the screen is closer to the electron source (the cathode) than the plate, its pulling power is greater. As a result, the plate voltage changes don't have anything approaching the effectiveness they had before in cutting down amplification. Even when the plate voltage is low, there is almost as much positive force pulling electrons through the tube as when the plate voltage is high. The amplification of a *tetrode*, as this tube is called, is many times higher than that of a simple triode.

Another advantage of the screen is its reduction of grid-to-plate capacitance. Those two elements form the plates of a small capacitor through which some of the tube's output can feed back to the input, especially at higher frequencies. *Feedback* can produce all kinds of hair-raising effects, as we will find later on, but the screen grid, placed right in the middle of the grid-plate capacitance, breaks it up by acting like a shield or screen (hence its name) and reduces the capacitance (which may be several micromicrofarads in a triode) to something less than .01 μμf in the tetrode.

In the next chapter we will take a quick glance at a couple of more tube types and then wade into tube characteristics. Knowing the characteristics of a tube is just like having a trusted friend give you the lowdown on a coming blind date: it tells you exactly what kind of a performance you can expect!

SERVICE SHOP HAS ROLLING TEST CABINET

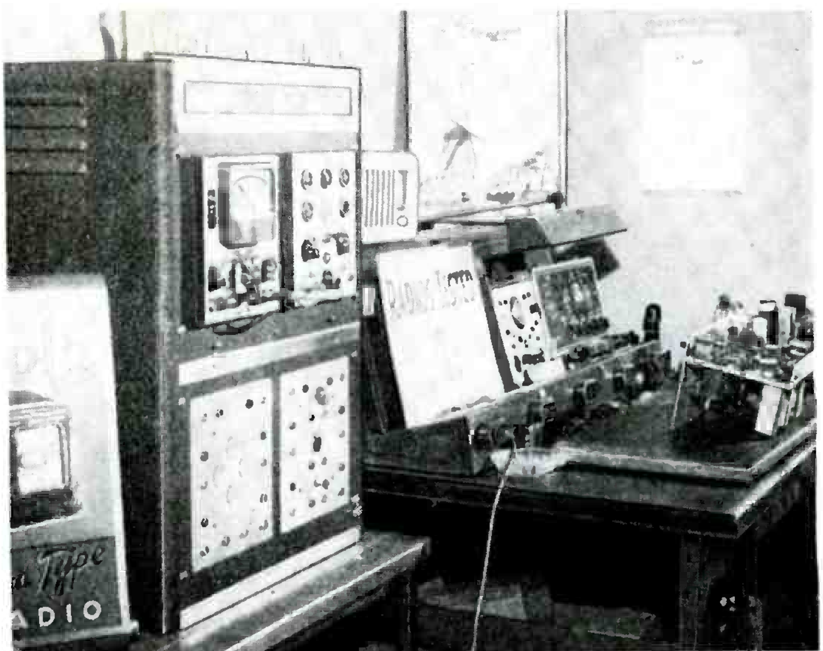
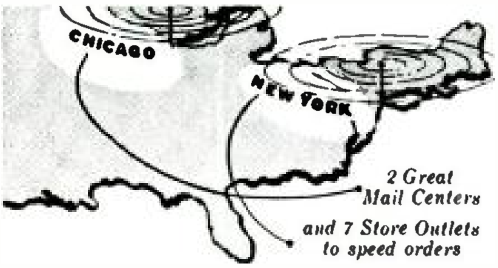


Photo by J. J. Cook

This is the service-bench section of Ward Custombuilt Radio in New York City. The test cabinet has four panels of instruments and is mounted on a roll table so that it can be used where needed. All tables and racks are made of steel. Fuses are provided for all bench a.c. outlets and a master switch turns off all power. An adjustable fluorescent lamp over the bench illuminates the critical spots.



Lafayette RADIO ELECTRO-NEWS

★ ★ ★ ★ 29 YEARS SERVING & SAVING MONEY AND TIME FOR 500,000 HAPPY CUSTOMERS ★ ★ ★ ★

FREE! GET YOURS QUICK!

(IF YOU DELAY THERE MAY BE NONE LEFT—SO MAIL COUPON NOW!)

SUPERB CHASSIS BRINGS WIDE ACCLAIM

COMPLETE AM-FM RADIO

- Static-Free FM
- 8 Tube Superhet
- 10 Inch Speaker

ONLY $47.50 with Tubes

Here's a powerful, deluxe FM-AM chassis that brings in regular broadcast programs plus brilliant, staticless FM — a two-band receiver for the price of one! This complete unit includes a built-in power supply, 10" speaker and loop antenna for AM reception...ready for installation in a suitable cabinet. Highly selective and sensitive circuit covers 550-1600 KC and 88-108 MC bands. Connection is provided for an external FM antenna, and an input jack for record player attachment. Has 3-position tone control. Tubes: 12AT7, 6BE6, (2) 6BA6, 6AQ5, 6AT6, 6AL5, 6X4 rectifier for 110v. 50/60 cycles AC.

1N820R—With Tubes...Shipping Weight 20 lbs......................**47.50**

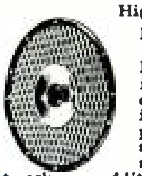
HI-FI MADE EASY with SPEAKER COMBINATION WOOFER-TWEETER $20.36

(Available Separately)

12" WOOFER

PM dynamic with 1" voice coil; 6-8 ohms impedance. 6.8 oz Alnico magnet. Capacity 14-18 watts.

99N710R..............**5.95**



TWEETER
High Freq. Adaptor

Response over 15,000 cycles. Impedance (units in series) 6-8 ohms. Power rating 8 Watts. Supplied with mounting screen for 12" speaker. No filter network or additional space required.

22N19384R—Wt. 3 lbs.......**14.41**

DUAL SPEED ADAPTOR

Adapts your standard 78 RPM record player for the new 45 and 33 1/3 RPM records. Kit includes speed reducing table, special pickup assembly and pickup.

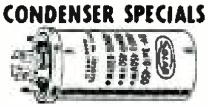
34N22610R—Wt. 5 lbs.......**11.95**

FM-TV SWEEP GENERATOR

Complete FM-TV frequency coverage from 2-227 MC on 3 bands. Sweep width 500 KC to 10 MC. Dial calibrated directly in frequency. Maximum output 500,000 microvolts. Built-in power line filter. Generator output can be used either FM or pure RF. 105-125 volts, 50/60 cycles AC. Steel cabinet finished in gray wrinkle enamel. Shpg. Wt. 16 lbs.

25N21736R....................**34.95**

ELECTROLYTIC CONDENSER SPECIALS



Prong Mounting Can Type
Each 25¢ 10 for $2.25

Stock No.	Capacity Mfd.	Voltage
99N3482R	30-50/20/100	150/50 10
99N3494R	10-10/10/20	450/350/25
99N3491R	30-30-15/30	450/50
99N3469R	30/20/20	350/300/250
99N3441R	30-50/100	150/25

SHOP IN PERSON AT LAFAYETTE OUTLETS
NEW YORK: 100 Sixth Avenue & 542 E. Fordham Rd.(Bronx)
CHICAGO: 901 W. Jackson Blvd. NEWARK: 24 Central Ave.
BOSTON: 110 Federal St. ATLANTA: 265 Peachtree St.

NEW 1950 CATALOG GOING FAST

164 PAGE BOOK
Brimful of Best Buys in

- ✓ TELEVISION
- ✓ AM & FM RADIOS
- ✓ HI-FI SYSTEMS
- ✓ PA EQUIPMENT
- ✓ ELECTRON TUBES
- ✓ RADIO PARTS
- ✓ HAM EQUIPMENT
- ✓ PHONOGRAPHS
- ✓ APPLIANCES
- ✓ TEST EQUIPMENT
- ✓ XMAS GIFT IDEAS

Plus
A BIG 16 PAGE BARGAIN SECTION

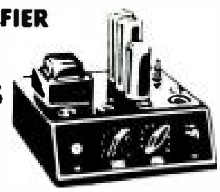
Every mail brings us hundreds of new requests for this latest and greatest Lafayette Catalog — bulging with the biggest bargains we've EVER offered in over 29 years of leadership in the radio industry. it's practically a free encyclopedia of everything new in the vast electronic field. Mail coupon for yours NOW — also start saving money at once by using the coupon to order items on this page. Remember, Lafayette's famous 30-day money-back guarantee insures your satisfaction! Get your FREE copy before this edition is exhausted.

TYPICAL CATALOG BARGAIN HAS MANY USES

5 TUBE HIGH GAIN PRE-AMPLIFIER

5-tube, four stage preamp. Input suitable for high impedance low output pickups and high impedance mikes. Has single circuit mike jack, volume and tone control and replaceable fuse. Shipping Weight: 10 lbs.

ONLY $8.95



99N9604R—Less Tubes...**8.95**

• RUSH FOR FREE CATALOG •

LAFAYETTE RADIO, Dept JL9
901 W. Jackson Blvd., Chicago 7
100 Sixth Avenue, New York 13

DON'T FORGET TO ORDER BARGAINS!

☐ Check here for FREE Catalog (Please don't check if you already have your catalog.)

☐ Please fill attached order. I enclose $..........in postal note, money order or check. (Include estimated shipping charges based on weight and zone. Overpayments promptly refunded).

NAME ....

ADDRESS..

CITY.............. ZONE. . .STATE..........

Intermittent Filaments

By DAVE GNESSIN

THE elusive intermittent is the bane of the serviceman's life. It follows no rules and keeps no hours. The raucous noise that emanates from the rear of most service shops is due largely to receivers operating open, full-blast (just as in normal operation in the home!) in the hope that the intermittent may be at least located, if not repaired. Many's the kilowatt consumed by electric radiant heaters operating on radio equipment on the service bench, in the hope that applying excess heat will open up the intermittent.

Like the poor, the intermittent will probably always be with us. But the malady will prove less virulent if we attack the disease with all the weapons at hand.

One such weapon is described here. Its purpose is to indicate immediately when a tube filament is open, be it even for a period hardly long enough for the receiver to go dead, cool off, and then let the filament wires fall together again. This condition accounts for a fair proportion—though by no means a majority—of intermittents, and represents a type very hard to find.

Other uses will be found for the device, such as indicating which tube in a series filament string is open. This quick technique might be applied as standard practice to all transformerless receivers arriving at the shop with filaments out.

An octal (or loctal or miniature) adapter, with prongs on the bottom and an octal (or loctal or miniature) socket on top is opened to admit the pair of wires from a miniature neon test light. This pair is connected to the filament prongs. (Different tubes have different filament terminals. Adapters should be prepared and marked on the base for ready identification). A whole set, certainly no less than six, should be made up.

In using the device, the tube is removed from its socket and the correct neon adapter is plugged in. The tube is then inserted into the adapter, with the neon indicator hanging out. See Fig. 1 for the setup. This is done for all the tubes in the receiver. Fig. 2 shows the application to three tubes; it holds for as many tubes as are in the receiver being tested.

How does it work? The neon indicators fire at about 90 volts. Since tube filaments don't rate that high, the indicators normally will not ignite. When they don't light up, they don't draw current. Hence, they will not affect normal operation. If one tube is open, as in Fig. 3, the filament string is broken. The series filaments will not light.

With no current flowing through the series filaments, both terminals of the neon bulb across the open filament are at full line potential (117 volts). The neon tube immediately ignites and stays lit as long as the filament of its associated tube is open.

Note that only the neon lamp across the *open* filament lights. The other indicators still have low-resistance filaments across them, shorting them out of the circuit. Thus the open circuit, whether intermittent or permanent, is immediately marked. Remove the lit neon adapter and faulty tube. Replace the faulty tube. Now watch the circuit for a while to see if any other neon indicator flashes. If all is quiet, the trouble has been spotted and repaired.

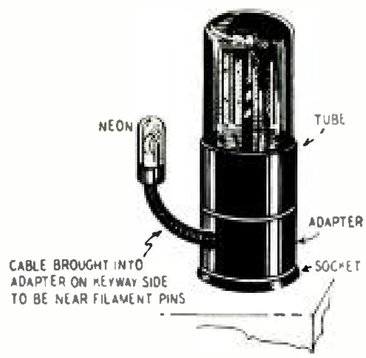


Fig. 1—A tube in the adapter assembly.

Two-way octal and other adaptors are available. They come apart for wiring. It may be necessary to drill a hole in the cover of the assembly to accommodate the neon-indicator wiring. If no adapters are available, they can be home-made, using old tube bases and sockets. Make them sturdy; they will undoubtedly be plugged in and out very frequently.

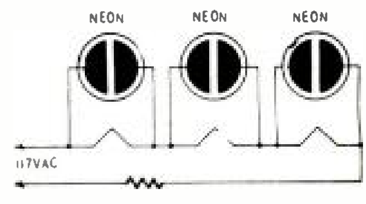


Fig. 2—Lamp shows up the bad filament.

This information is made available with the permission of Fred Colton, who has used the procedure for some time in his Columbus, Ohio, service shop.

(Another quick way of checking a suspected filament string is to measure all filament voltages with an a.c. voltmeter. An abnormal tube will often show surprisingly (to the uninitiated) high or low voltage across the filament. —*Editor.*)

ESSE RADIO CO.

Esse's Special Offer

INDIANAPOLIS INDIANA

ESSE WILL BUY ANYTHING ELECTRONIC

Attention Factories, Hams, Dealers, Individuals

. . . just Anybody

Some of the equipment listed below is urgently needed by our company to meet the demands of customers and we will pay the highest cash prices. Send letter with full description describing condition and quote price. We will immediately answer and if we can use your equipment, we will authorize you to send it to us COD.

We are dealers in surplus electronics and we are interested in anything dealing with radio or television. We are especially interested in large quantities of surplus and anything that can be bought at a bargain price. Please don't hesitate to write us immediately. Quote us prices on what you have and give us a full detailed description. We will not answer any letter unless description and price is quoted.

WE NEED AT ONCE!

We Are Especially Interested in Large Quantities

- BC-348 Receivers, AC or DC models
- BC-312 Receivers
- BC-221 Frequency Meters
- SCR-522 Transmitters & Receivers
- Hallicrafters BC-610 Transmitters
- Any factory built transmitters and receivers such as Hallicrafters, National, Temco, Collins, RCA, RME, Hammerlund, Millen, Meck, Harvey-Wells, Meissner, Sonar, McMurdo-Silver, Gonset, Stancor, Bud, etc.
- Amateur or commercial sets
- Large stocks of tubes
- Large stocks of transformers
- Large stocks of condensers
- Large stocks of resistors
- Large stocks of speakers
- BC-224 Receivers
- BC-342 Receivers
- Police type VHF transmitters and receivers for mobile application
- Collins ART-13 Transmitters APS-13's
- SCR-269F or G Fairchild or Bendix ADF's
- Headphones in quantity lots
- Microphones in quantity lots
- Field telephones
- Sound-powered telephones

We are especially interested in any factories, dealers or other outlets giving us a list of surplus electronic equipment that is for sale so that we may submit our bid.

AUTOMATIC DIRECTION FINDER RADIO COMPASS SCR-269-G

Brand new in original crates. Made by Bendix. Complete, a truly magnificent buy for airplane owners or boat owners $125.50

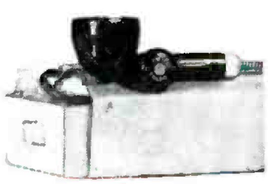
BC-221 FREQUENCY METER

Covers 125-20,000 Kc. Battery or 110 V. AC or vibra-pack operated. A beautiful instrument. The finest we have ever had. $69.50

CABLE CONNECTORS AND PLUGS

Choice .25 — All Brand New

Manufacturer	Type	Price
Amphenol	AN3101-16-10P	25c each
Amphenol	AN3101-18-18S	25c each
Amphenol	AN3101-22-5S	25c each
Amphenol	AN3102-22-15P	25c each
Amphenol	AN3102-28-10P	25c each
Amphenol	AN3102-32-5P	25c each
Amphenol	AN3106-18-11S	25c each
Amphenol	AN3106-18-18P	25c each
Amphenol	AN3106-24-6S	25c each
Amphenol	AN3106-24-7P	25c each
Amphenol	AN3106-32-5S	25c each
Harwood	AN3-08-14S-*	25c each
Aero	AN3108-14S-2S	25c each
Cannon	AN3108-14S-2S	25c each
Amphenol	AN3108-14S-2S	25c each
Amphenol	AN3108-18-12P	25c each
Amphenol	AN3108-22-5S	25c each
Cannon	AN3108-22-5S	25c each
Amphenol	AN3108-24-6P	25c each
Amphenol	AN3108-24-16S	25c each
Cannon	AN3108-24-16S	25c each
Amphenol	AN3108-32-5P	25c each
Amphenol	AN3108-28-10P	25c each



T-17-B Carbon Microphones

(Handmike) (New) $1.75

Army Phones Low Impedance

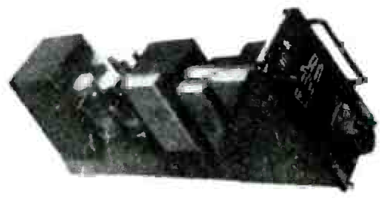
Used. With short cord and plug PL-354 and cushions.
Price $2.50

Magnesyn Indicator

To be used for beam antenna. Practically same as I-81-A Selsyn indicator. 15-25 V. 60 cycle AC. 3" size.
Excellent condition .... $1.25 ea.
Plug for connection .... .50

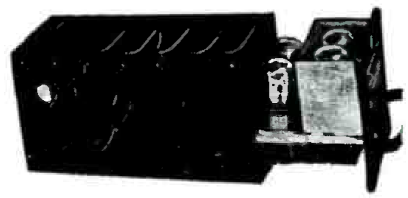
HASH FILTER

Mounted on strip 3½" x 1". Contains two hash chokes & one dual .35 MFD 400 Volt bathtub condenser.
Price .... .50



PP-51/APQ-9 RECTIFIER-POWER UNIT

400 cycle 115 V. Contains 4—5R4GY tubes, 2—4 Mfd. 1000 V. DC condensers, 2—1 Mfd. 1500 V. DC condensers, 400-2600 cycle transformers, power resistors, etc. Weight 38 lbs. Size 21"L x 5-1/3"W x 7¾"H $4.95



TURBO AMPLIFIER

Used for parts—shipped complete with the following tubes: 2—7C5's, 1—7Y4, 1—7F7.
Price .... $1.00 ea.

BC-1158 TRANSMITTER AND MODULATOR

Made by Bendix for airborne operation. Designed for remote control. Power source 28 V. DC input (not included). Operates in any place in the 53-60 Mc. and 80-88 Mc. frequency band. Is crystal controlled (crystals not included). Has RF stages, amplifier and driver section, contains 4-815's and 10-12SN7 tubes, 1-0/150 DC milliamp Weston meter which can be switched to various circuits. Has exhaust fan for ventilation. Can easily be converted to operate on several frequency bands. Size 12" x 8" x 18". 45 lbs. Limited quantity $27.50

A TREMENDOUS BARGAIN

Quartz Crystals without Holders

Get an assortment of these and grind to your own frequencies or use them as they are. .5x.6" B-cut lapped on faces and squared on edges. (Ready to use). We will give you an assortment of these from approximately 13 thousandths of an inch to 24 thousandths of an inch whereby you can grind to frequencies desired. These crystals are now ground to the approximate following frequencies:

3880	4640	6225	7300
3900	4900	6275	7400
4140	5300	6700	7500
4600	5580	6850	7800
4650	5800	6900	7900

Formula for converting thicknesses of B-cut crystals to frequency is as follows: F=98.4/T where F is frequency in kilocycles and T is thickness in inches.

AN ASSORTMENT OF 20 DIFFERENT THICKNESSES $1.50

ESSE Specials!

Here's a Special Bargain we are able to offer to our many Friends & Customers; the famous "HER MAJESTY"

AUTOMATIC DISHWASHER

Clean, Sparkling Dishes in 2 Minutes Flat

Now you can free yourself of the everlasting drudgery of washing dirty, greasy dishes! Just put 'em in "Her Majesty" Automatic Dishwasher for a couple of minutes and forget 'em! No more chapped, dishpan hands, no more dirty dish towels! Not only does "Her Majesty" save you lots of time and trouble, but it saves on soap. Just a thimbleful of detergent does the trick . . . thoroughly! You'll be amazed . . . and delighted at the job "Her Majesty" does. "HER MAJESTY" DISHWASHERS NOW GIVEN AWAY ON THESE COAST-TO-COAST RADIO PROGRAMS:

"Second Honeymoon," "Welcome Traveler," "Times a Wasting," "Take a Number."

A Wonderful Xmas Gift for her . . .

This is the most stupendous bargain that we've ever offered. These dishwashers were made to sell for many, many more dollars than what we are asking. They are brand new; in fact, still packed in shipping boxes.

Because of the low price that we are selling these dishwashers for, we absolutely do not offer any guarantee or refund whatsoever.

$20.00 each

Look at these Sensational Features

- Dishes Dry by Themselves!
- Easy to Use—Slip hose on faucet . . . put in dishes . . . turn on the water!
- Fits on Drainboard
- Holds 16 Dishes at once . . . Extra Basket for cups, saucers and silverware.
- No Motor . . . No Electricity . . . No Expensive Plumbing!
- Light Weight (only 12 lbs.) Rust-Proof Aluminum with Baked-on Finish.
- Double-Action Spray.

SCR-625 MINE DETECTOR

Brand New — **Metallic Objects Only**

Used by the Army to detect buried metallic mines. Its private use suggests the location of underground or underwater pipes, cables and ore bearing rock, the location of metallic fragments in scrap materials, logs, etc., and the screening of personnel in plants for carrying of metallic objects.

The unit consists of a balanced inductance bridge, a two-tube amp. and a 1,000 cycle oscillator. The presence of metal disturbs the bridge balance, resulting in a volume change of the 1,000 cycle tone. The tubes used are low-battery drain types such as 1G6 and 1N5. The circuit may be modified for control of warning signals, stopping of machinery, etc., when metal is detected. Operates from two flashlight batteries and 103 V. "B". However, a power supply operating from 110 V. may be used. Comes complete with spare tubes, spare resonator and instruction manual—in wooden chest 8¼"x28¼"x16". Weight in operation is 15 lbs. New, complete in original overseas packing container. Originally sold by War Assets for $166.00. The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

Price $59.50
Batteries . . . . $4.00 extra

Telrad 18-A Frequency Standard

Checks signals in the range of 100 Kc. to 45 Mc. with a high degree of accuracy. Self-contained power supply is 110, 130, 150, 220, and 250 V 25-60 cycle AC. Complete with tubes, dual crystal and instruction book. Brand new. Price $24.95

RF TRANSFORMER

For experimental use. Covers four bands. Range unknown. Measures 4" x 4⅞" x 2¼". Brand new. Price . . . . $.50

COLLINS AN/ART-13 XMTR.

A compact, light-weight, modern, highpowered transmitter. Frequency range 2-18-1 Mc. on any of its 11 auto-tune crystal controlled or master os channels. Dec. 1947 "Radio" gives conversion data for convert. V. DC operation to 110 V. AC are in exceptionally fine con. tested in our labs. Weight. (Dynamotor included) $234.50

BL-SELENIUM RECTIFIER

Type 23751, half-wave. Use 2 of these for full-wave circuit converting 110 V. AC to 135 V. DC at .75 amps. or parallel for higher current ratings. Voltage output controlled by condenser across output. Brand new. Price . . . . $1.75 ea.

AUTOMATIC RECORD CHANGER RECORDER COMBINATION

MODEL GI-130 or RC130L

play records, cut records

Manufactured by General Industries Company, this unit is ideally suited for installation in your phono-combination or can be used with any amplifier having approximately 5 watts output (although a power level of approximately ¼ watts is all that is required for satisfactory cutter operation). Cutter head is an Astatic Crystal X-26.

Record player mechanism is automatic and plays twelve 10-inch records or ten 12-inch records. Pick-up head is a sure crystal.

These mechanisms are brand new in original shipping boxes and we are selling them at a fraction of their original cost (original price $79.50). Our Price, complete with operating and service manual, brand new, Close-out sale.

$22.50 each

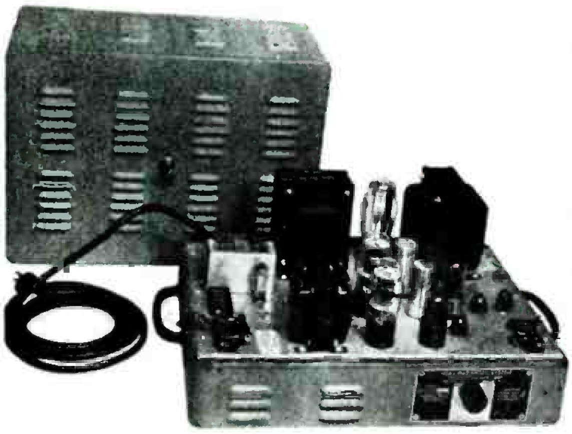
ESSE RADIO CO., 40 W. South St., Indianapolis, Ind.

ESSE RADIO CO.

Esse's Special Offer

INDIANAPOLIS, INDIANA

15 WATT POWER AMPLIFIER UNIT—*Brand New*



Model F Power Amplifier Unit manufactured by Personal Music Company, Newark, New Jersey. Formerly sold to jobbers at $129.50 each.

Chassis size 11½" x 17½" x 2½" high (with cover 11½" x 17½" x 7½" high). Net weight about 50 lbs. Gray crackle finish.

This amplifier delivers 15 watts of undistorted audio power with excellent frequency response. The tube line-up is 1—2D21, 1—6AL5, 1—6SJ7, 1—6SN7, 2—6L6G's, 1—5U4G. The total power drain is 300 watts from the 110 V. 60 cycle AC power source. Treble, bass, vernier volume and master volume controls are provided. This amplifier is beautifully designed and is sturdily constructed with the best of components. It can be used for continuous day and night service. Deluxe features such as high—low AC line switch, AC line fuse, good ventilation of chassis and cover, external carrying handles, lock and key, and heavy duty AC line cord are provided.

You can use this unit for microphone, phonograph, or radio input or fix it for combinations of such inputs. It will make an excellent foolproof and trouble-free unit for dance bands, lecture halls, schools, sports events, for rental purposes, for inter-office communication. It will handle a number of loudspeakers. Originally sold for $129.50. Our price

$35.00 *Brand New Complete*

RADIO TUBES 38c ea.

Your choice in quantities of 1000

Brand New. Individually, attractively boxed. Unconditionally guaranteed against anything except breakage, for 90 days. Any tubes found not satisfactory, return to us for credit.

Your choice. Mix up the types, we don't care.

Price each	$.50
100 or more	.45 ea.
250 or more	.42 ea.
1000 or more	.38 ea.

0Z4	2A7	6AK5	6K6	6T7	12AT7	12SN7	37	84/6Z4
1A5GT	3A4	6AL5	6K7	6T8	12AU6	12SQ7	38	85
1A7GT	3A5	6AQ5	6K7G	6U6G	12AU7	12SR7	39/44	89
1B5	3B7	6AT6	6K8	6U6GT	12AV6	12Q7	40	117P7
1C5GT	3D6	6AU6	6L6	6U7	12AX7	12Z3	41	117Z3
1C6	3Q4	6AV6	6L7	6V6	12BA6	14A7	42	117Z6
1D8	3Q5	6B4G	6N7	6W4	12BA7	14Q7	43	VR90
1G4	3S4	6B8	6P5GT	6W7	12BE6	14X7	46	1619
1H5	3V4	6BA6	6Q7	6X4	12BF7	19	47	VR150
1H5GT	5FP7	6BA7	6R7	6X5	12C8	19T8	50	182B
1J6	5R4G	6BE6	6S7	6Y6	12F5	24A	50B5	183
1J6G	5T4	6BF6	6S7G	6Y7	12H6	25A6	50C5	482B
1L4	5T4G	6BG6G	6S8	6ZY5	12J5	25AC5	50Y6	483
1LC6	5U4G	6BH6	6SA7	7A4	12J7	25L6	51	954
1LH4	5V4	6BJ6	6SC7	7A7	12K7	25Z6	53	717A
1LN5	5W4GT	6C4	6SD7	7A8	12K8	26	56	955
1N5	5X4	6C5	6SF5	7B6	12Q7	27	57	956
1Q5	5Y3GT	6C8G	6SG7	7C4	12SA7	30	58	957
1R4	5Y4G	6D6	6SH7	7C5	12O1/7E5	31	70L7GT	1005
1R5	5Z3	6D8	6SJ7	7F7	12S8	32L7	71A	1626
1S5	5Z4	6F5	6SK7	7H7	12SC7	35	75	1629
1T4	6A3	6F6	6SL7	7Y4	12SF5	35/51	76	2051
1T5	6A4	6F8	6SN7	7Z4	12SF7	35B5	77	2050
1U4	6A6	6H6	6SQ7	10Y	12SG7	35W4	78	9003
1U5	6A8GT	6J5	6SR7	12A6	12SH7	35Z5	80	CW931
1V	6AC5GT	6J6	6SS7	12A8	12SJ7	35Z6	81	307A
2A5	6AF6G	6J7	6ST7	12AT6	12SK7	36	83	9001
2A6	6AG5	6J8	6SU7					

ESSE Radio Co

40 W. South St. Indianapolis 4, Ind.

Unless Otherwise Stated, All of This Equipment Is Sold As Used
CASH REQUIRED WITH ALL ORDERS
Orders Shipped F.O.B. Collect

The Intermittent Headache

By MAX ALTH

NOTHING on a service bench will turn a man's liver a brighter shade of green than will an intermittent receiver. Other problems can be solved with time, special equipment, money, and even with sweat—but the only things to which an intermittent radio respond are hair tearing, nail biting, and tears.

This is the case inevitably whenever the service technician uses the wrong approach. But there is a right one.

The very first thing to do when a customer says, "My radio set fades," is to rush out of his house and get yourself a Sherlock Holmes hat—that's the double-ended job in green plaid—and a meerschaum pipe. The second thing to do is to return to the scene of the crime, slip your feet under the Morris chair, and prod the victim into talking.

Let him talk all he wants, but don't believe a word he says. Then tell him, "Show me." Get him to turn the set on . . . tune in the disappearing radio program. Then wait for it to fade.

All this may seem a silly waste of time, but believe me it is not. The problem of locating the causes of fading and intermittency is one of detection; and, if a Sherlock Holmes hat and pipe will help you think and act like a detective—go get them!

Make certain that the set actually fades, and that it is not tuned to a weak dx station which carries a program similar to the local one, and whose fading is caused by normal conditions outside the set.

If the set doesn't fade in your presence, you can suggest to the customer that he wait until the fading becomes more pronounced, in which case your job will be much easier and you will be able to charge much less for the repair.

Assuming that the customer's set really does fade, you may have a suspicion as to what is causing it. Keep your suspicions to yourself! This is where many a good radio technician goes wrong. Your guess may be very good—but *don't* yank the set until you are certain the trouble is not due to the installation.

Maybe it's not the set

The fade may be caused by a defective antenna, a loose ground connection, or even a low and changing line voltage. Make certain of it by disconnecting the antenna and using a length of bell wire as a temporary antenna, for example. Disconnect the ground completely, and put a voltmeter across the line when the set is at its nadir. A radio will play very nicely when the line voltage is high. But, when the line voltage is low, there is a critical point at which a slight variation will make a great change in the set's output, or may even cut the oscillator off completely.

When you have cleared the installation of suspicion, then everything else is suspect, including the extension speakers, record player attachments, telephone cutoffs, etc. First consider the chassis in relation to its cabinet. Someone may have stuffed papers inside, causing the temperature to go too high. Anything can have happened, including a visit from a family of mice. It is very possible that the set will play well on your bench where, well ventilated, it operates relatively cool. Won't you be the embarrassed one when you return the set, and it still fades, running hot in its cabinet? If possible, take the cabinet to the shop with you. If not, run the set, out of its cabinet and sitting on the floor, and see what happens.

Bear in mind during all these shenanigans that you are not trying to be the fair-haired boy of the radio service world, but that you are trying to simplify and localize your trouble by eliminating one possible source of fading after another.

Up to this point:

You have established by personal observation that an actual defect exists.

You have cleared the installation.

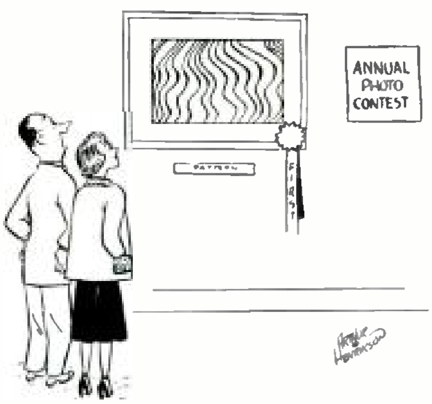
You have cleared the line voltage.

You have cleared the chassis-cabinet combination.

You know that a defect exists in the set proper—the chassis.

Do not yank the set until you have made all the foregoing checks.

When you do take the set to the shop, do so very carefully as not to jar it into normal operation accidentally. If you do jar the set, you won't know what's up when you get it on the bench; and what's worse, you may jar the set again on returning it—and start it fading again! (*Continued on page* 62)



Suggested by Arthur A. Henrikson, Chicago, Ill.
"See dear! I told you our television set would pay off!"

(Continued from page 60)

A number of tools on the market are designed to aid in the servicing of fading radios. The best of them is perhaps the Chanalyst, or channel analyzer. This five-eyed monster that never sleeps can watch five sections of your radio for you. In effect, it is five vacuum-tube voltmeters. You hook one section of it to each section of your set, and let her rip. When the set cuts out, you look into the electric eyes, and learn immediately whether it's the r.f., mixer, i.f., output, or power supply that has lain down on the job.

While this instrument is very good, a better instrument is still that brain supposedly lodged beneath that detective cap. Even after the Chanalyst has put the finger on the fading stage, or group of stages, *you* still have to locate the offending capacitor, coil, solder joint, wire, rosin drop, or whatever is causing the trouble. That component may well be in another portion of the circuit. And very often, the set will leap back into action when you try to clip the test lead on the first suspected component and not fade again for several minutes, or in some horror cases, several hours.

A few possible clues

The experienced technician can sometimes guess the trouble by listening to the set cut in and out. Here are some characteristic sounds, and their causes:

Breaks in the front end of the set, antenna, and r.f. stages cut in and out with a cleanness, or lack of thump, which is very distinctive as compared to rear-end breaks. Breaks in the audio usually have a heavy-footed thumping accompanying them.

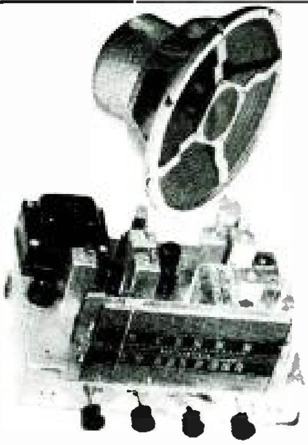
An oscillator cutting in and out can be spotted by the signal's disappearing, an increase of rush, and a seeping in of all stations, especially if the set is tuned toward the high-frequency end of the broadcast band.

When an r.f. stage cuts out on sets having a.v.c., the signal may or may not hold its level, but the background noise may increase as the a.v.c. turns up the gain. The same thing happens when an i.f. stage cuts out.

When one of several audio stages cuts out, the set performs normally with the exception of a great loss of volume. But the signal is clear and undistorted. Interstage coupling due to the existing wiring feeds some of the energy around the dead stage, making it harder to locate the trouble.

If the set cuts out when the volume is turned way up, very possibly the speaker voice-coil leads are making poor contact. If there is no hum whatever in the speaker, you can be certain the break is there.

When one or more of the filter capacitors opens up, there will be—in addition to an increase in hum—the possibility of decrease in volume (due to a lowering of plate voltage) of audio oscillation, motorboating, r.f. and i.f. oscillation, because of lack of the filter



hallicrafters

11-TUBE FM/AM CUSTOM CHASSIS ONLY $59.95

★ WORLD'S FINEST CHASSIS VALUE, REGULAR NET WAS $110.00

★ OUTPUT MATCHES 8 OHM VOICE COIL.

★ PRICE WITH 12" COAX. P. M. SPEAKER $69.95.

Model S-56 Hallicrafters, 11 tube AM-FM radio receiver chassis for broadcast and FM 88 to 108 mc. Automatic frequency control on FM, holds the receiver in perfect 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 14,000 CPS. Wide vision accurately calibrated slide rule dial, with preselection on broadcast band. Output transformer matches any 8 ohm PM speaker. 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 radio selling in the $400.00 to $600.00 class. The regular dealers net on this chassis is $110.00. However a lucky purchase enables us to offer these brand new, factory cartoned S-56 Hallicrafters chassis, complete with tubes and operating instructions, at only $59.95 less speaker. Chassis size 12¾ x 10 x 7¾". Weight 22 lbs. Brand new factory cartoned. Buy your S-56's with a wide range 12" coaxial PM speaker. Both for only $69.95.

Order your S-56 complete with a $32.50 list Cinaudagraph 12 inch coaxial PM speaker. Combined shipping weight 35 lbs. Both for only $69.95.

S-56 Hallicrafter FM/AM custom chassis. Matches any 8 ohm PM speaker. Only $59.95.

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 $9.95

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 $9.95** price possible. Stock No. FP-4X, complete kit less batteries. Shipping weight 9 lbs. **Net price $9.95. Kit of batteries,** 67½ volt "B" and "A", $2.25 extra.

BUILD YOUR OWN RADIO STATION

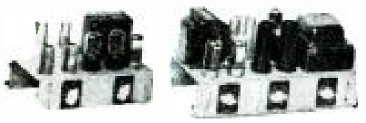
MINIATURE BROADCAST STATION KIT $6.95

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.

COMPLETE AMPLIFIER KITS



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—6V6, 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, 5Z4. 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.

8-TUBE HALLICRAFTERS MODEL S-59 COMPLETE WITH 12" COAXIAL SPEAKER $42.95

Model S-59 Hallicrafters, high fidelity, 8 tube FM/AM chassis, for custom installations. Receives broadcast 540 to 1700 kc and FM 88 to 108 mc. Size 12½ x 7½ x 9". An excellently engineered chassis, with accurately calibrated slide rule dial. Variable tone control and 60 to 14,000 CPS wide range audio. (Push-pull 6K6's) 8 ohm output transformer will match most speakers. No special output transformer required. Loop antenna built in for broadcast reception. Includes tubes: 2-6BA6, 6BE6, 6AL5, 6SQ7, 2-6K6 and 5Y3. This is without a doubt the most radio chassis we have ever been able to offer. Better rush your order now. We have them. Price less speaker $32.95.

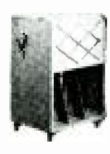
Hallicrafter S-59, 8 tube custom FM/AM chassis, with Cinaudagraph 12 inch high fidelity coaxial PM speaker, as pictured. Shipping weight 28 lbs. Both for $42.95.

Hallicrafter S-59, custom FM/AM chassis, output matches any 8 ohm PM speaker. Priced less speaker, shipping weight 18 lbs. Net $32.95.

ACCESSORIES FOR S-56 & S-59

Adapts your S-56 or S-59 for use with a microphone or variable reluctance pick up. Dual purpose preamplifier. Only 4 wires to connect. (Instructions furnished) Input jacks for General Electric variable reluctance pickup and crystal or dynamic mike. This makes your S-56 a home P. A. system. Shipping weight 2 lbs. Size 3½ x 4 x 3". Net $3.95.

Shure 708A, regular $22.00 list crystal mike with cord, $8.95 extra. Adjustable banquet type desk stand $2.95, extra.



CONSOLE CABINET FOR S-59 $19.95

Beautiful blond console cabinet, 33" high, 17" front to back and 21" wide. The lower half is divided for record albums. A hinged lid covers the radio changer compartment. Changer space 12 x 15". Radio panel is ready cut for the Hallicrafter S-59. Use any speaker up to 6 x 9". Shipping weight 40 lbs. Stock No. JB-4 blond cabinet, ready cut for S-59, with uncut changer board. Net $19.95. 6 x 9" PM speaker $2.95 extra.

Stock No. JB-5X, above blond cabinet with blank radio panel (radio area 8 x 15", changer area 12 x 15".) Net $19.95.

Stock No. B-1000, above blond cabinet, changer area 15 x 15", radio area 5 x 15". Build over to suit your needs as record player or combination. Net $14.95.

"COAXIAL" Reg $32.50 List P.M. SPEAKER $12.95

Made especially for us, to our own specifications by a nationally known speaker company. Response 40 to 17,000 CPS. Just hook in place of any 8 ohm PM speaker and have the finest tone quality. Shipping weight 8 lbs. Stock No. CR-13X, Net $12.95, Two for $24.95.

Hi-Fi OUTPUT FOR P.P. 626 $6.95

Why pay $20 or $30 for an output? Our lab test proved this the best value today. Response from 20 to 20,000 cycles. 6600 ohms plate to plate with 4-8-15-250 and 500 ohm secondary. Shipping weight 8 lbs. Stock No. A-103. Net $6.95.

CAPEHART TWO POST RECORD CHANGER $6.95

Require Adjustment.

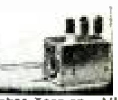
Capehart Changer Scoop. Used on famous, high priced combinations. These changers have been removed from sets; to be replaced with twin speed changers. Require Minor Repair. These have Capehart true-timbre variable resistance cartridges. Requires same gain as the G.E. VR cartridge. Connecting instructions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

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

TELEVISION MAGNIFIER $7.95

Regular $25.00—FOR ONLY ....

Stock No. HA-22, 12-inch x 17-inch Television Magnifier. Made of crystal clear plastic and oil-filled. Magnifies your present 7-, 10- or 12-inch television picture up to four times. We offer you these new factory cartoned magnifiers. You provide your own means of mounting to your TV set. Edge of magnifier may be drilled and hung on set with cord. This lens is a $25.00 value, but McGee offers it to you for only $7.95. When ordering, include postage for 22 lbs.

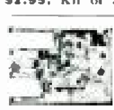


Sarkes Tarzian 13 CHANNEL T.V. TUNER ONLY $7.95

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 $7.95

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.



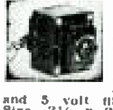
T. V. SCOOP $5.95

Farnsworth Television Chassis Model GVZ60 partially built up Chassis Size 12x17. Has 16 Tube sockets and over 150 small parts (Resistor and Ceramic Condensers) 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. 375 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, 60 cycle. 760 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. MB-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 $4.49.

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

RCA 201D1-201D3 Deflection Yoke. Sale Price regular $4.50. Net $3.49.

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 language. We think it's the finest value today. Net $3.00

RT-40LL Television antenna. Stacked high and low band folded dipoles, with reflectors and mast. Regular $15.00 net. McGee's sale price $6.4a

McGEE RADIO COMPANY • Prices F.O.B. K.C. Send 25% deposit with order. Bal. sent C.O.D. With Parcel Post Orders include Postage. • **WRITE FOR BARGAIN FLYER.** 1424 Grand Ave., Kansas City, Missouri capacitor's bypass effect on a.f. and r.f. currents.

When one of the cathode bypass capacitors in an audio circuit opens, there will be an apparent loss of bass and possibly a great loss of volume in the loud peaks.

Intermittent capacitors often react to line-voltage fluctuations. Switching on lights in the same room makes them cut in or out. Cold-soldered joints, on the other hand, are very susceptible to vibrations.

The cycle of fading should be carefully noted. A short cycle is more often due to a tube. A long cycle is possibly due to some heating or thermostatic effect.

Systematic procedure

These are but some of the many ways fades give themselves away. However, before you touch any of the set's components—unless the trouble is staring you plumb in the face—clear the tubes first. Replace them with another set known to be good. Do not depend upon a tube tester to check tubes suspected of fading. Most testers merely check the emission of the tube, and none of them duplicate the exact conditions it encounters in actual operation in a receiver.

Check the tubes by substitution because a tube can, and often does, react exactly like a cold-soldered joint or intermittent capacitor.

Your next step is to check the soldered joints. This is very important in new sets where a cold-soldered joint is much more common than in an old one. (Obviously, if the old set had a bad joint, it would have caused trouble before.)

Go over the joints with a hot iron. This seems to be a lengthy method, but is a wise one. For one thing, the hot iron marks the joints you have inspected. For another, it is slightly impossible to spot a bad joint by eye—or any other way!

With the accessible joints cleared, next have a go at the wires. Tug and pull on them, keeping in mind the fact that a wire has two (or more) ends, and that pulling on one end also moves the others.

Next in line come the capacitors. If you have more or less located the defective capacitor (or capacitors) with instruments, replace it (them) and check by listening. However, replacement of capacitors is not a simple problem, with one exception. If the set is fairly new, you can safely assume that the defective capacitor is an accident, and that the rest of them are up to snuff.

If the set is an old one—and a midget—your best bet is to *rip them all out*, excepting micas (they seem to last forever) and not waste time testing each one. **If the set is old, but huge, you are definitely faced with the cost of a complete capacitor replacement. Your best and safest bet is to sell your customer on the idea.**

Your next best bet is to replace all the capacitors on or in the defective circuit. That is, if the intermittent capacitor seems to be one of the filters—out with all the filters! If it is one of the bypasses in a tone network—out with all of them; and so on down the line.

Your next move, if none of the foregoing approaches are practical in the given case, and you believe the fault to lie in one of the capacitors, is to try and find the faulty one. The problem is that the capacitor at fault won't lie down and stay dead, but gets up and works when you approach with your test leads. Therefore, you have either to locate it by way of its associate circuits or by forcing it to lie down and stay down. A good stunt (if you *can't* replace all the capacitors) is to unsolder the hot end of each suspected one. When disengaging a capacitor duplicates the fade exactly, you may be a little nearer the solution of your mystery.

Some technicians test pigtail capacitors by wriggling them while the set is in operation. Other equally competent men will tell you that wriggling will send them on their way to intermittency.

Some bring a hot soldering iron near the suspected capacitor, and hope the additional heat will cause it to act up. Some use a loop coupled to a high-power, high-frequency generator in the belief that the induced current will cause the intermittent to become permanent.

Others drop one corner of the set a few inches to jar the components, and still others warp the chassis with their hands, to put mechanical strain on the set.

The most successful are those who toss the set out a ten-story window and quit the business. For the replacement of less than all the capacitors on an old set is a compromise—and just when to compromise depends upon the serviceman's judgment. No hard and fast rule can be laid down here or anywhere else.

Other components

With the tubes, joints, wires, and capacitors cleared we can go on to testing the remaining components in the receiver.

Coils can be checked by momentarily flashing a high voltage through them. The theory is that the overload will either make them or break them (either weld the break permanently together or melt the ends further apart.) Other components will have to be tested individually in fashions depending upon their nature.

Continue in this way, clearing part after part; follow a definite, systematic plan until you locate and arrest the offending part.

If you follow this Sherlock Holmes system, you will eventually locate the trouble. But if you cross your fingers, trust to luck and your technical skill, and jump around in the set, you may never, never find it!

Repair Electrical Appliances and Utilities with the aid of

THE AMSTERDAM MODEL 100

ELECTRIC TESTER

Compact—Measures: 3 1/8" x 5 7/8" x 2 1/4"

A NEW KIND OF INSTRUMENT FOR TESTING *ALL* ELECTRICAL CIRCUITS AND APPLIANCES SUCH AS—

- **RANGES**
- **SHAVERS**
- **HEATERS**
- **IRONERS**
- **WASHERS**
- **FANS**
- **VACUUM CLEANERS**
- **AIR CONDITIONERS**
- **REFRIGERATORS**
- **SUN LAMPS**
- **CIRCUIT BREAKERS**
- **LIGHTING SYSTEMS**
- **ETC.**

THE MODEL 100:

- Will accurately measure all Voltages both A.C. and D.C. between 70 volts and 660 volts.
- Incorporates a Continuity Indicator which is used for locating breaks in wiring, and "shorts" and "opens" in switches.
- Will indicate excessive leakage between a motor and a line up to 10 Megohms.
- Will indicate if an appliance, motor, etc. connected in a line is "open."
- Will indicate when a three phase motor is running erratically due to a "blown" fuse.
- Will indicate whether the current is A.C. or D.C. and if the frequency is 25 cycles or 60 cycles.
- Is the ideal trouble-shooter as it will instantly locate opens, shorts and grounds.
- Will test all bulbs, radio tube filaments, pilot light lamps, all fuses including cartridge, screw, etc., fluorescent bulbs, etc.
- Will test condenser for both opens and shorts.
- Will check field coils for opens and shorts.
- Will indicate when one side of an appliance or motor connected to the line under test is "grounded."
- Will instantly identify the "grounded" leg of any electric line.

ONLY $5.00

The Model 100 Electric Tester comes housed in a round cornered molded bakelite case. Complete with all test leads and operating instructions.

SHIPPED ON APPROVAL!

NO MONEY WITH ORDER—NO C.O.D.

TRY BEFORE YOU BUY! Yes, you need send no money with order or pay anything on delivery. Simply fill out this order form and mail it today. Try the Model 100 for 10 days. If completely satisfied remit $5.00. If not, return the instrument—no explanation necessary.

AMSTERDAM SALES CO.
Dept. RC-12. 98 PARK PLACE, NEW YORK 7, N. Y.

Gentlemen: Please rush one Model 100 Electric Tester. I will either remit $5.00 after a 10-day trial or return the instrument via Parcel Post.

SHIP TO:—Name ....

Address ....

City .... State ....

☐ ***FREE PREMIUM!***

Check here if you include $5.00 payment with order. In return for saving due to bookkeeping, we will include a set of 6 assorted key chains with your Model 100. If the Model 100 does not meet with your wholehearted approval after a 10-day trial, return it for full immediate refund of $5.00—keep the premium for your trouble.

European Report

By Major Ralph W. Hallows

RADIO-ELECTRONICS LONDON CORRESPONDENT

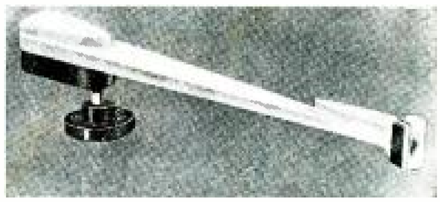
TELEVISION is said to have stolen the show at Radiolympia this year; in a way perhaps it did. TV still has a big novelty appeal and demonstrations of televisers on the stands and in the special viewing rooms were bound to be more exciting than those of plain and simple radios. Nevertheless not more than half of England's population will be served by TV when the Birmingham transmission is added at the end of the years to the existing London transmission. Of that half, only a comparatively small proportion can even think about affording the price of a TV receiver. Hence, the majority of the tens of thousands of folk who kept the exhibition packed from start to finish went to it with the idea of window-shopping at the television stands and of selecting at the others the new radio receivers that they are going to have now or hope to have shortly in their own living rooms.

There's no disguising the fact that Britain has had a big slump in radio sales for some months now for several interesting reasons. First, there's shortage of cash. Next comes purchase tax. This ups the cost of new radio by about 25%—and an increase of that magnitude is a pretty serious consideration. The radio manufacturers had a seller's market for a year or two after the war; hardly any domestic radios having been made between 1939 and 1945, when the war was over, there were hundreds of thousands of homes in which the old radio set was just worn out and simply had to be replaced, willy-nilly.

Those are all contributory causes of the slump, but the chief one is that the radio manufacturers decided, for some queer reason, not to hold an exhibition last year. Publicity is the life blood of modern business. If you don't keep on telling the man in the street what you're doing, keep on showing him what it means to him, and keep on giving him reasons why he should spend his hard-earned money on your products, he just dries up as a source of revenue to you. The Radiolympia that didn't take place last year was a loss indeed, but the exhibition that did come off this year has put the new radio receiver right back on the map for the ordinary man and woman. It gave visitors a thousand and one practical demonstrations to show that the old radio receivers in their homes weren't up to the task of bringing in today's radio programs as they deserve to be reproduced.

It showed them three more important things:

1. New radios cost much less now than a year or so ago. This year, radio set prices average about 15% less than last year.
2. Those endowed with critical ears can now obtain at reasonable cost far more faithful reproduction than was possible at a comparable price in recent years.
3. The radio receiver can be as pleasing to the eye as it is to the ear. British radios of today, with their cabinets made of lovely woods or of beautifully colored plastic materials, are designed by artists. They have ceased to be



This pickup has interchangeable clip-on heads for playing both standard and LP records. Magnetic, it has high output.

Savoy and Moore hearing aid doubles as a broadcast receiver for one station.

things that must be tolerated in an otherwise delightful living room because one cannot get anything better. On the contrary, these are models which are either so small and unobtrusive that their presence passes unnoticed, or which are in themselves so beautiful that they add to the attractiveness of their surroundings.

To take one example, the peacock is a glorious bird when you see him full-face with his tail fanned out. If, though, you happen to be behind him, his southern aspect leaves much to be desired! So with most radios: their fronts pass muster, but their far-from-beautiful backs must be placed out of sight against the wall, which very much limits the positions they can occupy as pieces of household furniture. One of the newest nonbattery portables is housed in a molded plastic cabinet, with front and back identical in appearance. Even the tuning scale appears at both sides of the set. It can thus stand *anywhere* in the apartment.

Some small receivers

Some tiny receivers were on view at the show. The "world's smallest superhet" is a four-tube midget measuring only approximately 10 x 4 x 3 inches. There were portables and personals making the fullest use of miniature tubes and components and weighing as little as 3½ lbs., including all batteries. An automobile radio set shown, measuring 9¾ x 5½ x 6½ inches and

This automobile radio receiver, said by its maker, Masteradio, to be Britain's smallest, is 9¾ x 5½ x 6½ inches.

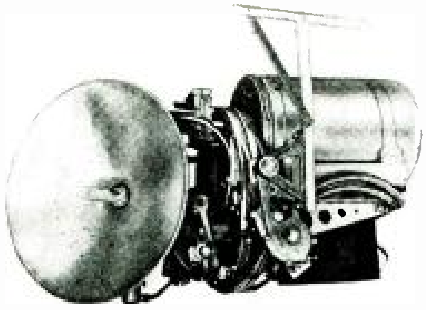
weighing only 10 lbs. (see photo), is particularly useful in the 7-15-horsepower autos of which we make so much use on this side of the Atlantic. They haven't much room to spare and these small radios fit in where others won't. In any case, though, why carry a large and heavy automobile radio if a small, light outfit does just as well?

Speaking of the radio set as a piece of furniture, one model interested me considerably. This is built rather on the lines of the expanding bookcase on the add-on system. Start, if you like, with a smallish table radio. Add a bigger loudspeaker in its own cabinet and this becomes a console model. When next your bank balance is again right, a new unit makes the whole a radio-phonograph. An automatic changer and a storage cabinet for records can be added as time goes on. Another add-on unit provides television. Thus, from quite a simple start can be built up progressively an instrument giving every facility for home entertainment provided today by electronics.

(*Continued on page* 70)

(Continued from page 68)

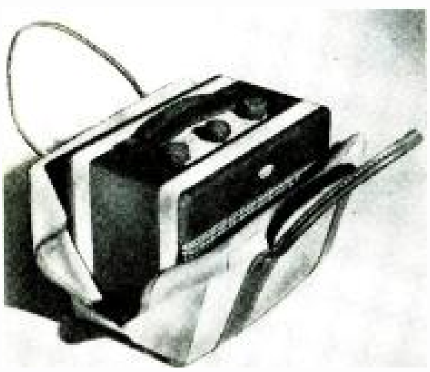
I like, too, the idea of several firms that it is their job to provide nothing but the "works" of the radio and that other firms (of which there are many) should supply whatever kind of cabinet the purchaser, and particularly his better half, may fancy. Anyone who buys a good-looking, expensive radio is liable to find that its trade-in price, after he has used it for a year or two, is pretty small in view of its excellent cabinet. If the radio is to be, as I think it should, an important part of the furniture of any home, a high-quality cabinet that has been carefully chosen should not have to be discarded after a comparatively short period of service. A good cabinet doesn't, after all, deteriorate rapidly in value; it continues to please the eye, and all that it needs to please the ear as well is a renewal of the radio or radio phonograph inside it.



Scanner unit of the Ekco cloud and collision warning radar. This is 3-cm system designed to warn aircraft pilots of storm clouds and other aircraft as far away as 40 miles. The entire radar setup consists of seven separate units. E. K. Cole, Ltd., manufactures the system.

Buy a cabinet to fit in with the furniture of any room and, as time goes on, discard the old radio or radiophonograph chassis and replace them with up-to-date models. Just think of the saving you'd make!

It is curious and interesting to notice how many one-time "stunts" have died a natural death. One of these is push-button tuning. Time was when there were radios with almost as many buttons as a bell-hop's uniform. Now tuning scales have become so large and clearly marked and tuning mechanisms are so simple to operate that buttons on a radio are very nearly as rare as crowsfeet on the face of a motion picture actress!



One of the portable broadcast receivers displayed at Radiolympia, this model is made by Roberts Radio. It operates satisfactorily even with the case closed. The cover is sold as part of the radio.

Use for mine detectors

Recently the owner of a valuable herd of pedigreed cattle found that one of his best cows was ill. In spite of all his treatment, she grew daily worse and worse and the veterinary was called in. Having made a very careful examination, the vet came to the conclusion that the trouble was due to the presence of some foreign body in the animal's stomach. He deduced that she must have swallowed something—possibly a piece of metal—while grazing. Being a man of ideas, he recalled that a friend of his had recently bought a war-surplus mine detector. This friend was summoned by telephone and arrived with the apparatus. When placed over the cow's stomach, it gave an instant strong response. An operation disclosed a 3-inch nail in the cow's stomach. Thanks to the use of the mine detector as a surgical aid, the cow is now as well as ever.

The recording or playback time of this magnetic recorder is 80 minutes. It employs a 1,000-yard-long plastic tape.

SONOBUOYS TRACK SUBS

In any future war submarines are likely to be an even greater danger to surface shipping than they were in the last because, with some sort of Schnorkel device they will be able to use their high-speed Diesel engines while submerged. *The London Illustrated News* points out in a recent issue that Sonobuoys may prove even more valuable in any future war than they already have in the last one.

The Sonobuoy is a metal cylinder containing a radio transmitter and an underwater microphone. It has been used to indicate to a listening plane the presence of a sub. In the new system, several Sonobuoys, each operating on a different frequency, will be dropped by parachute in the neighborhood of a submarine. The aircraft pilot plots the position of the submarine by tuning to each buoy and noting the volume of the sound its microphone is picking up. The nearest to the submarine will, of course, give the loudest sound, and so on. Thus he can track the sub until surface craft arrive to take over the hunt and make the kill.

SWITCHES AND CIRCUIT BREAKERS

Heinemann circuit breakers

110-15 amp. 1.49
110-20 amp. 1.49
110-5 amp. .... .95

Aircraft ckt. breakers 24V.-20 amp. amp.—AN 3160—Square D Co. $1.49

DPST 30 amp. toggle switch—bakelite case .... .39
DPDT 110V. slide switch .... .19
DPDT Toggle switch .... .39

RELAYS

Potter & Brumfield OVERLOAD relay relay No. 1 is 5000 ohms, coil current 10 ma., relay No. 2 is 110V. 60 cy. Ac coil. SPDT $1.95

Telephone type, plate sensitive relay-7000 ohm, SPDT 1.95

Plate sensitive relay—5000 ohm coil contact DPST 1.49

BK-22-K relay—used in conjunction with SCR-269-F—contains 28V step relay, 5 deck, 6 pos. switch—12V-DPST 2.95

RESISTORS and RHEOSTATS

POWER RHEOSTATS—25W-25 ohm—1 amp. max. ....$ .69
POWER RHEOSTATS—25W-25 ohm—1.7 amp. max. .... .95
75,000 ohm, 200W. bleeder .... .95
11,296 ohm, 100W. bleeder, IRC type tapped at 750-23-23-7500-3000 .... .49
1 Meg. multiplier, 1% tolerance .... .89
Thyrite discharge resistor type 5F HE 130V AC/DC .... .95
100 assorted ½ watt resistors in popular sizes 1.49

SILVER CERAMIC CONDENSERS

500 W.V.D.C. 10c ea. 12 for $1.00
Available capacity (MFFD's), 2, 3, 4, 5, 7, 8, 8½, 10, 11, 12, 15, 24, 25, 30, 40, 100, 120, 125, 140, 232, 350, 375, 400, 470, 45, 50, 61, dual 60, 70, 72, 75, 80, 81, 95, 500, 1000 and 5000.

CAPACITORS

2MFD-6000 V. paper oil type..........$8.95
2MFD-7600 V. paper oil type.......... 12.50
1MFD-5000 V. paper oil type.......... 2.95
1MFD-6000 V. paper oil type.......... 4.95
.1 MFD-7000 V. Sprague tubulars.......... 1.95
2 MFD-1000 V. ....$ .89
1 MFD-1000 V. .... .44
8 MFD-600 V. .... .95
4 MFD-600 V. .... .69
2 MFD-600 V. .... .49
20 MFD-2500VDC PK. Type No. 775, 65W. Sec.-PHOTOFLASH 9.95
32 MFD-2500VDC PK. No. 777, 100W. Sec.-PHOTOFLASH 14.95
.01 MFD 8000V, 16-20 Amps. Aerovox mica LS-217—1000-3000 KC.......... 4.95
.002 MFD-3000 VDC Mica.......... .69
3x.05-300VDC round can 1"x1", paper ....Doz. 1.00
50-30 MFD, 150V. tubular electrolytics, well known brands.......... .49
.008 Buffer 1600-V .... .29
Assorted micas..........per one hundred 1.95

VARIABLE CAPACITORS

5 Gang variable, approx. 50 MMFD per sect.—individual air tuned padders—18 to 1 vernier drive—shielded $1.95
6 Gang variable—silver plated—sec. 1: 350 MMFD, sects. 2, 3, 4, 5: 60 MMFD, sect. 6: 80 MMFD .... .89

BUTTERFLY WAVEMETER AND OSCILLATOR CONDENSERS

TN-2A 106-300 MC Antenna condenser—with acorn socket..........$3.95
TN-20 76-300 MC oscillator.......... 3.95
TN-3A 300-1000 MC Detector (uses 1N29 XTAL 2.95
TN-30 135-485 MC Oscillator
TN 300-1000 MC oscillator (uses 368AS doorknob tube) 3.95
Ceramic silver padders—dual 3 to 12 MMFD or 3 to 20 MMFD .... .19
Ceramic mica padder—single 5-20 MMFD per doz. .... .50

TRANSFORMERS

MODULATION & DRIVER XFMRS-RC 1206 mod. xfmr., 815 class AB2. 56W. audio. RC1205 driver xfmr. 6SN7 to 815, class AB-2 (companion to RC 1206). Both units for only $4.95
SCOPE XFMR.—pri. 110V-60 cy., sec. 4000V. at 10 ma., 6x4x3½".......... 3.95
AUDIO OSC. XFMR. with FEED-BACK and OUTPUT windings.......... .95
IF XFMR-5 MC with air trimmer-impedence coupled, mounted in Alum. shield can .... .95
DISCRIMINATOR XFMR. to match IF xfmr. above .... .95
FILAMENT XFMR. pri. 110-60 cy., sec. 4 volts at 16 amps. and 2.5 volts at 1.75 amps. INSULATED FOR 5000 volts. Ideal for 2x2 and 826 tubes. Hermetically sealed. 6x3½x4½" 1.95
IF XFMR., 30 MC, silver slugged.......... .35
500 ohm to GRID matching xfmr. No. 81749 (used with T-17 mike).......... .69

TUBES

304TL—Ideal for 1 KW final, induction heater or dielectric heater. Efficient operation at 1500-3000 V. —typical operation 2500V. at 400 ma. ....$ .75

CATHODE RAY TUBES

3AP1	$2.95
3BP1	2.95
5FP7	2.95
7BP7	3.95
9LP7	4.95
5BP1	2.75
5GP1	5.95
3GP1	3.50

CE PHOTOCELL—for use in projectors or burglar alarm .... .95
PHOTOFLASH TUBE 12,000,000 lumens output. Ignition coil included on back of bulb. 10,000 flashes-diagrams furnished on request.......... 5.95
Complete Photoflash kits—Write for information
Complete Stock of GE Photoflash Tubes

PLUGS AND CONNECTORS

AN-3102-24-3P	SK-C16-326
PL-Q65	SK-C16-23—½ AC-AN
AN-3106-36-1S	M-359-A
AN-3108-36-15S	AN-3100-32-6P
AN-3108-28-2S	10H-529
PL-Q17	AN-3057-24
AN-3106-24-2S	AN-3102-14S-1P
AN-3106-28-2P	PL-147
AN-3057-16	AN-3106-32-101S
AN-3057-8	AN-3102-18-20S
UG-21/U	U-16/
PL-Q171-10H/414	PL-112
AN-3108-14S-2S	PL-118
AN-3102-14S-2S	AN-3102-20-27P
AN-3108-40-1S	MC-136
PL-182-10H/258-S	ARC-9589
AN-3108-22-17P	AN-3102-22-14P
AN-3108-24-19P	AN-3102-14S-75
AN-3106-22-1S	AN-3106-18-12S
AN-3102-18-5S 2255-26	AN-3106-16S-1P
PL-419	AN-3057-S
AN-3106-18-8S	AN-3102-36-8P

45¢ each

BUILD YOUR OWN GEIGER COUNTER. Detects both Beta and Gamma rays. All parts, batteries, diagrams and instructions, nothing else to buy. This is the famous 49'er Geiger Counter. as described in Sept. Radio Electronics. $49.50

DETROLA RECORD CHANGER, automatic changer for 12 10" or 10 12" records 9.95

AIRCRAFT COMPONENTS

A5 SPERRY DIREC. GYRO, part No. 656029-115V., 400 cy., 3 ph..........$9.95
MK 18 Eastman Kodak gunsight.......... 2.95
MK 4 Bank and Climbgyro control head for MK 4 autopilot.......... 9.95
A 5 Autopilot Servel, 100 lb. max... 9.95

RADIO RADAR RCVRS-XMTRS-COMPONENTS

BC 223 AX Transmitter—BRAND NEW—801 oscillators and 801 PA's, (2) 46 mods. & (1) 46 speech amp, 4 xtal freqs. and master osc. on selec or switch—tone voice or CW mod., 10-30 W. output. Ideal for 80 meter band. Complete with 2 coils TU 17A 2000-3000 kc. TU-25 3500-5250 kc.—black crackle case. Two extra cases to store coils. Freq. chart and tubes incl., packed in orig. cases, less xtals..........$39.95

BC-702 A HIGH FREQ. RADAR XTMR. (4) 2x2 tubes; squirrel cage blower, 12-24V.; 25MA. 2" meter; 02-8000V cond.; (2) .01-500V conds.; .001-9500V. cond. $14.95

BC-AR230 TRANSMITTER with 4 tubes and RF ammeter.

BC-AL229 RECEIVER with 6 tubes—aircraft equipment, both units..........$9.95

T85/APT-5 UHF NOISE-MODULATED JAMMING XTMR—With these tubes: (2) 6AC7, (1) 6L6, (2) 829, (1) 931A, (1) 6AG7, (1) 522 blower-cooled UHF oscillator tube. This unit contains a lecher-line tuned cavity, with tunable plate, grid, and cathode lines. Lecher-line settings are read directly in CM on front panel with veeder type counters. Neon resonance indicator. Filaments operate from 115 VAC. No plate supply. Packed in orig. case with instruction book. Wt. 118 lbs..........$95.00

BC-375 XTMR TUNING UNIT—Approx. 65 MMFD cond., coils, RF chokes, dials, assorted micas, 25WVDC and many other parts $2.50

ARR7 AIRBORNE HALLICRAFTER VERSION OF SX-28A—Search rcvr., complete with tubes, less power supply, in sealed cases..........$129.00

BC-620A-TRANSSEIVER — 20-27.9 MC, dual channels, built-in fil. and plate meters, with tubes as follows: (4) 1LN5, (1LC6, (1) 1LH4, (2) 1291, (4) 1299, (1) 1294—Ideal for use between boats, vehicles, etc. Used, in good condition, less power supply. Wt. 38 lbs. Complete with carrying case and diagrams.

GE CONTROL BC-1103—Contains fuse F301, indic. lamps 1301, 1301A, receptacles as follows: 3 pole Russell Stole No. 6852, 2 pole Hart and Hegeman No. F7723, 4 pole Russell Stole No. 8087. Also relay 120V., 60a Struthers-Dunn No. AS8X1, Switch, Allen-Bradley cat. 2AS, and 250V. 10 amp. Interlock $4.95

SCR-625 Mine Detector, used..........$39.50

METERS and INDICATORS

Remote position indicator—I-82, 6-12V. 400 cy., 5" indicator with 0-360 degree dial $4.95
Azimuth control MN-52H-360 degree dial—60 to 1 ratio crank control—ideal for antenna rotating indicator. used...$ .49
Meter—3½" cross pointer. Two 200 micro-amp movements, brand new..........$2.95
METER, type DO-41, 0-1 mil. movement, scales 0-5 DC Kilo V. and 0-10MA DC $2.95

MISCELLANEOUS

BN IFF Antenna duplexer, 156-157 MC $5.95
BN IFF non directional doughnut antenna 5.95
Voltage REGULATOR, carbon pile, magnetic type, coil current 105 ma.-max. 5 amps at 18.25 volts.......... .95
THERMOSTAT, normally opens at 95 deg. F., No. F85-1/H5 .... .49
BLOWER, 400 cy., 115 Volts Type FL style No. I 171145C, 6700 RPM, Westinghouse 1.95
BLOWER, squirrel cage, 110/60 cy. AC, 2" outlet, silent oil lite bearing motor, with mtg. bracket.......... 7.95
Eclipse 24 V. carbon pile type. GE Voltage REGULATOR, brand new, Co., 2½ lbs.......... .95

Free Catalog

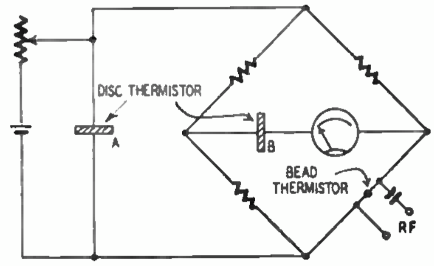
HERSHEL RADIO CO.

DEPT. R. E. 12
5249 GRAND RIVER DETROIT 8, MICHIGAN
All orders F.O.B. Detroit—Minimum order $2.00—Michigan customers add 3% sales tax—20% payment must accompany all orders.

R.F. POWER MEASUREMENT

Patent No. 2,465,683
Rudolph N. Griesheimer, Belmont, Mass.
(assigned to the U.S.A. as represented by the Sec'y of the Army)

The bridge method is one of the simplest and most sensitive for measuring r.f. power. Three of the arms are resistive and the fourth contains a tiny bead thermistor. First the bridge is balanced without r.f. applied. When r.f. current flows through the thermistor, the bead material is heated and its resistance lowered. A microammeter measures the bridge unbalance and indicates the amount of r.f. power.



Unfortunately the bead is affected by changes in ambient temperature as well as current flow. For example, if there is a drop in room temperature, the resistance of the bead drops. In this circuit two disc thermistors are added to correct the error. The disc type is affected chiefly by ambient temperature rather than current flow.

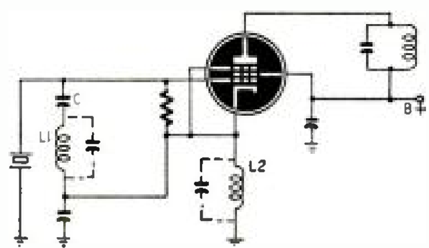
When the room temperature drops, for example, the resistance of thermistor A is increased. A greater portion of the d.c. battery voltage is applied to the bridge, and the resistance of the bead is reduced to normal.

This solves one problem but creates another. The greater bridge voltage increases the sensitivity. Thermistor B is added in series with the meter to compensate by limiting current flow and maintaining constant bridge sensitivity.

HARMONIC GENERATOR

Patent No. 2,455,824
Joseph C. Tellier and Harry H. Wilson, Jr. Philadelphia, Pa.
(assigned to Philco Corp.)

More efficient harmonic generation is claimed for this modification of the Colpitts crystal oscillator.



A coil L1 is added to accentuate the higher-order harmonics. With the usual capacitor alone these higher frequencies are bypassed to cathode and lost. A second coil L2 is added in the cathode circuit instead of a bias resistor. Here again the harmonics are strengthened.

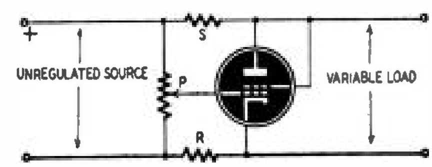
Dotted lines indicate the distributed capacitances of the two coils.

VOLTAGE REGULATOR

Patent No. 2,475,613
Allen E. Hastings, Washington, D. C.
(May be used by the U.S. Government without royalty payments)

The output of a d.c. supply is stabilized by this regulator at any voltage value up to the limit of the regulator tube. It compensates for changes in load current or source potential.

The regulation is provided by resistors R and S. For example, assume that there is an increase in load current. Usually this means lower potential across the output terminals. In this circuit, however, the following takes place. As the load takes more current, there is greater flow through R and therefore a greater drop across it. The grid side of this resistor goes more negative, thus raising the grid bias and decreasing plate current.



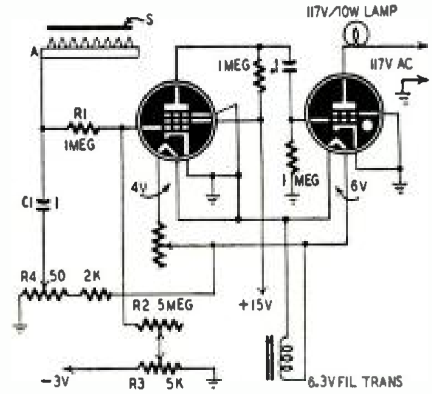
As a result there is less voltage drop across S which is also in series with the load. Since S is much larger than R, it controls the output voltage. The smaller drop across S makes available more voltage at the load. P should be adjusted until the compensation is complete.

A similar effect takes place if the source voltage varies. For example, if it is reduced, less current flows through the plate circuit. Again there is less voltage drop across S, making available a greater potential for the load and compensating for what would otherwise be a lower output.

STATIC DISCHARGER AND INDICATOR

Patent No. 2,475,356
Emery Meschter, Towanda, Pa.
(Assigned to E. I. duPont de Nemours & Co.)

The static electricity generated on sheets of paper, plastic material, or cloth moved rapidly along rollers is dangerous and troublesome. Sparks may ignite nearby material. Raw photographic film may be spoiled by exposure to



tiny flashes. Also, charged sheets are difficult to handle because they tend to adhere to nearby nonconductors. This simple discharger includes an indicator to show when correct discharge is taking place.

Referring to the figure, static from a sheet S may be discharged to ground by bringing near it a static accumulator A with a comb of fine metal points. The charges are transferred to the comb and grounded after flowing through R1, R2, and R3. The filter R1-C1 bypasses a.c. such as line-frequency pickup; therefore only d.c. can flow through R2. The drop across R2 is applied to the pentode grid. R3 is the bias control.

A portion of the filament voltage appears across R4. Part of it is applied to the pentode grid through C1. Therefore the plate current has an a.c. component as well as a d.c. component. However, it is obvious that the a.c. component disappears when the plate current is zero (as at cutoff) or when the tube is operated past its saturation point.

The pentode tube is a limiter because of the very low filament and plate potentials. It saturates if its grid goes positive by a few volts, and its plate current is cut off if the grid goes negative by a few volts. Therefore no a.c. plate component exists during a static discharge which produces more than a few volts across R2. This is true regardless of the polarity of the static charge.

The second tube is a thyratron, for example, type 2050. It conducts when its plate voltage is *positive*, provided the grid is *not negative* at the same time. No signal appears across its input during the discharge of static, and because its grid is returned to ground, the bias must be zero during a discharge. Therefore, the thyratron fires and the lamp is on.

If the discharge stops for any reason, the a.c. component appears across the thyratron grid. The phase of this voltage is chosen to make the grid negative while the plate is positive. If necessary, the filament transformer connections may be reversed to bring about this condition. With the correct connections the thyratron cannot fire and the lamp remains dark to warn that discharge is not taking place.

Stupendous! Gigantic! Colossal! BARGAINS in RADIO EQUIPMENT

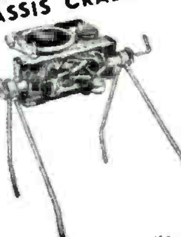
A. N. ELECTRICAL CONNECTORS

A. N. electrical connectors provide a fast, easy way to connect or disconnect one or many electrical circuits. This offering is of intense interest to ALL manufacturers of electrical equipment inasmuch as we have a huge supply of these connectors and can dispose of them at very reasonable prices on a sliding scale. The more you need, the lower the price. Plugs and receptacles supplied with either male or female contacts. All built to rigid Army & Navy specs.

3100	3100	3106	3106	3106
28-12P	12S-4S	20-19P	18-20S	22-2S
36-7S	8S-1S	10S-2S	24-7S	22-12S
36-7P	28-16S	12S-4P	18-12P	20-23P
20-1S	**3102**	20-8S	22-18S	20-23S
20-1P	18-10S	18-22	24-4P	**3108**
32-6P	18-11S	20-24P	24-10P	12-5P
20-22S	20-24S	20-11P	20-1S	22-30P
24-10S	14-3S	20-3P	22-14S	22-8S
28-16S	16-7S	18-13S	22-10P	12S-3S
24-7S	16-11P	16S-7P	24-28S	16-11S
18-2P	24-11P	16S-1P	18-11S	22-
24-4S	24-4S	16-7S	20-22P	10-15S
20-13S	18-8S	8S-1S	12-5P	18-8S
20-9P	14S-1P	18-11P	22-30P	22-30P
18-1P	14-3P	20-27S	22-8S	22-14S
18-4S	16S-4S	20-9S	12S-3S	12S-4P
36-15S	16S-5P	20-9P	16-11S	14S-2S
22-18P	16S-10P	12-5S	22-	16S-1S
18-12S	18-12P	28-12S	10-15S	16S-8S
12-5P	20-3P	18-4P	18-8S	18-12S
20-19S	20-8P	32-1S	22-30P	28-15P
18-8P	3-160	18-3S	22-14S	14S-2S
24-5S	32-6P	16-11S	12S-4P	16S-8S-#1
24-7P		16-11P	16S-1S	16S-8S-#2
20-11S	**3106**	32-9P	18-12S	28-1P
20-3S	32-101S	14S-7P	20-3P	28-15P
20-8S	28-9P	18-1S	18-5S	**97-5107**
32-9S		18-1P	18-19	28-7S
32-18P		14S-1S	16S-4S	

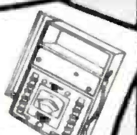
Inquiries invited from manufacturers, foreign governments, distributors, etc. Prices quoted on basis of quantity!

ACRO TELEVISION CHASSIS CRADLE



Eliminates broken tubes, coils, dials, etc. Cadmium plated steel, fingertip control. A necessity for Television Service. Your Cost $4.69

MODEL 592 SPEED TESTER By Supreme Instrument Corporation



Finest multimeter money can buy. Tops in quality, accuracy and speed of operation. 44 ranges. Double Microampere to 14 amps. 1000 ohms per volt sensitivity—1000 ohms per volt or 2500 ohms per volt. 0.1 to 1400 DC volts. 1/4 ohm to 50 megohms. No removal of test prods necessary for all ranges. Pin jacks. Beautiful case. Regularly $58.95, our surplus price (limited time only) $49.95

Special Buy AC-DC POCKET TESTER

Sensitive repulsion meter in bakelite case. Specs: AC-DC Model Volt-Ohm-Milliammeter. AC Volts—0-25, 50, 125, 250; DC Volts—0-25, 50, 125, 250 Ma. AC and DC Ma. 0 to 50; Ohms Full Scale—100,000; Center Scale—2400; Capacity—.05 to 15 mfd. Prepaid anywhere in USA $7.00. DC meter, lacking AC ranges $5.50.

SOS EMERGENCY TRANSMITTER

Famous Gibson Girl Transmitter that saved so many lives during the war. Use only as a distress call transmitter on boats and airplanes. No external power supply required for operation. It is merely necessary to turn the crank on the top of the transmitter and power is generated and the distress signal is automatically sent out on international distress frequency. Brand New Gibson Girl Transmitter complete with tubes.

$9.95

ANTENNA KIT

For Gibson Girl transmitter. 300 ft. antenna wire, 2 balloons, 2 hydrogen generators, box kite for windy weather, searchlight. Complete kit.

$9.95

SINGLE-GANG INSULATED-VARIABLE CONDENSERS

Ideal for high-frequency applications in receivers and low power transmitter stages. All types.

10 mmf	$.35	—10 for $2.90	—100 for $23.00
15 mmf	.35	—10 for 2.90	—100 for 23.00
25 mmf	.35	—10 for 2.90	—100 for 23.00
35 mmf	.40	—10 for 3.40	—100 for 26.00
50 mmf	.45	—10 for 3.70	—100 for 30.00
75 mmf	.50	—10 for 4.40	—100 for 38.00
100 mmf	.55	—10 for 4.90	—100 for 39.00
140 mmf	.60	—10 for 7.40	—100 for 44.00
180 mmf	1.00	—10 for 8.50	—100 for 70.00
140-140 mmf	1.60	—10 for 12.50	—100 for 100.00

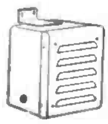
LINE FILTERS

For suppressing noise on all cars and appliances. Each contains 4 mfd oil filled condensers, 50 amp choke in full shielded case and heavy current connectors. $17.00 value for $1.98.

TWIN COAXIAL CABLE

Two #12 stranded conductors, shielded, vinyl-jacket, polyethylene core, 70 to 95 ohms. Reg. 72c per ft. Your price $15 per 100 ft. Order RG-57U. Also RG-59U 72-ohm Coax. $4.50 per 100 ft.

P.M. SPEAKERS



Latest type PM Speaker in a fully-enclosed metal cabinet. Speaker and case match communication receivers, in addition make perfect intercom remote stations. $4.50. Including output transformer $4.95.

HEAT GUN

Red plastic, streamlined, pistol grip heat gun. Blasts 160° hot air at 20 cu. ft. per minute. Big rugged vacuum cleaner type AC-DC motor that also blows cold air. Use to clean radio chassis, heat carburetors, dry ignitions, quick-dry paint, thaw out radiators or water pipes, etc. Guaranteed or money refunded if returned, prepaid, in 5 days. $12.95

ISOLATION TRANSFORMERS

Eliminate shocks and fireworks from the adjustment jobs on radio and TV sets that require grounding of chassis, with our Isolation Transformers. As auto transformers they can also be used to change 110V to 220V or reverse. Buy now at ½ price. $1.95

3-FOR-1 SALE

ALL 3 ITEMS ONLY $7.00

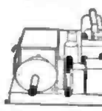
ALUMINUM GEAR BOX 18x8x7 contains two powerful electric motors and two matched gear trains. 62 gears in all varying in size from ½ to 4 inches in diameter. Readily converted to rotate a beam antenna or any other similar use. $5.00

SIGNAL CORP INTER-CONNECTOR RELAY BOX 730A

This valuable unit, BC616, made by Bell, is encased in a highly polished aluminum case 6½ x 5½ x 2½, and contains 150 mfd. of condenser capacity, sensitive relays, resistors, and terminal strips. Order several at the giveaway price of only $1.95.

REMOTE CONTROL UNIT—Aluminum case 4 x 3 x 2 containing revolution counter, 2 potentiometers, triple pole switch, 4 knobs, phone jack, and gear mechanism. Including 8 prong JAN connector to fit box—$1.39.

RT 1579 WITH TUBES, DIAGRAM AND PARTS LIST $14.95



Consists of three stages (cascade 6SJ7's and 6F6 output stage) high gain, high fidelity amplifier with 60 cycle 110V power supply on same 13½ x 14½ chassis, which is protected by substantial steel cover over tubes and parts. Made by Western Electric with typical quality components such as husky power transformer and oil condensers, this unit is obviously intended to give years of trouble-free service with no more need for repairs than a telephone. Disconnecting one wire each from the special tuned input and output filters, results in as high a fidelity amplifier as can be obtained.

SELENIUM RECTIFIERS

All types are rated at 130 V.A.C. Do not assort to make quantity.

	Single Lots	10 Lots	50 Lots
75 MA....	$0.70	$6.50	$31.00
100 MA....	.75	7.00	32.50
150 MA....	.80	7.50	35.00
200 MA....	1.00	10.00	47.50
250 MA....	1.25	12.00	57.50

STROMBERG CARLSON

Power Switching Relay Box. Neat 3½ x 4 x 5½" steel case with tight fitting cover finished in Stromberg's usual beautiful chocolate color crackle finish. Hurry! Only a few orders will be filled on first come, first served basis. $1.00

AUDIO AMPLIFIER

Push-Pull stage triode amplifiers having 2 of the valuable and scarce ouncer type audio transformers that sell for over $10.00 each. Neat aluminum case fully enclosed. Perfect for intercom system, phono, mike or signal tracer amplifier for testing radio. A $25.00 bargain at only $3.40 each.

AC-DC Superhet Radio Kit

Extra high quality standard production line radio in kit form with complete instructions. Features 2 iron core I.F. transformers, 2 gang condensers, and polyethylene insulated edgewise wound antenna loop. Tubes include 12AT6, 12BE6, 50B5 & 35W4. Receives broadcast band from 550 to 1700 KC. Kit form $8.75 or 2 for $17.00. Assembled, wired and tested $12.95 or 2 for $25.

1000 CYCLE AUDIO FILTERS

Navy PD52010—1 low pass audio filters that are the exact electrical and physical equivalent of commercial audio filters selling for $33.00 wholesale. Far superior to surplus Radio Range Filters now being offered. Twice as selective as Q-fiver section of 274N, which has previously provided the amateurs highest standard of interference elimination. With diagram $2.00.

Bandswitching Tuning Turret

4 bands above 100 Mc. #14 silver plated coil wire. Tuning condensers, driving motor diagram included. Only $2.95.

SELL OUT

24th Edition of Radio Amateur's Handbook. Tells all, shows all, over 600 pages of valuable information. $1.00.

SAFETY SWITCHES

Spend a dollar to save your life! G.E. Interlock Safety Switches eliminate fatal shocks. $1.00 each.

HURRY

2 gang midget superhet tuning condensers with ¼" shaft and trimmers. Reg. $1.25 each, now 5 for $2.00.

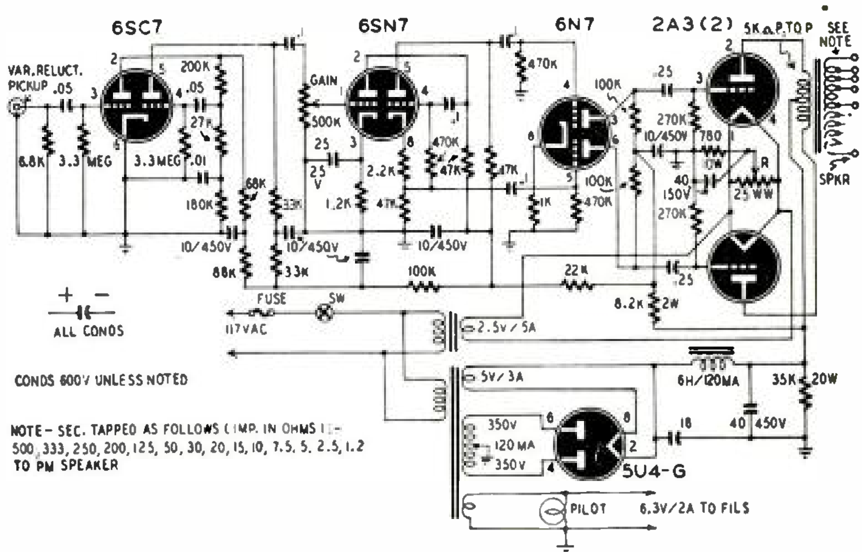
WORLD-WIDE MAIL ORDER SERVICE

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. RE-12, BUFFALO 3, N. Y.

PORTABLE AMPLIFIER FOR RELUCTANCE PICKUP

? *Please show an amplifier I can use with the General Electric variable-reluctance pickup. It should be a high-fidelity unit using 2A3's in the output stage.—M. L. G., Charlotte, N. C.*

A. The schematic shows the amplifier you want. The 6SC7 input stage, especially designed for the GE pickup, should be well shielded. Adjust the 2A3 filament pot R for minimum hum.

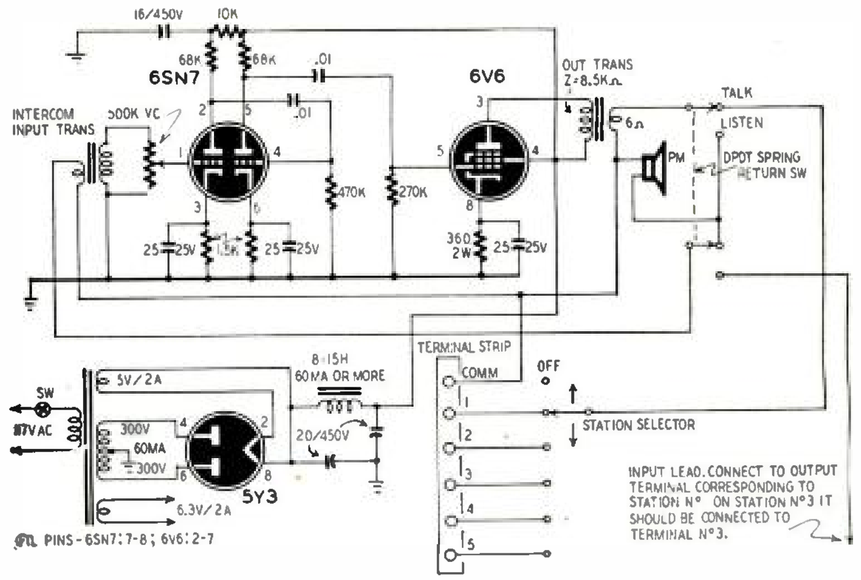


MASTER-TO-MASTER INTERCOM AMPLIFIER

? *Please show an amplifier I can use plifier for use in a master-to-master intercommunication system. I want to use five master stations connected so one station can call any of the others even when their amplifiers are turned off. I have several 5Y3's, 6SN7's, and 6V6's which I would like to use.—W.B.S., Inglewood, California.*

A. This diagram is for a single amplifier. You will need one for each station. A spade lug may be soldered to the free end of the input lead to permit fastening under one of the screws on the terminal board. This lug connects to the output terminal corresponding to the number of the station.

The input transformer should have a 6-ohm primary and a high-impedance secondary. Shielded intercom cable should be used on long runs. It may be necessary to connect the common conductor to the chassis of each of the amplifiers.



CONVERTING RECEIVER OF BC-654-A

? *I have acquired the receiver section of a BC-654-A transmitter-receiver radio set. This receiver has a 12-point terminal strip on one end. Please show how the receiver can be made to operate from batteries.—L.P., Ojai, Calif.*

A. The receiver was controlled by a CW-OFF-PHONE switch on the transmitter panel; therefore it will be necessary to replace some sections of this switch be-

For the greatest selection of kits in the world
PROGRESSIVE ELECTRONICS COMPANY

SIGNAL GENERATOR KIT

- 150 kc . . . to 34 Mc on fundamentals.
- Over 100 Mc on strong Harmonics.
- 5 Bands on scale.
- 400 cycle Modulation.
- 400 cycle audio available without modulation.
- Provides markers for sweep generators.
- 110 volts . . . 60 cycles.
- Ideal for AM, FM, and TV Alignment.

Kit is complete with all parts and tubes necessary for construction. Detailed step by step analysis of assembly. Large dial. Convenient size and weight.

SIGNAL GENERATOR KIT COMPLETE **$18.95**

FREE GIFT: Book on Radio Test Instruments.

SWEEP GENERATOR KIT

A Sweep Generator is an absolute necessity for FM and TV servicing, alignment, and experimenting. We have designed our kit to give you the maximum performance in all three categories mentioned.

Operating and constructional features:

- Range . . . 2 Megacycles to 226 Megacycles
- AM or FM output.
- Variable sweep width up to 10 Megacycles.
- Variable PHASING control.
- SWEEP OUTPUT for Oscilloscope.
- Miniature tubes used for best results.
- 110 volt . . . 60 cycle operation.
- Extra large calibrated scale.

SWEEP GENERATOR KIT COMPLETE **$22.95**

Free Television & FM Servicing Notes.

MULTI-TESTER KIT

A versatile, compact test instrument ideal for radio receiver servicing. Equipped with 3½" round 0-1 Ma. Employs the following ranges:

- Volts AC/DC: 0-9;—50; 150;—500;—1500
- Milliamperes DC: 0-5;—50;—150
- Ohms: 0-2000;—20,000;—200,000
- Internal source: 4½ volts
- Size: 4" x 7" x 3"

1000 ohms per volt sensitivity.

MULTITESTER KIT COMPLETE **$11.05**

Free Book on Radio Test Equipment

AMPLIFIER KIT

The PROGRESSIVE AMPLIFIER KIT is the Ideal Amplifier. Electrifies musical instruments. Separate mike and phono input. Maintains constant voltage supply. DC Heater supply. Whether used on AC or DC, provides humless operation by eliminating cathode-heater leakage hum. Tone and volume controls completely variable. 5 Watts output. Seven-tube performance. Uses 2 selenium rectifiers, 2 beam power amplifiers, 1 high-gain pentode microphone amplifier, 1 twin-triode phase inverter, and 1 voltage regulator tube.

AMPLIFIER KIT COMPLETE **$15.00**

Free Book on Amplifiers.

SIGNAL TRACER PROBE KIT

This Signal Tracer Probe Kit will allow you to signal trace with your own Audio Amplifier or VTVM. Consists of a Germanium Crystal detector and associated RC network. A very handy, professional-looking probe, enclosed in a beautiful aluminum casing. The probe detects RF and allows AF to pass through. It can be used to trace in any stage of a receiver or audio amplifier. Can be wired in a few minutes. Simple, easy-to-follow instructions, pictorial and schematic.

SIGNAL TRACER PROBE KIT COMPLETE **$5.75**

Free Book on Radio Test Instruments.

FREQUENCY MODULATION (FM) RECEIVER KIT

Here is a complete, seven tube FM kit.

- Front end section pre-assembled at factory.
- Uses 2 IF stages, 1 Limiter stage, and 1 Discriminator.
- Utilizes the Armstrong system of noise elimination; best for FM reception.
- Complete with cabinet, tubes, pictorial, schematic, detailed instructions.
- Tubes: 1-12BE6, 3-12BA6, 1-12AU6, 1-19T8, 1-35B5.

FM RECEIVER KIT COMPLETE **$29.95**

Free Gift: 50 Feet of Twin-Lead Transmission Line.

SIGNAL TRACER KIT

Engineered for audible tracing of I.F., R.F., F.M., video and audio circuits. Provisions included for VTVM visual signal tracing, enabling actual stage-by-stage gain comparison. The Signal Tracer may also be employed as a small public address or intercom system. Handsome etched panel, sturdy steel case. 110-125 volts, 50-60 cycles A.C. Complete with 6SJ7, 6K6, and crystal probe.

SIGNAL TRACER KIT COMPLETE **$18.95**

Free Book on Radio Test Instruments.

TOOL KIT

Consists of 75 Watt Electric Soldering Iron, Combination Long Nose Pliers-Cutters, diagonal cutters, amber handle screw-driver, and supply of Rosin-Core Solder.

TOOL KIT COMPLETE **$5.75**

Free, 35 Watt Midget Electric Soldering Iron and Supply of Hook-up Wire.

Only Progressive has the World Famous Progressive Radio Kit

NOW! BUILD 15 RADIOS $14.75 COMPLETE KIT ONLY

Absolutely No Knowledge of Radio Necessary. You Need No Additional Parts

EXCELLENT FOR BACKGROUND IN TELEVISION . . . .

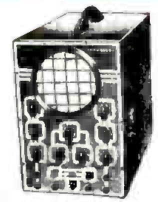
Contains everything you need: instruction book, metal chassis, tubes, condensers, resistors and all other necessary radio parts. The Instruction Book written by expert radio instructors and engineers teaches you to build radios in a professional manner. The circuits are designed to provide excellent performance.

Each of the 15 radios you will build operates on 110-120 volts AC or DC. The PROGRESSIVE Radio Kit is excellent for learning the principles of Receiver, Transmitter and Amplifier design. It is used in many Radio Schools and colleges in U.S.A. and abroad. It is used by the Veterans Administration for Veteran training.

FREE: ELECTRICAL AND RADIO TESTER, plus FREE Membership in the Progressive Radio & Television Club. You will be entitled to FREE expert advice and consultation service with licensed radio technicians. ORDER YOUR KIT NOW!

PROGRESSIVE RADIO KIT COMPLETE **$14.75**

OSCILLOSCOPE KIT



1. All controls on front panel.
2. Horizontal sweep circuit range . . . . 15 to 30,000 cycles.
3. Frequency response flat from 50 cycles to 50 KC on both horizontal and vertical amplifiers.
4. Input impedence, 1 megohm and 50 micro-microfarads; excellent for FM and TV work.
5. Ideal linear sweep, utilizing Thyratron type tube #884.
6. Uses 2-6SJ7; 2-5Y3; 1-884; 1-5BP1 tubes.
7. Deflection sensitivity: 30 volts per inch full gain.
8. Provision for external synchronization.
9. Test voltage jack.
10. Intensity modulation.
11. Large screen: 5" tube.
12. Detailed instructions for assembly and wiring.
13. Pictorial diagrams included.
14. The finest Oscilloscope Kit obtainable anywhere.

OSCILLOSCOPE KIT COMPLETE **$39.95**

Free Book on Cathode Ray Tube Oscilloscopes.

VACUUM TUBE VOLTMETER KIT

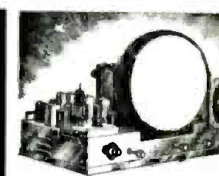
1. You can actually measure antenna voltage with this meter.
2. 9-500 micro ammeter movement, the finest available.
3. Output Meter . . . you can measure DB gain or loss directly.
4. AC-DC voltage range . . . 5 separate scales covering 0-3, -30, -100, -300, -1000 volts.
5. Ohmmeter ranges . . . 5 separate ranges . . . 0-1000, -100,000, -1 meg, -10 meg, -1000 meg. (Shows slightest condenser leakage.)
6. DC Input Impedence . . . 11 megohms . . . perfectly linear movement.
7. AC Input Impedence . . . 6.5 megohms . . . perfectly linear movement in accuracy.
8. Designed specifically for use in AM, FM, and Television work.

VTVM KIT COMPLETE WITH SET OF PROBES **$23.95**

VTVM KIT COMPLETE WITH SET OF PROBES, RF PROBE, AND 30 KV HIGH VOLTAGE PROBE **$29.95**

Free Gift: Book on Advanced Servicing Techniques.

FAMOUS #630 TV CHASSIS



Not in kit form, completely wired and ready to operate. A COMPLETE 16 inch TELEVISION CHASSIS, ready for custom built installation. Licensed by RCA.

- Built-in voltage doubler.
- 31 RCA tubes incl. rectifiers.
- RCA 13-channel tuner.
- 16" brackets included.
- Automatic picture stabilizer.
- Long-range fringe reception.
- New improved daylight viewing.
- Dimensions W-21½" H-10" D-16".

NO FINER RECEIVER AT ANY PRICE **$179**

Your net Price Complete as Pictured (Less C-R Tube)

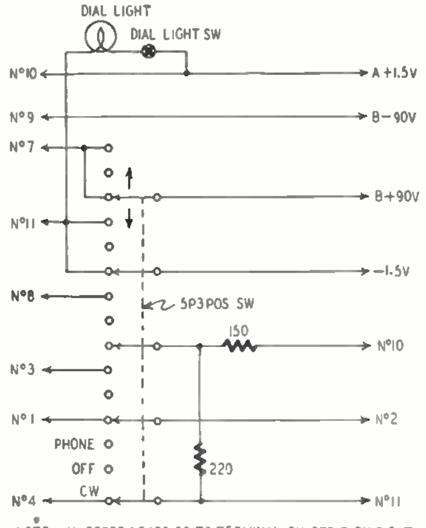
2% DISCOUNT ON CASH ORDERS

C.O.D. Orders accepted in U.S.A.

PROGRESSIVE ELECTRONICS CO.
497 Union Ave. • Brooklyn 11, N. Y.
Phone: Evergreen 8-0054

FREE GIFT WITH EACH KIT

fore the receiver can be used. A three-position, five-pole switch and A- and B-batteries should be connected to the numbered terminals as shown in the



NOTE-NUMBERED LEADS GO TO TERMINAL ON STRIP ON RIGHT SIDE OF CHASSIS

diagram. A heavy-duty A-battery is required. A 2-volt storage battery and a suitable series dropping resistor should last much longer than dry cells.

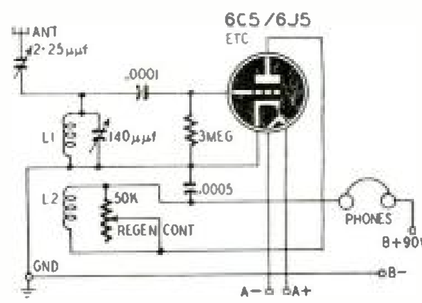
THE OSCILLODYNE CIRCUIT

Please print a circuit of the famous one-tube Oscillodyne receiver along with coil data. I built one of these sets a long time ago and found it to perform better than any other 1-tube set I have constructed.—L.E.P., Dayton, Ohio

A. The Oscillodyne circuit is shown. The performance of this circuit depends on overcoupling between L1 and L2 and on critical values of resistance and capacitance in the grid circuit. The coils are wound on 1½-inch, low-loss, plug-in coil forms. The tickler L2 is wound ⅛ inch below the grid coil L1. The outside ends of the windings go to plate and grid circuits and the inside ends go to phones and ground, respectively. Coils for different tuning ranges are wound as follows:

Tuning range (approximate)	L1 (turns)	L2 (turns)
550—850 kc	105	105
800—1,500 kc	67	67.
1.5—2.5 mc	36	36
2.4—3.5 mc	23	23
3.4—7.5 mc	14	12
7.2—14.5 mc	7	9
14.0—28.0 mc	4	6

Both windings are made with No. 36 d.sc. wire. The tuning capacitor and coil and tube sockets should be designed



for good high-frequency performance.

The original circuit was designed for a type 27 or 37 tube. Modern medium-mu triodes such as the 6C5 and 6J5 may be used. Dual-purpose tubes having a medium-mu triode can also be used in the circuit.

If the set does not oscillate smoothly over its tuning range, try using a smaller grid capacitor and experiment with grid resistors between 1 and 7 megohms.

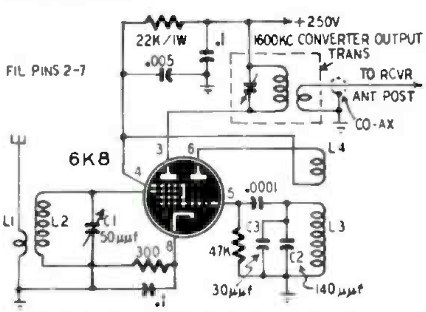
A good outside antenna is required for best results. The antenna trimmer will have to be adjusted to eliminate any dead spots that may appear in the tuning range.

SHORTWAVE CONVERTER

? *I have a small a.c.-d.c. broadcast receiver to which I want to add shortwave coils to increase the tuning range to 14 mc. The receiver has a 6SS7 r.f. amplifier, 12SA7 converter, 6SS7 i.f. amplifier, 12SQ7 second detector and first a.f., 50L6 power amplifier, and 35Z5 rectifier. It has a loop antenna and cut-plate tuning capacitor.—T. P., Monmouth, Ore.*

A. We do not feel that your receiver is suitable for conversion to all-wave reception. We recommend that you construct a small converter similar to the one shown in the diagram. Plug-in coils are used in the antenna and oscillator circuits.

The plate of the mixer tube is connected to the antenna post of your receiver through a 1600-kc converter output transformer. C1 and C2 are bandset capacitors and can be fitted with standard bar-type knobs. The bandspread capacitor C3 should be fitted with a slow-speed dial. A B-supply delivering from 180 to 250 volts can be used.



Coils are wound with No. 22 enameled wire on 1¼-inch plug-in forms. The number of turns per winding is shown in the table.

Coil	Turns 1.7-3.5 mc	3.5-6.5 mc	6.5-14.5 mc
L1	22	7	5
L2	70	25	12
L3	55	22	9
L4	18	6	3

All coils are closewound except for the highest range. Here, it may be necessary to space L2 and L3 to cover the desired tuning range and to make the coils track. Spacing between L1 and L2 and L3 and L4 should be approximately ⅛ inch, except for the 6.5-14.5-mc range for which L4 is interwound with the ground end of L3.

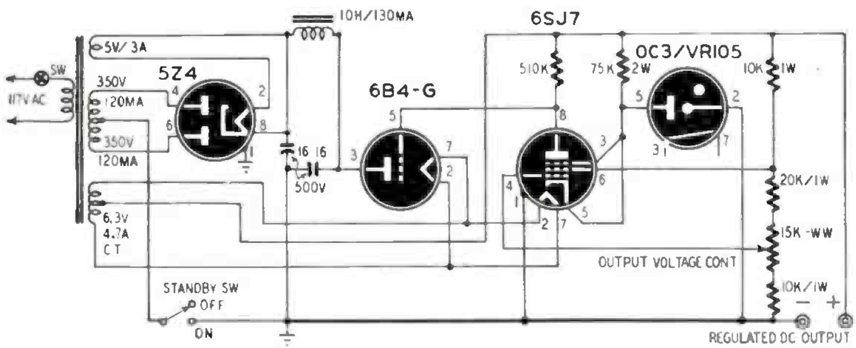
REGULATED POWER SUPPLY

Voltage-regulated power supplies have many applications in radio and electronic fields. Gaseous voltage-regulator tubes such as the OA2, OB3, and OC3 perform well in circuits in which the load current does not vary over too wide a range, but are not suitable when a variable regulated output is desired.

A circuit of a variable-output regulated supply was presented recently in *The C-D Capacitor*. This supply, shown in the diagram, maintains the output voltage within 1 volt with input voltage or output current variations up to 30%. The output voltage can be set at any desired level between 175 and 300 with a front-panel control. The maximum drain is 60 and 110 ma when the output voltage is 300 and 175, respectively.

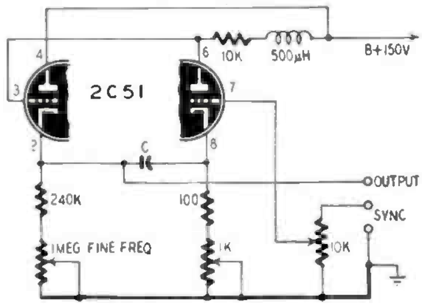
In this circuit, the 6B4-G acts as a variable resistor between the filter and the B-plus output terminal. The resistance of this tube is controlled by the bias applied to its grid by the 6SJ7 d.c. amplifier. The tubes are connected so a decrease in output will lower the bias on the 6B4 and decrease its internal resistance to restore the output to its present value. The output voltage is controlled by varying the voltage on the control grid of the d.c. amplifier. This stage is stabilized by passing its cathode current through the 0C3-VR105.

Oscillations of a relaxation type may occur in this (and other voltage-regulated power supplies) if the voltage across the gas tube is too low. Keep it well above the extinction point.



WIDE-RANGE SWEEP

The over-all usefulness of oscilloscopes is, in many instances, limited by the highest frequency of its sweep generator, usually in the order of 100 kc. High-frequency sweep circuits have



been developed, but they are seldom used in low-cost equipment because they require several tubes. A new wide-range sweep generator having a range from 15 cycles to 500 kc was described in *The Review of Scientific Instruments*. The circuit is shown here.

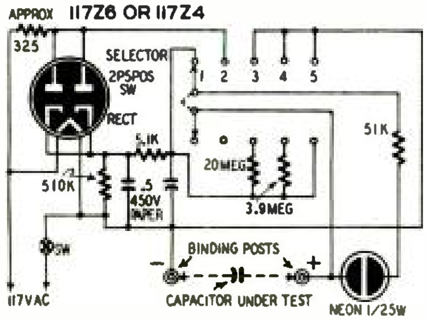
The frequency ranges are changed by switching in different values for capacitor C. The frequency is varied within a given range by the FINE FREQUENCY control. The ranges are: 15-60, 45-180, 130-500, 400-1,700, 1,200-5,000 cycles, and 4-6, 11-42, 40-200, 100-500 kc, when C is 0.5, 0.15, .05, .015, .005, .0015 μf, and 500, 150, and 50 μμf, respectively.

A 20-volt sawtooth is available at the

output terminals over the entire range. The generator may be synchronized by applying a 0.2-volt peak signal to the grid of the right-hand triode. which is normally grounded. The 1,000-ohm variable resistor in the cathode return of this triode should be adjusted for short flyback time on one of the low ranges. Flyback time is decreased and the upper frequency raised as this resistor is reduced. Do not set the value too low as this may cause the lower portion of the output signal to be clipped.

CAPACITOR ANALYZER

The capacitor analyzer, designed by Mr. Henry Levine and described in *ARSNY News* (New York), is somewhat different from these usually described. Provisions are made for testing capacitors under static and dynamic conditions, the type of test being determined by the setting of the double-pole, five-position selector switch.



When the selector is in position 1, d.c. is applied to the capacitor under test to check for shorts and leakage. Reject the capacitor if the neon lamp glows continuously or flashes more than once each second. Alternating current is applied to the capacitor when the selector is in position 2. A good unit will cause the neon lamp to glow continuously while an intermittent capacitor will cause the lamp to flicker spasmodically. If the lamp glows constantly, tap or press the capacitor to make sure it is not intermittent. The indicator does not glow when a capacitor is open. The analyzer becomes a relaxation oscillator when the switch is on position 3 or 4. Position 3 is for capacitors up to 0.5 μf and 4 for larger units. In either position, a good capacitor produces a constant glow. Good capacitors of approximately .0005 μf or smaller will produce a halo around one of the electrodes. Electrolytics are tested with the selector in position 5. Open capacitors will not produce a glow. The lamp will glow brightly and then taper off as a good electrolytic charges.

CORRECTION

An error was made in describing the Hopax Circuit Breaker Plug in the August issue. It was stated that on overload the small lever between the prongs "springs up and pushes the plug out of the socket." Under any ordinary overload the lever does *not* spring up and push out the plug, its only function being to reset the contact of the circuit breaker.

INTERMITTENTS IN AUTO SETS

Intermittent operation or oscillator failure in Zenith radios in Hudson automobiles can be caused by a leaky coupling capacitor between the plate of the r.f. amplifier and the control grid (pin No. 6) of the 7B8 converter. The control grid draws so much current that the oscillator section is paralyzed.

The same trouble occurs frequently in Philco UN6-550 models. In this set, the coupling capacitor is one of the two mica trimmers in the can housing the i.f. rejector and wideband coupling circuits.

Failure of the muting switch to open when the push-button is released is another cause of intermittent operation of the Zenith sets.

T. M. FERREIRA,
Port Elizabeth, South Africa

MOTOROLA VT105, VK106, VT107

Check the focus coil for shorted turns or short to chassis when the focus and brightness controls do not function properly. The coil has a resistance of 345 ohms in sets using chassis TS-9, -9A, and -9B; and 540 ohms on chassis TS-9C and TS-9D. Check the chassis number to be sure of the correct resistance.

T. S. PARKER,
Hartford, Conn.

HEIGHT AND WIDTH ADJUSTMENTS

Upon removing the average TV set from its cabinet, you will probably find the C-R tube covered with a film of dirt and dust except for the portion protected by the mask. If you outline the mask area with wax crayon, you will be able to check the operation of the width and height controls before the set is returned to its cabinet.

CHRISTIE URBACK,
Philadelphia, Penna.

ZENITH M-790-Z (FORD-MERCURY)

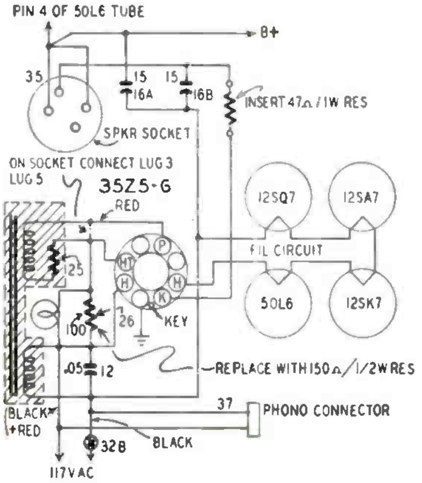
The set muted intermittently and the touch-tuning failed to operate. The trouble was traced to dirt jamming the moving parts of the tuning solenoid. A cardboard shield was fitted around the parts to prevent further trouble after the unit had been cleaned with carbon tetrachloride.

ROBERT E. WHALLON,
Troy, N. Y.

"John likes a speaker that gives lots of bass."

CROSLEY MODEL 52TQ

This partial schematic shows a method of eliminating the power transformer in this model. All parts shown in the



shaded area are either removed or merely disconnected.

CROSLEY DIVISION,
AVCO MFG. CO.,
Cincinnati, Ohio

SLOW FADE ON OLD SETS

A slow fade in older models, particularly Philcos, can often be traced to corroded terminals on the tube sockets. Clean and bend them to restore positive pressure on the tube pins. If the socket has been subjected to heat, its fiber may be weakened, and it should be replaced.

J. G. DODD,
Chicago, Ill.

SHORTWAVE INTERFERENCE

A.c-d.c. receivers are particularly bad offenders in cases of shortwave interference or BCI. This is especially true of sets on which the grid of the first a.f. amplifier, usually a 12SQ7 or similar tube, is returned to ground through an 8- or 10-megohm resistor. This leaves the grid floating for r.f. and causes grid rectification which produces the interference.

To effect a cure, bypass one side of the heater to ground with a 100-μμf mica capacitor; reduce the grid resistor to 3 to 5 megohms and bypass it at the socket with a 100- or 250-μμf mica capacitor.

WILBUR HANTZ,
Columbus, Ohio

MOTOROLA 67L11

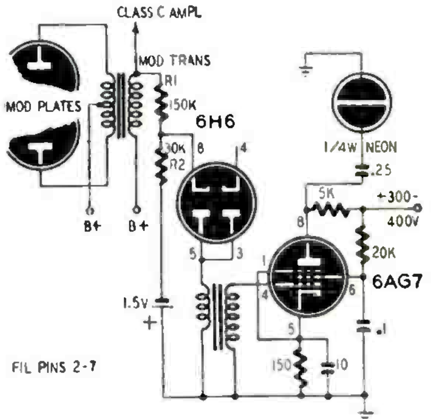
If this set distorts when operated from power lines, check the operation on batteries. If it plays OK on a good battery, replace the selenium rectifier.

A bad selenium rectifier will result in low heater and filament voltages and distortion will take place in the 3V4 output stage. In most 3-way sets, with low operating voltages, the oscillator cuts out before distortion occurs so this may be overlooked as a source of trouble. This does not hold true in this model as severe distortion occurs when the B-voltage drops below 75 volts.

JOHN W. TURNER,
Newark, N. J.

OVERMODULATION INDICATOR

Constructed well below the cost of most C-R-tube or meter-type modulation indicators, the flasher-type overmodulation indicator shown in the diagram does not require calibration or continual visual concentration and monitoring to prevent overmodulation. It causes a neon lamp to flash each time the modulating voltage carries the



class-C plate voltage below zero on peaks. If the indicator is allowed to protrude from the panel of the indicator, it will be visible over a wide angle and some distance away—a feature not possible with other types of indicators.

When the class-C stage is overmodulated, its plate voltage goes negative, causing the 6H6 to conduct momentarily and thus producing a sharp pulse. The diode plates are connected to a 6AG7 amplifier through a standard step-up interstage a.f. transformer. The amplified pulse causes the neon lamp to flash. The 1½-volt bias battery increases the sensitivity of the diode and causes it to conduct just before the class-C stage swings negative.

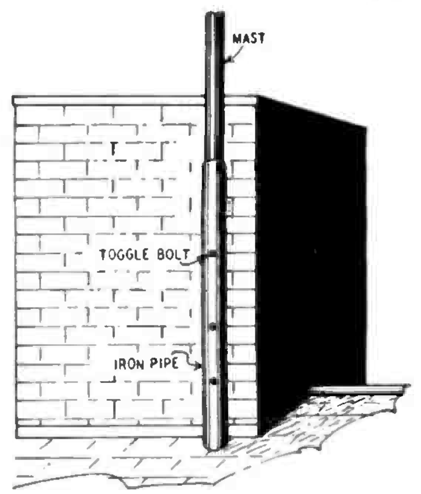
The values of R1 and R2 are suitable for transmitters with no more than 500 volts on the class-C stage. They are selected to drop the modulated voltage to between 70 and 90 volts—well below the inverse peak voltage and peak heater-cathode voltage ratings of the 6H6. The 6H6 and 6AG7 may take their plate and filament voltages from a speech amplifier or from the transmitter power supply.

FRANK S. GUE, VE6BH,
Edmonton, Alta.

NOVEL ANTENNA MOUNT

This method of mounting TV, FM, and lightweight amateur beams does not require straps, turnbuckles, guys, or other hardware normally used to mount antennas. Furthermore, the antenna can be taken down in a few seconds without using tools.

Select a length of iron pipe which has an inside diameter equal to or slightly larger than the outside diameter of the antenna mast. Drill several holes through the pipe, each large enough to pass a toggle bolt. Place the pipe against the chimney or wall, and mark the location of each hole. Drill holes through the wall or chimney. Bolt the pipe to the surface with toggle bolts; then insert the mast in the pipe.



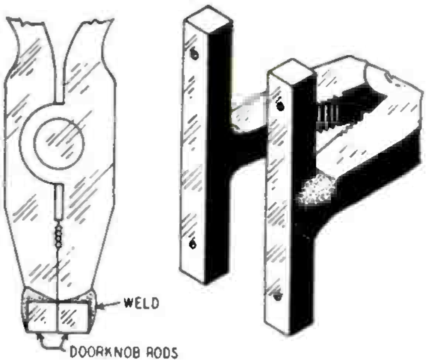
A 10-meter beam, on a 15-foot mast, supported in this way, stayed up through-out the winter without guying.

G. SAMKOFSKY, W2YSF,
Brooklyn, N. Y.

(Better drill the first hole at least a foot below the top of the pipe to give the mast ample supporting surface. Or possibly saw a slot in the mast so that it will slide down past the toggle bolts, thus affording additional support.—*Editor*)

HANDY BENDING TOOL

Experimenters and constructors will find this tool useful for bending light sheet metal for mounting brackets, shields, and panels used in radio and electronic devices.



Take two pieces of doorknob rods and weld them to the jaws of a pair of lineman's pliers as shown in the drawing.

BILLY R. POGUE,
The Dalles, Ore.

CRO AS STROBOSCOPE

A cathode-ray oscilloscope can be used as a stroboscope to "stop" motion. The only requirement is that it must have a short-persistence screen.

Disconnect the saw-tooth generator from the deflection circuits and connect it to the Z-axis input (the electrode which controls the intensity of the pattern). With the sweep generator operating at a low frequency, adjust the brightness control so that the spot appears on the screen only at the peak of the saw-tooth wave. Then apply external signals to the deflection plates to get as large a light pattern as possible. The frequency of the external signals should be high compared to that of the sweep generator.

CHARLES ERWIN COHN,
Chicago, Ill.

TV PREAMP ON HIGH BAND

The cascode preamplifier for channels 2-6 described by I. Queen on page 60 of the October, 1948, RADIO-ELECTRONICS can be used on channels above the FM band. L2, the 6AK5 grid coil, is a National AR-5, which has a center tap (not used in the original diagram). If a switch is connected between the center tap and ground, half of the coil can be shorted out and the circuit will tune to the higher-frequency television channels. Be sure to use short switch leads.

AUGUSTINE MAYER,
Tiffin, Ohio

CAUSE OF SHORTED FILTERS

Be sure to check the contacts on the speaker plug and socket before replacing shorted filter capacitors in a receiver or amplifier with electrodynamic speakers. When the contacts open, a voltage surge—produced by the collapsing field about the speaker field—may be high enough to break down the filter capacitor.

JAMES R. LIMBECK,
Glendale, Calif.

IOWA RADIO TECHNICIANS STUDY TV

Members of the Radio Technicians of Iowa Association recently attended two television lectures given by David G. Sinclair of KVFD and Ken Stienhogel of Ken-El's Radio Supply. The subjects were receiver layouts and adjustments of the deflection assemblies. The members meet on the second Tuesday of each month at the Worden Hotel in Ft. Dodge. The photograph was taken at a recent gathering which combined a banquet and a meeting.

▶ TO ALL RADIO TECHNICIANS' ASSOCIATIONS! ◀

Don't fail to report any and all of your noteworthy activities, campaigns, social affairs, radio or television classes or extraordinary meetings. Publicizing your activities will help your association by advertising it to prospective members, and will help all associated radiomen by calling attention to activities in areas far from their own. If you haven't already elected a publicity agent to supply RADIO-ELECTRONICS and local newspapers with news of your activities, elect one at your next meeting!

ROCHESTER HAS LECTURE

Rochester technicians listened to the first lecture of the Television Technicians Lecture Bureau on September 11. Speakers were F. C. W. Lazenby, who discussed electronic equipment, Walter R. Jones, whose subject was basic circuits and basic test equipment, and A. C. W. Saunders. who told the assembled technicians how to maintain their equipment and how to calibrate it for accuracy.

Before the formal lecture period, there was an informal discussion of Solovox circuits and servicing.

HOLD ANNUAL OUTING

The Whaling City Chapter of the Radio Technicians Guild of New England held its annual outing recently in New Bedford, Mass. Features of the event were a softball game and a clambake.

Members of the chapter took part in recommendations on the proposed new city regulations on television antenna installations. New Bedford is believed to be the first New England city to list specific requirements. The Guild felt that their cooperation with the city's special committee on building codes would help to bring about a set of regulations that would be reasonable and about which there would be no later complaints.

TV CLASS IN BOSTON

A one-night-a-week television class was opened for members of the Radio Technicians Guild in Boston this September. Students are working in a laboratory supplied with test equipment of all the better manufacturers as well as a complete variety of television receivers. Total value of laboratory equipment is estimated at $30,000, according to Albert C. W. Saunders, chairman of the Education Committee.

N. Y. TECHNICIANS MEET

Technicians of New York State met October 9 in New York City, at a regular meeting of the Empire State Federation of Electronic Technicians Associations (ESFETA). Delegates to the meeting, which was held at the Riverside Plaza Hotel, represented Rochester, Ithaca, Binghamton, Poughkeepsie, Fishkill, Kingston, Westchester, New York City and Long Island. The Kingston and Fishkill delegates represented new member associations. Endicott, Corning, and Cortlandt were not represented.

Chief business of the meeting was the adoption (subject to convention approval) of the Federation's new constitution, smoothing out the final roughnesses on the winter lecture program, and preparation for the Federation meeting and banquet at Rochester, November 12 and 13.

Messages Printed by Cathode-Ray Tube

AN interesting new type of electronic communication is reported from the West. Called *Electrontype*, it prints words on the face of a viewing screen with the help of a special coding tube. Some of its features remind one of facsimile, others of Ultrafax, and yet others of the Bell pulse-code system. But it resembles none of these and operates on an entirely new principle. Invented by J. T. McNaney of Consolidated Vultee Aircraft Corp., it has reached the development stage and is expected to replace many older methods of sending and recording printed material.

The main element in the Electrontype is the *Charactron*, a new type of cathode-ray tube. The operating principles of one type of Charactron can be understood from Fig. 1. The tube is equipped with means by which an electron beam can be converted into shapes of predetermined characters. There is an electron gun at one end and a fluorescent screen at the other. Midway down the tube is a character-shadowing disc.

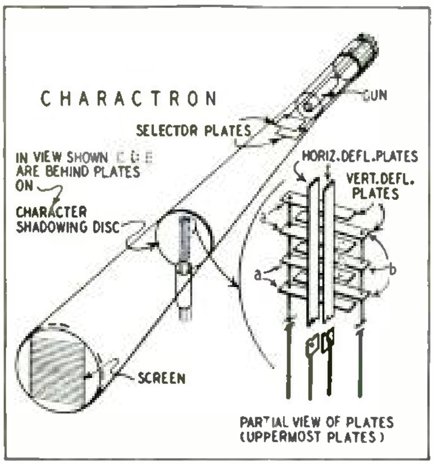


Fig. 1—Construction of the Charactron.

The individual character openings in the disc are arranged vertically, in a line one above the other. Their respective shapes and quantity depend on the intended application of the Charactron. Any character is selected for presentation by means of a voltage applied to a pair of selector plates. After the beam is directed through an opening in the disc, its cross section will represent a message character, such as a letter of the alphabet. Then, with a set of horizontal and vertical deflection plates, the character-shaped beam can be directed to any part of the fluorescent screen.

An enlarged portion of the deflector assembly is shown in Fig. 1. Characters C, D, and E represent openings in the shadowing disc. Vertical deflection plates consist of two sets a and b, and horizontal plates consist of a single pair. There is, essentially, a pair of plates for each character. Each vertical plate, however, is common to two individual characters, while the horizontal plates are common to all characters.

In response to a series of input signal potentials, lines of information will be Electrontyped across the viewing screen of the tube.

An 8-inch screen could accommodate 60 or more lines, or approximately 150 words. Such presentations would be intended for projection on larger screens, or for recording purposes. By increasing the size of characters (consequently reducing the number of lines) messages can be read directly from the fluorescent screen.

Provisions within the tube allow for a selection from 40 different characters, which include the letters of the alphabet, digits 1 to 9, and various punctuation marks. The number of different characters employed in a single tube does not necessarily present any particular problem. Several hundred may be incorporated in a tube if desired, and it is not necessary that they be arranged in a single straight line as indicated.

One version of a complete Electrontype recorder is shown diagramatically in Fig. 2. The Charactron displays a single line of symbols, with space for 70 per line. The fluorescent screen is 7½ inches across the face of the tube and 3/16 inch in height. The screen in this case is a short-persistence, zinc-oxide type.

Other major units of the complete recorder include servo-controlled film supply and film take-up mechanisms (with the servos actuated by the position of the supply and take-up idlers),

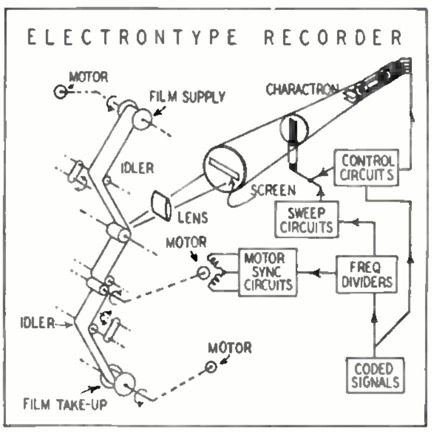


Fig. 2—Complete Electrontype recorder.

film-synchronizing circuits and control mechanisms, lens system, Charactron input selector circuits, and input sweep control circuits.

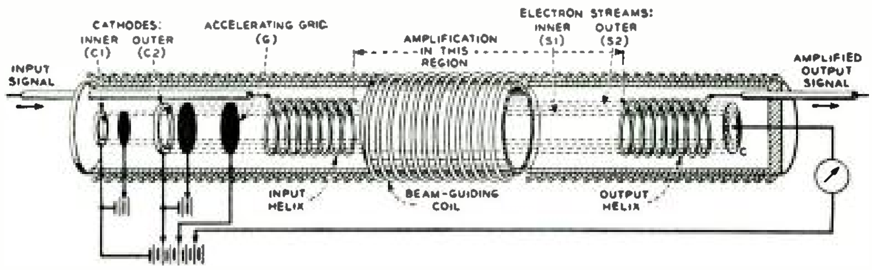
With 70 exposures per line, when using 35-mm film, it is possible to expose 10,000 characters on 150 mm of film. At input signal speeds of 20,000 characters per second, for instance, the film will be traveling through the printer at only approximately 300 mm per second. Equipment can be designed to produce messages in printed form at the rate of one million words per minute.

DOUBLE-STREAM AMPLIFIER

An improvement on the travelling-wave tube, an interesting double-stream amplifier depends for its gain on the interaction of two streams of electrons travelling at different speeds. The two electron streams flow from the two ring-shaped cathodes C1 and C2 in the drawing through the length of the tube to the collector C. The streams are accelerated to different speeds by differing voltages on the screen-like, disc-shaped grids and further accelerated by the accelerating grid G.

The signal is impressed on the stream by feeding it to the input helix. It then travels down the stream, increasing in amplitude as it goes. All other things being equal, the longer the tube, the greater the amplification. A tube 16 wavelengths long at the frequency being amplified may have a gain of over 40 db. The amplified signal is picked up by the output helix. A third coil around the tube helps to guide the streams of electrons straight down the cylindrical tube.

Though the scientists say there is no simple physical explanation of the tube's action, it is well know that—like the earlier travelling-wave tube—it is able to amplify over a startlingly broad band. There may be a gain variation of only 3 db over the whole range between 200 and 310 mc. Experiments show that the amplification in the tube takes place in the central portion and depends to some extent on the velocity difference between the two beams.

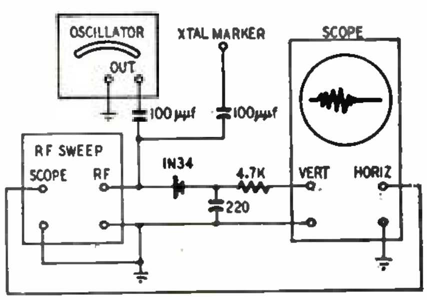


PANORAMIC FREQUENCY METER

An effective frequency meter can be quickly set up with the aid of an r.f. sweep generator, an oscilloscope, and a mixer as in Fig. 1. The sweep generator is set to the desired r.f. range and its 60-cycle output fed to the horizontal plates of the 'scope. A horizontal trace is produced on the 'scope.

When the output from an oscillator is coupled to the mixer, it produces a pip if its frequency is within the sweep range. This pip moves along the horizontal 'scope trace as its frequency is adjusted. An unknown frequency may be measured or calibrated by checking with a marker pip from a crystal oscillator. When the two pips coincide, they have the same frequency. Of course beats and harmonics also produce pips (if they have sufficient amplitude); therefore it is necessary to use care in identifying them.

The method may be used to measure the limits of the r.f. sweep. A calibrated oscillator is adjusted to produce a pip at the beginning and end of the 'scope trace. The frequency values are read off from the oscillator dial.



Sweep and crystal marker generators and oscilloscope used to measure frequency.

The advantage of this type of frequency meter is that a wide spectrum is visible at one time. All beats and harmonics which occur within the range of the sweep may be observed, and relative amplitude is apparent. —*Nathaniel Rhita*

CITIZENS RADIO

The FCC, in release No. 39460-8/49, states that because highly specialized experience in u.h.f. techniques is required to successfully design or modify equipment to meet the technical requirements of Citizens Radio Service rules, *there is no simple method by which the home constructor or experimenter can meet these requirements.* Furthermore, the possibility of complying with the requirements is remote if the designer or constructor does not have auxiilary equipment for measuring voltages, currents, frequency, bandwidth, percentage of modulation, and spurious and harmonic radiation.

In applying for license of equipment which has not been type-approved (see RADIO-ELECTRONICS, Sept. 49, p. 36), the applicant should specify the measuring equipment used in conducting all tests, giving the manufacturer's name, the type number, and the percentage of accuracy of the equipment.

The BC-645, in its original form, is not sufficiently stable to permit licensing in the citizens radio service. Extensive modifications—amounting to almost complete redesign of the original equipment—would be required. No modified BC-645 has passed FCC tests so far.

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.

D-1—SELENIUM RECTIFIERS

Westinghouse has issued a catalogue listing its standard and high-voltage selenium rectifiers. Circuits, characteristic curves, and general application notes are included.—*Gratis*

D-2—RECORDER CATALOGUE

This 16-page booklet lists all models of the Twin-Trax tape recorder made by Amplifier Corp. of America. There are portables, table models, rack mounts, long- and short-playing models, single- and dual-speed mechanisms, and several accessories.—*Gratis*

D-3—TV SET TUBE CHART

This chart of television receivers—issued by Sylvania—shows all tubes used in each. One hundred ten receivers of 44 manufacturers are listed. The three pages are folded and punched for filing in a standard 8½ x 11-inch loose-leaf book.—*Gratis*

D-4—VARNISHED INSULATION BOOK

The V.I. Story—Varnished Insulations in Electrical Engineering, by David O. Woodbury, is published by the National Electrical Manufacturers Association. The 88-page book tells in nontechnical terms the history of varnished insulation and its application.—

D-5—TELEVISION PICT-O-GUIDE

A 100-page loose-leaf book, 4¼ x 6¾ inches, put out by RCA, contains about 50 photographs of test patterns illustrating most of the possible faults in a receiver. With each picture is a brief explanation of the trouble and of what to do about it.—*Given to RCA dealers with purchase of 100 RCA tubes*

D-6—RECTIFIER HANDBOOK

Federal Telephone and Radio Corp. has published a highly useful booklet of 48 pages listing applications and circuits for selenium rectifiers. All standard circuits are shown with actual component values, with the correct rectifiers listed for each. A separate page is also devoted to each rectifier type in much the same manner as in a tube manual.—*25¢*

D-7—MICROPHONE CATALOG

Four-page bulletin No. 104 gives information and prices on Electro-Voice microphones and stands, as well as the speech clipper and matching transformer.—*Gratis*

D-8—DURANITE DECODER CHART

Aerovox Corp., New Bedford, Mass., has issued a decoder chart showing the RMA color coding for molded tubular paper capacitors. Colors on a given capacitor are compared with those on the chart and the values read off.—*Gratis*

Radio Thirty-Five Years Ago
In Gernsback Publications

HUGO GERNSBACK
Founder

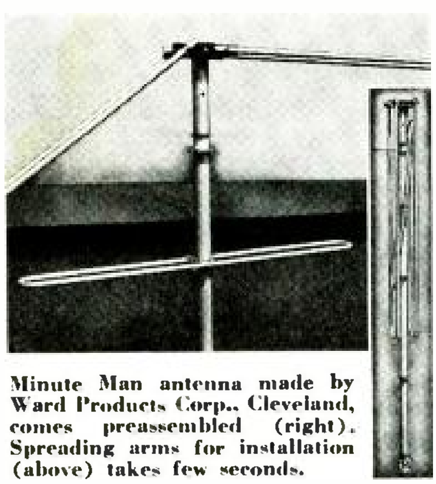
Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

IN THE DECEMBER 1915 ISSUE OF ELECTRICAL EXPERIMENTER

The Radio League of America
By Wireless 'Phone from Arlington to Paris
Audion Bulbs as Producers of Pure Musical Tones, by Dr. Lee de Forest
Wireless Telegraphy Aids the Teutonic Allies
Dr. de Forest to Help Detect Zeppelins
The Radio Transmitting Set at Arlington, Va.
U.S. Army Field Radio Set
Marconi Company Develops New 2-KW Radio Panel Set
A Huge Oil Type Radio Condenser
Photographing Radio Waves
A New Vibrating Reed Radio Amplifier, by Homer Vanderbilt
The Telefunken Permanent Crystal Detector
Spiral Antennae for Radio Purposes
The Resistance of Wireless Antennas
A Neatly Designed Radio Receiving Set, by J. L. Green
"Pocket" Wireless Receiving Outfit, by Percy M. Roope
A Sensitive Galena Detector, by Hans Helle
Official International Radio Code

PREASSEMBLED TV ANTENNA



Minute Man antenna made by Ward Products Corp., Cleveland, comes preassembled (right). Spreading arms for installation (above) takes few seconds.

Dr. Adolph E. Rosenthal, physicist and inventor, was appointed director of physics of FREED RADIO CORP. recently, according to Freed's director of research and development, Joshua Sieger. Dr. Rosenthal has secured many patents for inventions in color and three-dimensional television. He is particularly well known for his Skiatron or dark-trace tube (which he described in the March, 1949, issue of RADIO-ELECTRONICS). Dr. Rosenthal and Mr. Sieger have worked together before—in the British Scophony Corp.

Robert A. Seidel, formerly vice president and comptroller of the W. T. Grant Co., has joined the RCA VICTOR DIVISION, Camden, N. J., as vice president in charge of distribution, it was announced by **J. G. Wilson**, executive vice president of the Radio Corp. of America, in charge of the division. Mr. Seidel will make his headquarters at the division's home office in Camden, N. J. Mr. Seidel joined the W. T. Grant Co. in 1940 as comptroller and was appointed vice president in 1944. He is well known for his activities in the National Retail Dry Goods Association, where he served as a member of the board of directors, chairman of the executive committee, and chairman of the association's Committee on Government Affairs. He was awarded the Gold Medal of Honor of the NRDGA in January of 1946, and a special citation of merit in January, 1949.

Joseph F. Bozzelli was recently appointed assistant sales manager of L. S. BRACH MFG. CORP., Newark, N. J., maker of television antennas, according to G. Philip Galloway, sales manager. Mr. Bozzelli was recently sales engineer for JFD Mfg. Co., and has been in electronics for many years.

Dr. E. M. Honan, an authority on the development of sound in the motion picture field, who until his retirement on September 30 was engineering manager of Electrical Research Products Division of Western Electric, joined the ALTEC COMPANIES on October 1 in the capacity of engineering manager, according to an announcement by G. L. Carrington, president of Altec Service and Altec Lansing Companies.

Louis G. Pacent, veteran radio engineer and president and technical director of Pacent Engineering Co., New York, has been appointed consulting engineer by Plessey International of Ilford (England).

Percy L. Spencer, veteran RAYTHEON tube expert and manager of Raytheon's power tube division, Waltham, Mass., was given the Navy's Distinguished Public Service Award, the highest honor the Navy can bestow on a civilian, at the Waltham plant. Rear-Admiral Hewett Thebaud made the award. Admiral Thebaud cited Mr. Spencer for his work as a scientist, his creative genius, and his ability as a leader of men. Particular mention was made of Mr. Spencer's work in microwave magnetron development, with special reference to the improved methods for volume magnetron production.

OPPORTUNITY AD-LETS

WANTS MORE SET DATA

Dear Editor:

I was much interested in your August editorial, "Squeezing the Service Technician," as well as the article, "Manufacturers versus Service Technicians," on page 50 of the same issue. This spring I had to service a receiver which required a new tube socket. The socket was not standard, so I ordered it from the maker (through the distributor). It took five months, four unanswered letters, three long-distance phone calls, and some frayed tempers before I obtained the simple little tube socket that I needed.

Another instance was six Emerson TV receivers, all with the same model number but with no two chassis alike, and no service data available. You can imagine the grief!

Manufacturers may feel that contact with service technicians is beneath their dignity, but with the increasing popularity of television they will have to cooperate in some sort of parts replacement and data procurement or the set owners will rise up in arms against all of us.

I am guaranteeing sets for 90 days (in cooperation with the dealer) but am making only three free calls during that period—all others are charged for at $5 apiece. I have no intention of contracting for a year's service as so many organizations do, as I know it can't be profitable.

I think trade papers such as the one Sylvania sends out (*Sylvania News*) show good cooperation with the technician and help both parties. If set manufacturers adopted this plan, they could tell us about production changes, service hints, and anything else that would help not only to facilitate our work, but to boost their own reputations and sales.

LYMAN E. GREENLEE
Anderson, Indiana

LIKES TV ARTICLES

Dear Editor:

I notice that you have recently increased your attention to television and hope you will keep up this good work, perhaps adding a little more on test equipment. I was a rabid high-fidelity fan, but since the advent of television I have dropped some of my intense devotion to audio.

More case histories on video receiver faults and reports of the modifications that have been incorporated in commercially produced receivers would do much to help the repair technician's daily work.

HARRIS D. POUND
Montreal, Canada

TELEVISION IS NO GOOD

Dear Editor:

You have published many good articles in the past year which have been useful to me in part-time servicing and construction. However, material like the "Electronics in Medicine" series, Geiger counters, and microwaves merely wastes space that could be used for something more suitable for the average technician.

I suppose you must publish a certain amount of TV material to keep up to date, but I personally believe TV picture quality and program material are an insult to anyone's intelligence. How anyone can gaze at those blurred black and white blobs that jump and flicker like the old-time movies is beyond me. I've seen all the best receivers, and they're all stinkeroos. Until a high scanning rate and higher frequencies are developed, TV will amount to nothing. It's little better today than it was 10 years ago.

ROBERT O. BARG
Rochester, N. Y.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946

Of Radio-Electronics, published monthly at Philadelphia, Pa. for October 1st, 1949.
State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the editor of the Radio-Electronics, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radcraft Publications, Inc., 25 West Broadway, New York 7, N. Y.; Editor, Hugo Gernsback, 25 West Broadway, New York 7, N. Y.; Managing Editor, Fred Shunaman, 25 West Broadway, New York 7, N. Y. Business Manager, none.

2. That the owner is: Radcraft Publications, Inc., 25 West Broadway, New York 7, N. Y.; H. Gernsback, 25 West Broadway, New York 7, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

Signed, H. Gernsback, publisher.

Sworn to and subscribed before me this 27th day of September, 1949. Maurice Coyne, Notary Public. [Seal]

BRITISH GIMMICKER

Dear Editor:

I enjoyed your correspondence with Dennison of the Better Business Bureau! Many years ago, when a friend was boasting of his skill in tracking faults, I bet him five shillings that he would not spot in 15 minutes a "gimmick" that I'd put into a *single-tube set with headphones.* I won the bet easily.

(All I did was remove the receiver diaphragms!)

RALPH W. HALLOWS

Berkhamsted, Herts, England

APPROVES OF VARIETY

Dear Editor:

I agree with Mr. Goodstern (page 75, September issue) that you have published many one- and two-tube set diagrams. But I do not agree that this is bad—after all, RADIO-ELECTRONICS is not published for the service technician alone. In fact, I wish you would give us complete articles on these subjects once in a while to help beginners.

On the other hand I do not agree with Mr. Jeffries (same page) that you should avoid 10-tube receivers and other large projects. Even if the builder does not use entire circuits, he can use parts of them. In any case, reading such articles adds to his knowledge.

I'd like to see an article on audio equalizers—formulas and design procedure, not just typical circuits.

LEON G. WILDE

North Andover, Mass.

THE COMMON GOOD

Dear Editor:

Our association is backing you 100% in your fight to help the electronic technician. By forming an association, we have bridged part of the gap between us and the owners of the receivers we service.

Before we had an association, every one of us was a competitor. Now, knowing our competitors as good fellows with the same problems as our own, we feel free to call on each other for data, hints, or other assistance.

It is a pleasure to see that you are attempting to fill the gap between the service technician and the manufacturer, by seeing that the manufacturer supplies technical data well in advance. Even the association cannot fill that lack—calls to the best available sources of information that our group can reach are no good when the data hasn't been released by the manufacturer.

We thank you for your consideration and hope that your efforts will help bring about a better understanding between the manufacturer and service technician.

FRANK J. MOORE
Secretary-Treasurer,
Radio & Electronic
Technicians Assn.
of Indiana, Inc.

South Bend, Ind.

ELECTROENCEPHALOGRAPHER

Dear Editor:

I read with much interest your July, 1949, editorial, "Biological Electronics," as well as Eugene Thompson's series on medical electronics. My own field is electroencephalography and I have been doing research on its history; the following may interest you.

You said in your editorial that as far back as 1911 you suspected that the animal brain generates electricity. In an article published in 1937, Dr. H. H. Jasper shows that early neuropsychologists proved this in 1875. The first work done on the human brain was in 1924 but in 1902 Dr. Hans Berger worked on dogs.

The first crude electroencephalograph was made by Dr. Berger's bother-in-law, I don't know just when. Washington University has an instrument, made, I think, in 1922. About the same time Dr. Alexander Forbes of Harvard made a Hindle string galvanometer which, with a one-stage amplifier, was used to record cortical responses to afferent stimulation. Responses were indistinct, largely obscured by what we now call alpha waves. Mr. Lovett Garcea of Electro-Medical Laboratory, Holliston, Mass., has written that he believes himself to be the first man to develop an instrument in the U. S. He demonstrated the first portable machine in 1935.

Incidentally, the first name of Dr. Davis, whom you mentioned in the editorial, is Hallowell, not Hollowell.

C. DAVID HELLMAN

Caro, Mich.

BRITON LIKES LANGHAM

Dear Editor:

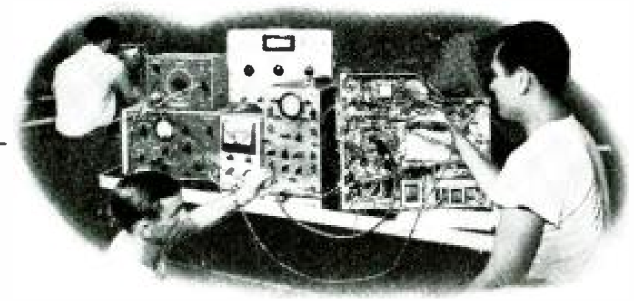
We shall look forward to receiving our subscription copies of RADIO-ELECTRONICS. Special mention should be made of contributor Langham's articles, which we find instructive as well as enjoyable for their undercurrent of humor.

BERNARD J. BROWN
Director, Cole-Bernard
Productions, Ltd.

London, England

Suggested by Robt. W. Glueckstein, Menominee Falls, Wisc.

"Sure we're a hundred miles from the TV transmitter and we pick it up easily."



Build your Career—Become an ELECTRICAL ENGINEER

MAJOR IN ELECTRONICS—B.S. DEGREE . . . IN 36 MONTHS

Capitalize on your electronic interests — decide to become an *Electrical Engineer*. Save a valuable year by earning your B.S. Degree *here* in 36 months of year-round study.

This 46-year-old, non-profit Technical Institute offers a world-famous course in Electrical Engineering *with a major in Electronics*. You follow an industry-guided program which is constantly attuned to current developments. It presents a solid background in the basic sciences . . . Chemistry, Physics, Mathematics, Economics, and Electrical Engineering subjects . . . plus 19 technical specialty courses in Engineering Electronics, including four courses in Electronic Design.

Practical, military or academic training will be evaluated for advanced credit.

ELECTRONIC TECHNICIAN

At the end of the first year of study of the Electrical Engineering course, the student is qualified as an Electronic Technician.

RADIO-TELEVISION TECHNICIAN

To young men interested specifically in radio and television: Prepare here for a career in television—the field which business leaders predict will be among America's top ten industries by 1951. In 18 months you become a Radio-Television Technician, ready for positions in receiver and transmitter testing, servicing, sales, supervision and production. Because of this school's *concentric curriculum*, the Bachelor of Science degree in Electrical Engineering (Electronics major) may be earned in 24 additional months.

A SPECIAL PREPARATORY PROGRAM is offered for men lacking high school diplomas. TRAIN in modern, well-equipped laboratories, shops and classrooms. Faculty of 85 specialists—over 1500 students and 30,000 graduates.

MILWAUKEE SCHOOL of ENGINEERING

Founded 1903 by Oscar Werwath

Send Coupon for free 48-page Pictorial Bulletin, "Your Career", and 110-page Catalog.

NEXT TERMS OPEN JAN. 2—APRIL 3

Electrical Engineering ....36 months
Electronics Major
Electronic Technician ....12 months
Radio-Television Technician ....18 months

MILWAUKEE SCHOOL OF ENGINEERING
Dept. RE-1249, N. Broadway and E. State, Milwaukee, Wis.

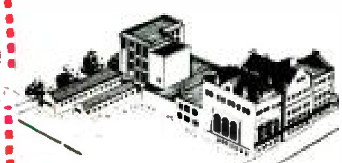
Without obligation send me the Bulletin, "Your Career", and your catalog.

I am interested in .... course.

NAME .... AGE ....

ADDRESS ....

Veteran of
CITY .... STATE .... ☐ World War II



RADIO SCHOOL DIRECTORY

TELEVISION

Laboratory and theoretical instruction under the guidance of experts, covering all technical phases of Radio, Frequency Modulation and Television. Prepares for opportunities in Broadcasting, Industry or Own Business.

MORNING, AFTERNOON or EVENING SESSIONS. Licensed by N. Y. State. Free Placement Service. APPROVED FOR VETERANS.

ENROLL NOW FOR NEW CLASSES

Apply Daily 9-9; Sat. 9-2

VISIT, WRITE or PHONE

RADIO-TELEVISION INSTITUTE

Pioneers in Television Training Since 1938
480 Lexington Ave., N. Y. 17 (46th St.)
PLaza 3-4585 2 blocks from Grand Central

NEED HELP?

TRAINED MEN AVAILABLE

Solve your trained manpower shortage by employing C.T.I. graduates. These men have completed a rigid course of training. What they've learned has been *practical*, because most of their training period was spent *in the shop*. We probably have graduates from your area. Write for prospectus on available men. (No employment fees).

COMMERCIAL TRADES INSTITUTE
1400 Greenleaf Dept. P108-11, Chicago 26

CODE SENDING RECEIVING SPEED

Be a "key" man. Learn how to send and receive messages in code by telegraph and radio. Commerce needs thousands of men for jobs. Good pay, adventure, interesting work. Learn at home quickly through famous Candler System. Qualify for Amateur or Commercial License. Write for FREE BOOK

CANDLER SYSTEM CO.
Dept. 3-O, Box928, Denver 1, Colo., U.S.A.

RADIO-TELEVISION QUESTIONS AND ANSWERS. Elements 2, 3, and 4, by Woodrow Smith. Published by Editors and Engineers, Ltd., Santa Barbara, Calif. Three volumes, 5½ x 8½ inches. Price: single volume $1; two or three volumes, 95¢ each.

These books contain questions taken from the FCC's *Study Guide and Reference Material for Commercial Radio Operator Examinations*. Each question is answered by the author, and whatever background is deemed necessary is given. While the reader is not likely to learn radio from the books, a study of them will equip the prospective examinee with the knowledge specifically required for the FCC examinations.

The present volumes cover Element 2 (Basic Theory and Practice), Element 3 (Radiotelephony), and Element 4 (Advanced Radiotelephony). They are based on the recently revised study guide, which obsoletes older books of this type.—*R.H.D.*

ATOMIC MEDICINE, edited by Charles F. Behrens, M. D., Captain, U. S. Navy. Published by Thomas Nelson & Sons, New York. 6¼ x 9½ inches, 416 pages. Price $7.50.

Containing contributions by 20 of the country's most knowledgable medico-neucleonic specialists, this book is said to be "the first text on atomic medicine written in the atomic age." While covering much ground of general interest to those concerned with neucleonics, its special slant is toward the prevention and cure of radiation-caused damage to the human body and to the use of radioactivity as a medical tool.

The opening chapters are devoted to a surprisingly complete explanation of nuclear fission itself and a verbal picture of the manner in which the atomic bomb does its damage. Then follow chapters on the biology, pathology, and hematology of ionizing radiations, cumulative effects, pathogenesis and therapy of radiation sickness, radiation detection, safety precautions, and disaster planning. The character of isotopes is discussed, with several chapters on their manufacture and use. A chapter on radiation effects in dentistry is included, and one outlining problems which are still in the research stage. The appendix includes a 21-page table of isotopes and a glossary of terms.—*R. H. D.*

EXPLORING ELECTRICITY, by Hugh Hildreth Skilling. Published by Ronald Press Co., New York. 6 x 8¾ inches. 277 pages. Price $3.50.

Written by a professor of electrical engineering at Stanford University, this volume of Ronald's *Humanizing Science* series is entirely unprofessorial. Covering the progress of electrical development from the time of Thales (the first electrician) to the explosion of the first atom bomb, the book is more a tale of people than of science. It is written in narrative fashion, with dialogue, descriptions of places, and many excerpts from personal letters and other sources.

To the novice the book presents an interestingly written story. To those familiar with the science of electricity, it humanizes the subject and presents some of the historical background every worker ought to have.—*R. H. D.*

ADVERTISING INDEX

RADIO SCHOOL DIRECTORY
(Pages 94-95)

NEW ADVANCES IN PRINTED CIRCUITS. Proceedings of the First Technical Symposium on Printed Circuits. Published by the United States Department of Commerce. Miscellaneous Publication 192 (available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.) 8 x 10 inches. 73 pages. Price 40 cents.

This is a sequel to the Bureau of Standards Circular 468, *Printed Circuit Techniques*. Since it is the report of a symposium, there is a certain amount of overlapping, but there is much new information in the later book, which is roughly twice the size of the earlier one.

Considerable attention is given to the various methods of applying conductive and resistive elements, and to the materials on which they may be applied. A number of typical commercial applications are described and illustrated, and some interesting information is brought out in the questions asked and answers given during the discussion.

ELECTRONIC TIME MEASUREMENTS. edited by Britton Chance, Robert I. Hulsizer, Edward F. MacNichol, and Frederick C. Williams. (Volume 20 of the Massachusetts Institute of Technology Radiation Laboratory Series.) Published by McGraw-Hill Book Co. 6 x 9 inches. 538 pages. Price $7.00.

Radar made the problem of accurate measurement of small time intervals a decisive one. There are other important fields in which accurate measurement of short time intervals is of great importance, as, for example, study of the velocity of nuclear particles in nucleonic research.

While the pulse methods of radar are most common, measurements of other time intervals, such as the phase intervals of the absolute altimeter and the Decca distance and position finding system, have wide application and are discussed, as well as equipment, techniques, systems and methods for the various types of time measurements.

MAGNETIC RECORDING. by S. J. Begun. Published by Murray Hill Books, Inc., New York. 6¼ x 9¼ inches, 242 pages. Price $5.

As a good, solid background in magnetic recording, this volume should be of great value to both amateurs and workers in the sound field. Dr. Begun, vice-president and chief engineer of the Brush Development Co., has written a book of unusual clarity and completeness on a field in which he is an outstanding figure.

Starting with a chapter on the history of magnetic recording, the book takes up the subject technically even before its beginning—with the character of sound and the devices used to transform it to electrical impulses. The introduction to recording takes the form of an explanation of the relevant principles of magnetism. From that point Dr. Begun leads his readers to a smooth, step-by-step understanding of the entire subject.

It is impossible to include all information available in 242 pages. The treatment is principally qualitative, therefore, though the mathematical basis is given for each of the important phases. Much of the material is not available in coordinated form anywhere else.

In addition to theory, the author has included a chapter describing representative recorders in detail, another on instrumentation and measurements, and a third on applications, as well as a glossary of terms.

More and more is appearing in the current technical press on magnetic recording. This book does a fine job of supplying the background for a complete understanding of new developments and techniques and for the reader's own work in the field.—*R.H.D.*

RADIO COMPONENT HANDBOOK. Published by Technical Advertising Associates, Cheltenham, Pa. 6 x 9¼ inches. 210 pages. Price $2.50.

This is a data handbook on the characteristics of the major electronic equipment components, with some application information on each. The first chapter covers design in general. The others deal with transformers and inductors, capacitors, resistors, speakers, switches, insulators, and tubes and metallic rectifiers.

RADIO-TELEVISION QUESTIONS AND ANSWERS. Elements 2, 3, and 4, by Woodrow Smith. Published by Editors and Engineers, Ltd., Santa Barbara, Calif. Three Volumes, 5½ x 8½ inches. Price: single volume $1

These books contain questions taken from the FCC's *Study Guide and Reference Material for Commercial Radio Operator Examinations*. Each question is answered by the author, and whatever background is deemed necessary is added. While it would not be possible to learn radio from the book, a study of them will equip the prospective examinee with the knowledge specifically required for the FCC examinations.

The present volumes cover Element 2 (Basic Theory and Practice), Element 3 (Radiotelephony), and Element 4 (Advanced Radiotelephony). They are based on the recently revised study guide, which obsoletes older books of this type.—*R.H.D.*

REFERENCE DATA FOR RADIO ENGINEERS, third edition. Published by Federal Telephone and Radio Corp., New York. 5¾ x 8½ inches, 640 pages plus index. Price $3.75.

The first two editions of this valuable book should be familiar by now to most radiomen. This, the third, is twice as large as the second (1946). Like its predecessors it contains a wealth of design data in skeleton form—formulas, tables, graphs, basic circuits, outline drawings, and so on—intended, not to instruct, but to remind.

The additional material, not only brings the book up to date, but also adds much that was omitted because of restrictions on book production. Notable additions are: frequency allocations; principal atomic constants; radar fundamentals; AM, FM, and TV broadcasting data; servo mechanisms; and expansions of previously included material—*R.H.D.*

WELLS RADIO-ELECTRONIC COMPONENTS

COAX-- CABLES AND CONNECTORS --TWINAX

A COMPLETE LINE OF LOW-LOSS CONNECTORS AND ADAPTERS FOR USE WITH RG CABLES. RUGGED CONSTRUCTION DIE CAST ZINC AND MACHINED BRASS SHELLS, HEAVILY SILVER PLATED. INSERTS ARE MICA FILLED AND POLYSTYRENE.

ALL ITEMS ARE IN STOCK FOR IMMEDIATE SHIPMENT.

SMALL SINGLE CONTACT CONNECTORS

83-1SP	STRAIGHT PLUG- With molded low-loss mica filled insert	$0.40
83-1SPN	3 PIECE PLUG- TAPERED BACK SHELL FOR .405" O.D. cables	.40
83-1T	"T" CONNECTOR for 83-1R Factory wired	1.50
83-1R	RECEPTACLE CHASSIS OR BOX TYPE- Low-loss mica insert	.40
83-1RTY	RECEPTACLE CHASSIS OR BOX TYPE- Polystyrene & mica insert	.45
83-1AP	ANGLE PLUG ADAPTER- Polystyrene insert- pin & socket	.40
83-1J	JUNCTION- For use with 83-1SP or 83-1SPN	.75

SMALL TWIN CONTACT CONNECTORS

83-22SP	TWIN PLUG- With low-loss mica filled dielectric insert	$0.45
83-22R	TWIN CHASSIS RECEPTACLE- For 83-22SP connector	.46

HOODS, CAPS, AND ADAPTERS

83-1H	HOOD- For RG cables, 8/U, 22/U, 63/U, 65/U, etc.	.08
83-1AC	CAP- For connectors 83-1R, 83-1RTY, 83-22R, etc.	.10
UG-175/U	ADAPTER- For adapting 83-1SP to accommodate RG-58/U	.20
UG-176/U	ADAPTER- For adapting 83-1SP to accommodate RG 59/U	.20
10H/177N	CABLE CLAMP M-297 for use with British Connectors	.15

MISCELLANEOUS CONNECTORS

UG-18/U	$0.40	UG-83/U	$0.40	UG-187/U	$1.00	10H/520	$0.40
UG-21/U	.50	UG-87/U	1.00	UG-191/U	.45	10H/522	.40
UG-27/U	1.00	UG-98/U	1.00	UG-191/U	.60	10H/523	.40
UG-29/U	1.00	UG-100/U	1.40	10H/388	.40	10H/701	.40
UG-30/U	1.80	UG-107/U	1.25	10H/381	.40	10H/703	.40
NAVY TYPE CI-49546	.50			83-1B LARGE TWIN RECEPTACLE			.50
83-1D-PL-271 at SCR-533	.40			PL-310 at AN-3057-4 at SCR-522			.75

COAX AND TWINAX CABLES

AN NO.	NOMINAL IMPEDANCE OHMS	INNER SHIELD	JACKET MATERIAL	MAX. O.D.	SPECIAL INFORMATION	PRICE PER FT NET
RG-7/U	97.5	COPPER	BLACK VINYL	.370		$0.04
RG-8/U	51	SILVER	GRAY VINYL	.420		.15
RG-10/U	52	COPPER	" "	.475	Armored	.07
RG-17/U	52	"	" "	.870	Sh. Lgth	.40
RG-18/U	52	"	" "	.945	Armored	.40
RG-21/U	53	SILVER	" "	.332		.14
RG-23/U	47.1	COPPER	BLACK RUBBER	.500		.08
RG-25/U	47.1	"	COTTON	.475		.07
RG-26/U	48	"	BLACK RUBBER	.525	Armored	.11
RG-27/U	47	"	" "	.675	Armored	.11
RG-28/U	48	"	" "	.800		.30
RG-29/U	53.5	"	POLYETHYLENE	.184		.035

AN NO.	NOMINAL IMPEDANCE OHMS	INNER SHIELD	JACKET MATERIAL	MAX. O.D.	SPECIAL INFORMATION	PRICE PER FT NET
RG-29/U	53.5	COPPER	COTTON	.178		.03
RG-30/U	72.5	"	POLYETHYLENE	.305	Sh. Lgth	.04
RG-41/U	68.5	"	BLACK RUBBER	.466		.05
RG-54/U	58	"	" VINYL	.275		.05
RG-55/U	53.5	"	POLYETHYLENE	.206		.07
RG-57/U	95	"	BLACK VINYL	.625	2 Cond.	.18
RG-74/U	52	"	GRAY	.615	Armored	.18
RG-37/U	55	"	POLYETHYLENE	.184		.05
RG-58/U	72	"	"	.242	Sh. Lgth	.04
LOW-LOSS BEADED COAXIAL CABLES						
72/12	72	COPPER	BLACK VINYL	.480		.09
72.139	72	"	"	.460	80' Coils Only	.06

NOTE THE FOLLOWING LIST OF SPECIAL OFFERINGS

RG-7/U This material is on the original manufacturers reels ranging from 2000 ft. upward..$37.50/M
100 foot coils .... .04/ft.

RG-29/U This material is on reels of 2000 feet or more $27.50/M
100 foot coils .... .035/ft.

6-.20/UV Same as above except with cotton braid covering $25.00/M
100 foot coils .... .03/ft.

TRANSMITTING MICA CONDENSERS

Manufacturers' Legend: 1-Aerovox; 2-Cornell Dubilier; 3-Faradon; 4-General Electric; 5-Illinois; 6-Micamold; 7-Sangamo; 8-Solar; 9-Sprague

Cap. Mfd.	Wkg. Volts	Mfr. Leg.	Price Each
STYLE "AA" CONDENSERS			
.02	3000	4	$4.50
.06	1000	2,7	3.50
STYLE "A" CONDENSERS			
2mmfd	6000	9	1.65
STYLE "B" CONDENSERS			
.00003	2000	2	$0.70
.000047	3000	1	.60
.00005	1560	2,9	.75
.00005	1800	1	.80
.000065	2500	GE Co.	.70
.00007	1100	6	.70
.00007	3000	2,4	.75
.00009	3000	2,7,8	.75
.000091	3000	7	.80
.0001	3000	2,7,8	.80
.0001	4000	7	.90
.0001	5000	2,7	1.00
[illegible]	[illegible]	[illegible]	[illegible]

Cap. Mfd.	Wkg. Volts	Mfr. Leg.	Price Each
STYLE "C" CONDENSERS			
.000025	2500	4	$0.40
.00005	600	7,8	.30
.0001	600	2,7	.25
.0001	1200	7	.30
.0001	2500	4,7,8	.30
.0002	600	2,7,8	.25
.0002	2500	7	.40
.00022	2500	4	.40
.00024	2500	7,8	.45
.00025	2500	2	.45
.0003	2500	7	.45
.00039	2500	7	.50
.0004	600	7,9	.30
.0004	2500	2,7,9	.45
.0005	600	1,7	.35
.0005	1200	2,7	.40
.0005	2500	1,8	.45
.00056	1200	7	.40
[illegible]	[illegible]	[illegible]	[illegible]

Cap. Mfd.	Wkg. Volts	Mfr. Leg.	Price Each
STYLE "D" CONDENSERS			
.00005	1200	7	$0.25
.0001	600	7	.20
.0001	1200	2,8	.20
.00015	1200	1,7,9	.25
.00015	2500	2,8,6	.30
.0001	600	9	.20
.0001	1200	7,8	.25
.00015	600	8	.20
.00015	2500	2,8	.35
.0002	1200	2,7	.30
.0002	2500	9	.35
.00024	2500	8	.35
.00025	1200	8,8	.25
.00025	2500	8,8	.35
.0003	600	2	.25
.0005	1200	7	.30
.0005	2500	1,8	.40
.00051	2500	1	.35
[illegible]	[illegible]	[illegible]	[illegible]
STYLE "E" CONDENSERS			
[illegible]	[illegible]	[illegible]	[illegible]

METAL DRAWN PAPER CAPACITORS

STOCK NO.	CAPACITY MFG.	DCW VOLTS	NO. OF LEADS & LOCATION	FIG.	MANUFACTURER'S NAME & PART NO.	UNIT PRICE
335-14	.05	400	2 SIDE	A	POTTER P-1017	$0.30
347-28	.05	600	1 SIDE	A	POTTER CO-503B	.25
347-10	.05	600	2 SIDE	A	MICAMOLD - SPRAGUE	.25
335-30	.1	200	1 SIDE	A	MICAMOLD	.25
407-19	.1	600	2 TOP	A	BELMONT A-BB-4606	.35
407-38	.1	600	2 SIDE	A	INDUSTRIAL SPRAGUE C.D.	.35
335-7	.1	600	2 TOP	A	AEROVOX 171170	.35
407-12	.1	1000	2 SIDE	A	INDUSTRIAL	.55
335-3	.2	400	2 TOP	A	SOLAR 179330	.30
335-8	.2	600	2 TOP	A	SPRAGUE 195216	.35
347-4	.25	330AC	2 SIDE	C	AEROVOX 25 B 00-2	.35
335-15	.25	330AC	2 SIDE	C	SPRAGUE AEROVOX	.35
335-28	.25	400	2 TOP	A	SOLAR 188826	.30
335-31	.25	400	2 SIDE	A	SOLAR 176676	.30
335-2	.25	400	2 SIDE	A	AEROVOX 25 1249-3	.30
407-16	.25	400	1 SIDE	A	AEROVOX	.30
347-3	.25	400	2 SIDE	A	AEROVOX 25 1249-3	.30
449-2	.25	600	2 TOP	A	SPRAGUE 85491	.35
333-41	.25	600	2 TOP	A	C.D. DYRT6026	.35
335-29	.3	400	2 TOP	A	SOLAR 209165	.30
335-64	.35	400	2 BOTTOM	A	MICAMOLD	.35
335-61	.5	120	2 TOP	A	POTTER CD-504N	.25
347-17	.5	200	2 SIDE	A	MICAMOLD 10497	.30
335-11	.5	400	2 SIDE	A	SOLAR BR-105024-2	.30
347-6	.5	400	2 SIDE	A	SIG. C. TYPE CA-177A	.30
407-15	.5	400	2 SIDE	A	FAST	.30
407-18	.5	400	2 TOP	A	SPRAGUE GUDEMAN	.30
335-8	.5	600	2 SIDE	A	SOLAR 174171	.35
335-4	.5	600	2 TOP	A	C.D. 177400	.35
335-13	.5	600	2 TOP	A	SOLAR	.35
335-63	.5	600	2 SIDE	A	C.D.	.35
347-14	.5	600	2 BOTTOM	A	C.D. DYRB-6050	.35
333-43	.5	600	2 BOTTOM	A	SPRAGUE 300447-3	.35
407-24	.5	1000	2 TOP	B	GUDEMAN 75 17-TN	.65
335-83	1	400	2 SIDE	B	SPRAGUE	.35
407-14	1	600	2 SIDE	B	MICAMOLD	.45
333-45	1	600	2 SIDE	B	SPRAGUE	.45
407-21	1	600	2 SIDE	B	SPRAGUE MICAMOLD	.48
336-48	1	600	2 END	D	AEROVOX	.48
335-58	1	1000	2 SIDE	B	C.D. DYR10100G	.70
347-39	1.25	100	2 SIDE	C	ELEC. UTILITIES CO-126	.35
347-21	1.25	100	2 SIDE	C	GUDEMAN CO-225	.35
336-68	2	600	2 BOTTOM	B	SPRAGUE	.40
333-42	2	600	2 SIDE	B	C.D. DYR-6200	.40
335-32	4	50	2 SIDE	A	C.D. SPRAGUE	.35
347-1	4	60	1 SIDE	B	AEROVOX C-60933	.35
347-27	4	60	2 SIDE	B	C.D. CA-275	.35
407-8	20	25	2 SIDE	A	INDUSTRIAL	.40
407-35	20	50	2 SIDE	A	SPRAGUE	.48
338-45	25	25	2 SIDE	A	AMER. COND. 5068	.40
449-3	25	40	2 BOTTOM	D	CD-2469	.45
347-43	25	50	1 SIDE	A	SPRAGUE D9260	.45
407-13	40	35	2 SIDE	A	MICAMOLD	.40
347-42	50	25	1 TOP	A	C. D. 680308-4	.48
335-40	2 x .1	100	3 SIDE	B	POTTER BR-108027-5	.25
336-63	2 x .1	200	2 BOTTOM	A	CSI-1576	.25
347-7	2 x .1	200	2 SIDE	A	POTTER CP-208	.25
347-M	2 x .1	300	3 TOP	D	SOLAR SJ-382	.30
407-30	2 x .1	400	3 SIDE	A	SPRAGUE PB-6161-1	.35
333-44	2 x .1	400	3 TOP	A	SPRAGUE A-4616	.35
335-35	2 x .1	600	3 TOP	A	C. D.	.40
407-17	2 x .1	600	3 SIDE	A	C. D. - SPRAGUE	.40
407-36	2 x .1	600	3 BOTTOM	A	AEROVOX 630MB	.40
335-1	2 x .25	400	4 BOTTOM	B	#174060	.30
449-1	2 x .25	400	3 SIDE	A	ELEC. UTIL. C-364B	.30
347-8	2 x .5	100	3 TOP	A	AEROVOX A-108504	.25
335-55	2 x .5	400	2 BOTTOM	D	C. D. 1575	.35
407-4	2 x .5	400	3 SIDE	B	SOLAR - SPRAGUE	.35
335-43	2 x .5	600	3 SIDE	B	SPRAGUE P-9727	.40
407-31	.1 & .5	400	3 TOP	C	SPRAGUE PB-61613-1	.35
347-30	1 & .1	300	3 TOP	D	SPRAGUE P-3062	.35
347-18	3 x .1	200	3 SIDE	A	POTTER CP-304C	.30
335-21	3 x .1	400	3 TOP	A	C. D. AB 096	.35
335-26	3 x .1	400	3 SIDE	A	AEROVOX - SPRAGUE	.35
335-23	3 x .1	600	3 SIDE	A	FAST	.40
335-12	3 x .1	600	3 TOP	A	C. D. - SOLAR	.45
335-42	3 x .1	600	3 SIDE	A	SPRAGUE P-9728	.45
335-44	3 x .1	600	3 BOTTOM	A	SPRAGUE - SOLAR	.48
335-27	.1	600	4 BOTTOM	B	SOLAR	.35
	.5	200				
	.2	200				

FIG. A

FIG. B

FIG. C

FIG. D

TUBES *Guaranteed by* WELLS

IMMEDIATE DELIVERY AT LOWEST PRICES IN OUR HISTORY

Check this list for exceptional values in magnetrons, cathode ray tubes, voltage regulators, transmitting tubes—also neon, pilot and flashlight bulbs. These are brand new, standard make tubes. Order enough for future needs directly from this ad or through your local parts jobber.

01A	$0.45	6SF5	.65	VT-127A	2.95	714AY	9.95	878	2.15
1B22	4.35	6SG7	.70	VR-150	.55	RK715B	7.95	930	2.20
1N21 Xtal Diode	.65	6SH7	.40	VT-158	8.85	717A	.90	954	.56
1N21B Xtal Diode	.80	6SJ7GT	.65	FG-172	29.50	721A	3.95	955	.55
1N23 Xtal Diode	.85	6SK7GT	.65	205B	1.95	724A	4.65	956	.55
1N23A Xtal Diode	.85	6SL7GT	.65	211 (VT-4-C)	.60	724B	4.25	957	.65
1N27 Xtal Diode	.95	6SN7GT	.80	215A	1.95	725A	19.95	991 (NE-16)	.55
1R4/1294	.45	6SQ7GT	.60	231D	1.30	726A	19.95	1005	.35
1R5	.95	7A4	.65	282B	4.25	730A	11.95	1148	.40
1S5	.95	7A7	.65	304TH	5.95	801	.60	1201	.75
1S21	1.10	7C4/1203	.65	304TL	.75	801A	.75	1616	1.75
1T4	.55	7E5	.65	307A	.65	803	6.95	1619	.55
2C26	.35	7E6	.65	316A	.75	804	9.95	1621	1.25
2C26A	.45	7F7	.75	350B	2.55	805	5.45	1622	.65
2C34	.35	7H7	.75	371B	.85	807	1.75	1626	.45
2J21A	11.45	7N7	.75	388A	.75	809	2.75	1629	.45
2J22	9.85	7Q7	.65	417A	19.95	810	7.95	1635	.95
2J26	14.45	10Y/VT-25A	.40	431A	7.45	811	2.35	2051	.60
2J27	14.45	10Y/VT-25	.45	446A	1.55	813	7.85	7193	.45
2J31	9.95	12A6	.45	450TH	19.95	814	3.75	8011	2.55
2J32	14.85	12K8	.65	GL-471A	2.75	815	2.85	8012	4.25
2J33	15.95	12SF7	.70	527	11.28	826	.55	8020	3.35
2J37	13.85	12SH7	.40	WL-530	17.50	830B	3.25	8025	7.50
2J38	12.95	12SL7GT	.60	WL-531	17.50	837	3.95	9001	.70
2J48	14.95	12SN7GT	.70	532A 1B32	3.55	838	1.75	9002	.60
2X2 879	.65	12SR7	.60	GL-559	2.75	841	3.25	9003	.45
3A4	.35	12A25 2 amp Tungar	2.25	KU-610	3.25	843	.55	9004	.45
3A5	1.05	13-4 Ballast	1.40	HY-615	1.20	845	.55	9006	.45
3AP1 CRT	3.85	15R	2.85	700B	2.50	851	39.50		
3B22	2.95	FG-17	3.25	700C	9.95	WL-860	2.50		
3B24	1.75	RK1-21	.75	700D	9.95	861	32.50		
3BP1 CRT	3.75	22C4 Ballast	.65	702A	2.95	864	.55		
3CP1-S1	1.95	25Z6 GT	.55	703A	3.95	865	2.55		
3C24 24G	.47	2X2	.60	705A	2.65	866A	1.30		
3D6/1299	.45			706BY	19.50	869	26.50		
3FP7 CRT	2.95	30 VT-67 (For Walkie Talkie)	.75	707A	23.25	869B	28.95		
3HP7 CRT	2.95			707B	29.95	872A	2.45		
3GP1 CRT	3.75	33 VT-33 (For Walkie Talkie)	.75	713A	1.58	874	2.15		
3Q5	.95	RK-34	.45						
REL-5	17.95	34	.35						
5AP1 CRT	3.95	39/44	.35						
5BP1 CRT	2.95	45 Spec.	.55						
5CP1 CRT	3.85	46	.75						
5GP1 CRT	6.55	EF50 VT250	.45						
5J23	14.25	CRO 72	1.10						
5J29	14.25	72 3D24	1.75						
5Y3G	.40	VR-75	.90						
6A6	.90	75	.55						
6AB7	.75	VR-78	.65						
6AC7	.90	80	.50						
6AK6	.90	FG-81-A	3.95						
6B7	.65	83	.85						
6BE6	.65	83V	.85						
6C4	.45	89Y	.60						
6C6	.75	VR-90	.70						
6C21	19.75	VR-92	.60						
6D6	.60	100R	2.25						
6E5	.70	FG-105	9.95						
6H6	.50	VR-105	.85						
6J5GT	.50	VU-111	.65						
6J6	.60	117Z3	.50						
6N7GT	.80	VT-127 English	.25						
6R7G	.80								

NEON BULBS FOR RADIO USE

NE-2	$0.06
NE-15	.06
NE-16	.24
NE-20	.06
NE-21	.24
NE-48	.24
NE-51	.06

PILOT AND FLASHLIGHT BULBS

[illegible]	[illegible]

10% DISCOUNT ON ORDERS OF $100.00 OR OVER

Brand new, complete catalog for Manufacturers, Distributors and Amateurs now ready. Write for your copy today.

Manufacturers: We carry thousands of electronic parts in stock. Send us your requests for quotation.

Distributors: Our standard jobber arrangement applies. Order directly from this ad.

WELLS SALES, INC.

320 N. LA SALLE ST., DEPT. Y-12, CHICAGO 10, ILL.

PRINTED IN THE U. S. A. BY THE CUNEO PRESS, INC.

YOU Need My PRACTICAL Training to Make Money in TELEVISION-RADIO and ELECTRONICS!

I'll Send You
8 BIG KITS of
Radio Parts and Equipment . . .

Learn at **HOME** IN YOUR SPARE TIME

NOW IS THE TIME To Get Into This Fast Growing Industry—Prepare For A Fine Paying Job Or Your Own Business!

If you want to get into Radio-Television and Electronics . . . you owe it to yourself to get the facts about my training. I have trained hundreds of men to become outstanding service technicians—and I'm ready to do the same for you. Whether your goal is a fine paying job in one of Radio's many branches—or a successful Radio and Television business of your own—*you need the kind of training I offer!* My training is practical and down to earth. YOU NEED NO PREVIOUS EXPERIENCE. You'll be astonished at your rapid progress. I start you with basic fundamentals and give you plenty of practical shop-bench training with many kits of parts I send you. This is the training that sticks with you and makes money for you on the job!

Get Paid For Spare Time While Learning

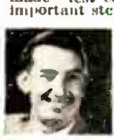
Soon after you start training I send you my famous BUSINESS BUILDERS that show you how to make money in spare time doing interesting Radio jobs. Look at the useful and valuable equipment you get while training with me (illustrated at left)—I send you these 8 big kits of Radio parts and equipment and help you build step-by-step a powerful 6-tube superhet radio, a 16-range test meter, plus other mighty useful equipment for Radio and Television servicing. You will perform over 175 fascinating experiments while training. You will learn about Television—so that you will be qualified to step into this fast growing, profitable field. I also send you many valuable service manuals, diagrams and my book telling exactly how to set up your own Television and Radio shop. *I want you to learn all about my training*—and that is why I urge you to clip and mail the coupon below for my two big FREE Radio books. I employ no salesmen—and nobody will call on you. The important thing is to act now and get the facts.

HAVE A BUSINESS OF YOUR OWN

A profitable Radio and Television Service Shop may be started with little capital. I will show you how to get started and how to build your small business. At left is pictured one of my graduates, Mr. Merrit C. Sperry of Fairmont, Minnesota in his own shop. The way is also open for you to build a good SERVICE BUSINESS FOR YOURSELF.

ALL KITS ARE YOURS TO KEEP

Each of the hundreds of Radio parts and other items I send my students is theirs "for keeps." You may use this equipment in your Radio and Television service work and save many dollars by not having to buy expensive "ready-made" test equipment. Each of my 8 kits will help you advance and learn important steps in Radio and Television servicing.



CALVIN SKINNER of New Orleans, La. tells us he makes $5 to $10 in spare time repairing radios. He is now also working with his own Television set.

LOREN D. SAUCIER of Coloma, Mich. reports that my training has made it possible for him to repair large numbers of Radio and Television receivers.

RADIO AND TELEVISION INDUSTRY BOOMING

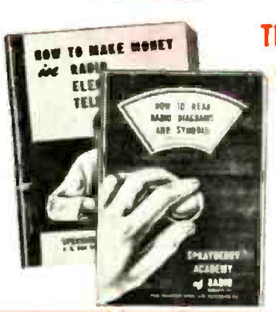
You couldn't pick a better time to get into Radio-Television and Electronics. New Television stations are going on the air to serve every major city—hundreds of new AM and FM Radio broadcasting stations are also on the air to serve practically every community in America. All this creates new and bigger opportunities for the trained man who knows Radio-Television and Electronics. Good Radio and Television service men are needed NOW!

VETERANS

THIS TRAINING AVAILABLE TO YOU UNDER THE G.I. BILL

My Training Includes:

Radio Servicing
Television
FM Frequency Modulation
Public Address
and **High Frequency Applications**



These Two Big Radio Books **FREE!**

Just mail coupon for a FREE sample Sprayberry Lesson and my big FREE book, "How To Make Money In Radio-Television and Electronics." Learn why my really *practical* training is best of all for you. Discover what's ahead for you in the fast moving Radio-Television and Electronics industry. No obligation. Don't delay—the future is too important to you. Mail the coupon now—and count on me for fast action.

SPRAYBERRY ACADEMY OF RADIO
111 N. CANAL, DEPT. 20-D CHICAGO 6, ILL.

RUSH COUPON *Today!*

SPRAYBERRY ACADEMY of RADIO, Dept. 20-D
111 North Canal St., Chicago 6, Ill.

Please rush my FREE copies of "How To Make Money In Radio-Television and Electronics" and "How To Read Radio Diagrams and Symbols."

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

Address..

City.................................State.................

( ) Check here if you are a Veteran.