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OCTOBER, 1949
NEW GLASS for television tube faces produces greater contrast, giving sharp black-and-white pictures in well lighted rooms without need for excessive brightness, Pittsburgh Plate Glass Co. engineers announced last month.

In any television tube, as the drawing shows, light from the bright portions scatters, some travelling straight ahead and some at an angle that it is reflected by the glass surface. Part of this reflected light strikes the dark portions of the phosphor and is reflected again straight ahead, making the dark portions of the picture lighter and weakening the contrast. In ordinary glass, the reflected light is little weaker than the direct beam. The new tube face is made of a special light-absorbing glass, which acts as a filter. The reflected-light paths are more than three times as long as that of the direct beam. Thus undesirable reflected light is attenuated to an extent which makes the increase in contrast impressive to even the most casual looker-on.

Since the tube face is itself a filter, it reduces the effect of room light. The result is a more natural, easy-to-see picture that can be viewed without eyestrain, Pittsburgh Plate Glass engineers believe. Television receivers with the new glass tube faces have been featured by Zenith and it was expected that they would soon be adopted by other manufacturers.

HAM CONVENTION termed the “biggest show in amateur radio” will be held in New York City October 7, 8, and 9 by the Hudson Division of the ARRL. Features for all classes of amateurs have been planned, with particular emphasis on the younger generation with a “how to get started” theme. The show and convention will be held at the Ninth Regiment Armory.

SYMPOSIUM on electronic instrumentation in nucleonics and medicine will be held at New York’s Hotel Commodore on October 31, November 1 and 2. This second annual conference on the subject will be sponsored jointly by the Institute of Radio Engineers and the American Institute of Electrical Engineers. The first day will be devoted to electronics in medicine, the second to nucleonics in medicine, and the third to the physical aspects of nucleonics instrumentation.

TV PROJECTION systems are kindest to the eyes, according to last month’s journal of the New York State Optometric Association. The statement followed a study of the Philips Protegrum system. A projection system was said to cause less eyestrain because of the larger image, need less eye accommodation for close viewing, and give the visual advantage of a softer image of photographic quality on an optically correct screen.

TV SERVICE CALLS should be paid for at a nominal rate after the 90-day manufacturer’s warranty on the receiver expires, according to Television Manufacturers Association. Michael L. Kaplan, president of TMA and of Sightmaster Corp., announced last month that because of the New York State Attorney General’s statement that some service contracts infringe on the insurance domain (see page 9, September issue), TMA is redoubling its efforts to arrive at a standardized per-service-call fee.

TMA is conducting a survey of manufacturers and service organizations to determine a standard agreement satisfactory to all. The fee for service calls would eliminate the insurance aspect of the business, the Association says, and would best serve the public, since most major troubles appear during the 90-day warranty period.

AUDIO FAIR will be held at the Hotel New Yorker in New York City October 27, 28, and 29. Sponsored by the Audio Engineering Society, the Fair will show audio products of leading manufacturers and will include technical sessions on each of the three days. The subjects of recording—tape, disc, and film—and microphones, loudspeakers, and amplifiers will be covered. A banquet is planned for the 27th.

PREVENTIVE MAINTENANCE will be the theme of Pennsylvania’s radio service technicians throughout the month of October. Heralded by the Philadelphia radio technician’s convention September 18, 19, and 20, Preventive Maintenance Month will be dedicated to the task of showing the radio owner the advantages of having his radio looked after before instead of after it breaks down.

An intensive campaign of advertising by direct mail, newspapers and radio will be carried on by the organized radio technicians, with the cooperation of components and tube manufacturers, the association of manufacturers’ representatives, many of the broadcast stations, and the parts distributors of the state.

Experience gained in the Harrisburg area, last year, indicates that a Preventive Maintenance Month can increase the prestige of the radio service technicians, obtain a great deal of additional business, and increase the actual number of operating radio receivers as much as 25%.
The landlord, ruled TV brought permission to leave. Valuable phrases are dangerous to health, the Atomic Energy Project at UCLA reported last month. The brushes, consisting of ordinary bristles with a strip of polonium-impregnated material fastened to the ferrule, neutralize the attraction of the plastic for dust by emitting alpha rays. They are widely used in industry to drain the static from fast-moving machinery and especially from nonconductive surfaces, such as the speeding paper in a printing press.

The alpha rays do not penetrate the skin, but microscopic flecks of the metal or foil on which the polonium is carried are released into the air. If these are inhaled or carried to the mouth by the hands, a sickness similar to radium poisoning may result.

Dr. Fred A. Bryan, dean of the UCLA medical school, said in an interview for the New York Times that even cautious users of the record brushes and other similar products using polonium would be likely to ingest some of the radioactive flakes.

Radio Month Briefs

Color television experiments have been authorized for two more stations, WMAR-TV, Baltimore, and WCBS-TV, New York, by the FCC. Theatre television channels were requested of the FCC last month by the Motion Picture Association of America. End of sound radio in three or four years was predicted last month by Henry L. Pierce, sales manager for Sparton Radio-Television. New York television dealers formed an association last month called Television Dealers Association of New York for the primary purpose of stabilizing receiver prices by enforcing the "fair-trade" laws.

The 54-channel allocation plan proposed by FCC for television stations could accommodate approximately 2,245 stations compared with a possible 400 under the present setup. Ban on rooftop television antennas imposed in Washington, D. C., by the director of the National Capital Housing Authority for public housing projects was decried by Washington receiver dealers as discriminatory. Reply of the Authority was that antennas may injure the house and "certainly are not good looking."

Television Technicians Lecture Bureau held its first lecture on September 11 in Rochester, N. Y. The bureau brings technical training to technicians, by whom paid admissions is it supported. Lecturers are not industry representatives but trained educators without commercial affiliation. The proposed program of lectures is countrywide. The Bureau, which was organized by Paul Wendel and Al Saunders, both well known in the field of radio technical literature, has its headquarters in Chicago, and has a large schedule of lectures already booked for the fall and early winter.

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Radio Business

The Sprayerby Academy of Radio has moved to Chicago. The move had been planned by Frank L. Sprayberry, president, for some time because of the increasing importance of Chicago as a television and radio development and manufacturing center. Mr. Sprayberry believes he will be able to serve his students much more effectively because he will be able to include the newest developments into his training.

American Television, Inc., Chicago, put their first television sets on the market late in August. The line, known as "Home Theatre" television receivers, includes all popular direct-view sizes and modern design.

Radio Corporation of America has issued a consolidated statement of income for the second quarter of 1949 and the first six months of the year, with comparative figures for the corresponding periods of 1948, announced Budaider General Manager, Sarnoff, chairman of the board.

Total gross income from all sources amounted to $187,257,987 in the first half of 1949, compared with $176,079,713 in the same period of 1948, an increase of $11,178,274.

Net income, after all charges and taxes, was $10,122,049 for the first six months of 1949, compared with $10,850,288 in 1948, a decrease of $728,239.

After payment of preferred dividends, net earnings applicable to the common stock for the six month period of 1949 were $1.6g per share, compared with 68.8¢ per share in the first half of 1948.

Howard W. Sams & Co., Inc., Indianapolis, publishers of electronic technical manuals and books, have declared the regular semi-annual dividend of $2.50 per share on its 5% cumulative preferred stock.

Payable to stockholders of record June 27, this dividend covers the first six-month period of 1949 and represents the fourth consecutive semi-annual dividend on cumulative preferred stock of the three-year-old organization. The company's balance sheet as of June 30, as prepared by company officers, shows total assets of $287,757,666, with a net earned surplus of $46,591.

Sylvania Electric Products, Inc., consolidated net income for the second quarter of 1949 was $378,252, equal to 19¢ per share on the 1,456,550 shares of common stock outstanding, after deducting dividends of $1 per share on the $4 cumulative preferred stock. This company with consolidated net income of $948,565, equal to 84¢ per share, earned on the 1,066,550 shares of common stock in the second quarter of 1948. For the six months ended June 30, 1949, company earnings of $1.01 per share based on the average number of shares (1,343,290) outstanding during the period compare with earnings of $1.90 per share for the six months ended June 30, 1948.

Second-quarter net sales of $22,556,653 compare with sales of $23,662,547 for the second quarter of 1948. For the six months ended June 30, 1949, sales were $49,655,546, compared with sales of $48,210,076 for the same period ended June 30, 1948, an increase of 3%.

Motorola, Inc., Chicago, retaining a new peacet ime sales record for the six month period ended July 2, 1949, provided net earnings of $1,908,256.96, equal to $2.39 per share, it was announced by Paul V. Galvin, president. This compares with earnings for the corresponding period last year of $1,650,039.82, which is equal to $2.06 per share.

Andrea Radio Corp., manufacturers of television receivers, reports a 73% increase in sales for the period of January 1-May 31 of this year, over the corresponding period of 1948. In addition to this sales increase, Frank A. D. Andrea, president of the company, reports a corresponding increase in net profits for the January-to-May period of this year.

Admiral Corp., Chicago, in a mid-year earnings statement to stockholders, reported that sales and earnings for the first six months of this year hit an all-time high.

Sales for the second quarter of 1949 were $29,607,308 as against $15,682,176 for 1948, an increase of $14,215,132 or 92%. Net earnings were $1,619,472 as against $706,887, an increase of $912,585 or 129%.

Sales for the six months ending June 30 were shown at $53,110,405 as against $27,386,344, an increase of $25,724,061 or 94%. Net earnings were $3,155,689 as against $1,237,297 or an increase of 155%.

Earnings per share (on 1,000,000 shares outstanding) for the first half of 1949 were $3.16 as compared with $1.24 for last year's first half or an increase of $1.92.

Intra-Video, Inc., New York, will manufacture master radio antenna systems for apartment houses, hotels, and department stores. Last December at the convention of the Television Broadcasting Association, their antenna system was used to demonstrate the sets put on display by the television manufacturers.

Westinghouse Electric Corp., Sunbury, Pa., as a price-protection policy, announced that factory list prices on all current television receivers were guaranteed for all dealers and distributors.

The plan, retrospective to July 1, will protect dealers and distributors from loss on any television inventory purchased within a 60-day period prior to price readjustment. The policy has been put into effect because of an increasing trend toward indiscriminate price slashing in the "hotly competitive" television industry, F. M. Sloan, division manager, said.

Motorola, Inc., added 1,000 employees to its payroll for the 1949 fall season. This brings its payroll to more than 4,500, highest employment level in the company's history, according to Paul Galvin, president.
New Training Offer!
NOW you build and keep a top quality TELEVISION RECEIVER to help you prepare for a real job in TELEVISION RADIO-ELECTRONICS.

Choice of 10, 12 or 16 INCH TELEVISION 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, 12 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.

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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!

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Here's a big, complete book that gives you step-by-step instructions for using the oscilloscope in testing and servicing radio receivers, audio amplifiers and transmitters.

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New 1950 Heathkit

PUSH-PULL EXTENDED RANGE 5" OSCILLOSCOPE KIT

Features

- The first truly television oscilloscope.
- Tremendous sensitivity -0.6 Volt RMS per inch deflection.
- Push-pull vertical and horizontal amplifiers.
- Useful frequency range to 7.5 Megacycles.
- Extended sweep range 15 cycles to 70,000 cycles.
- New television type multivibrator sweep generator.
- New magnetic alloy shield included.
- Still the amazing price of $39.50.

The new 1950 Push-Pull 5" Oscilloscope has features that seem impossible in a $39.50 oscilloscope. Think of it—push-pull vertical and horizontal amplifiers with tremendous sensitivity only six one-hundredths of a volt required for full inch of deflection. The weak impulses of television can be boosted to full size on the five inch screen. Traces you couldn't see before. Amazing frequency range clear useful response at 7.5 Megacycles possible by improved push-pull amplifiers. Only Heathkit Oscilloscopes have the frequency range required for television. New type multivibrator sweep generator with more than twice the frequency range. 15 cycles to 70,000 cycles will actually synchronize with 250,000 cycle signal. Dual positioning controls will move trace over any section of the screen for observation of any part. New magnetic alloy CR tube shield protects the instrument from outside fields. All the same high quality parts, case, electronics, shielding power transformer, aluminum case, all tubes and parts. New instruction manual now has complete step by step pictorials for easiest assembly. Shipping Weight 30 lbs. Order now for this winter's use.

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

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MORE Features THAN EVER BEFORE

- Beautiful chromium Bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjust control.
- 400 Microampere meter movement.
- Quality Bradley AC rectifier.
- Multiplying type ohms ranges.
- All the convenient ranges 10-30-300-1,000-5,000 Volts.
- Large quality 2" bulb in meter.
- Easy pictorial wiring diagrams eliminate all assembly problems. Uses only 1% precision ceramic divider resistors and wire wound shunts. Twelve different ranges. AC and DC ranges of 10-30-300-1,000-5,000 Volts. Ohms ranges of 0-3,000 ohms and 0-300,000 ohms. Milliampere ranges of 10MA and 100MA. Hearing aid type ohms adjust control fits conveniently under thumb for one hand adjustment. Banana type jacks for positive low resistance connections. Quality test leads included. The high quality Bradley instrument rectifier was especially chosen for linear scales on AC. The modern case was styled by Harrah Engineering for this instrument. The 400 microampere meter movement comes already mounted in the case protected from dust during assembly. An ideal classroom assembly instrument useful for a lifetime. Perfect for radio service, cars, elcetricals, garage mechanics, students, amateurs and beginners in radio. The only quality voltmeter under $20.00. An hour of assembly saves you one-half the cost and quality parts give you a better instrument. Order today. Shipping weight 2 lbs.

$39.50

$13.50

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BENTON HARBOR 20, MICHIGAN

OCTOBER, 1949

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A LABORATORY INSTRUMENT NOW WITHIN THE PRICE RANGE OF ALL

Measures Inductance from 10 microhens 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 experimenters.

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimenters 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 ¼" centers. Beautiful birch cabinet. Directly calibrated "Q" and dissipation factor scales.

Ready calibrated capacity and inductance standards of Silver Nica, accurate to ½ of 1% and with dissipation factors of less than 50 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

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

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TEST PROBE KIT
No. 310. Extends range of any 11 megohm VTM to 3,000 and 10,000 Volt ranges. A necessity for television. Shipping Wt., 1 lb. .... $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., 5 lbs. .... $8.50

New Heathkit

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GENERATOR KIT

Everything you want in a television alignment generator. A wide band sweep generator covering all FM and TV frequencies 0 - 110 and 165 to 220 Megacycles, a marker indicator covering 19 to 43 Megacycles, AM modulation for RF alignment — variable calibrated sweep width 0 - 30 Mc. — mechanical driven inductive sweep. Husky 110v. 60 cycle power transformer operated — step type output attenuator with 10,000 to 1 range — high output on all ranges — bandswitching for each range — vernier driven main calibrated dial with over 45 inches of calibration — vernier driven calibrated indicator marker tuning. Large grey crackle cabinet 16½"x10½"x7-½". Phase control for single trace adjustments. Uses four high frequency triodes plus 5Y3 rectifier — split statom 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, rectifier, leads — every part with instruction manual for assembly and use. Actually three instruments in one — TV alignment generator — TV AM generator and TV marker indicator. Also covers FM band.

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Now a complete tool kit to assemble your Heathkit. Consists of Kruzer diagonal cutters and pointed nose assembly pliers, Xcelite screwdriver, 60 Watt 110v. soldering iron and supply of solder. Shipping Wt., 3 lbs. Complete kit .... $5.95
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 shutterproof full view meter
8. Large size 11" x 14" x 4" complete
9. Checks new 9 pin miniatures

Check the features and you will realize that this Heathkit has all the features you want. Speed—simplicity—beauty—protection against adolescence. The modern type of tester—measures each element beautifully. 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 combination 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 1/2 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 chair—ready to wire up and operate. Shipping Wt., 15 lbs.

HEATHKITS...

SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Nothing ELSE TO BUY

$34.50

Experimenters and servicemen working with square waves 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, cut 110V, 60 cycle power transformers, Mallory F.P. filter condensers, 3 tubes, calibrated 2 color panel, easy-crank 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

The Heathkit Battery Eliminator Kit combines reliability, simplicity, and economy in a basic, complete power supply. The kit utilizes a 6 Volt 7 1/2 Amp power supply for auto radio testing, headphone testing, etc. It delivers more than 50W of power. The kit includes all necessary parts and accessories to construct the unit. 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 intermittent—defective parts quickly—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.

The HEATH COMPANY
BENTON HARBOR 20, MICHIGAN

OCTOBER, 1949
The NEW 1950 Heathkit VACUUM TUBE VOLTME hello 1950 Heathkit 1950 Features

- New 200 microammeter meter.
- Uses 1% precision ceramic divider resistors.
- Burn-out proof meter circuit.
- 24 complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory probe (extra) extend ranges to 10,000 Volts and 150 Megacycles.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.

A new Model V2 Heathkit VTVM with new 200 microammeter four additional ranges—full scale linear ranges on both AC and DC of 0-3 V., 10 V., 30 V., 100 V., 300 V., and 1,000 V. Accessory probe listed elsewhere in ad extends voltage range to 3,000 and 10,000 volts D.C. New model has greater sensitivity, stability and accuracy—still the highest quality features—shatterproof plastic full view meter face—automatic meter protection, push-pull electronic voltmeter circuit—linear scale—db scale—ohmmeter measures 1/10 ohm to 1 billion ohms with internal battery—isolated DC test prod for dynamic measurements—11 megohm input resistance DC—AC uses electronic rectification with 6N6 tube. All these features and still the amazing price of only $24.50. Comes complete with cabinet—panel—three tubes—new Mallory switches—test prods and leads, 1% ceramic divider resistors and all other parts. Complete instruction manual for assembly and use. Better start your laboratory with this precision instrument. Shipping weight 8 lbs. Model V-2 $24.50

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

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

The most popular signal generator kit has been vastly improved—the experience of thousands combined to give you the best. Check the features in this fine generator and consider the low price $19.50. A best buy for any shop yet inexpensive enough for hobbyists. Everyone can have an accurate calibrated source of R.F. signal voltage. The new features double the value—think of being able to make fidelity checks on receivers by inserting a variable audio signal. Internal 400 cycle saw-tooth audio oscillator modulates R.F. signal and is available externally for audio testing. The new 5 to 1 ratio vernier drive gives linear tuning for maximum accuracy in scale settings. The coils are already precision wound and calibrated. Uses turret type coil and switch assembly for ease of construction. The generator is 110 V. 60 cycle transformer operated and comes complete in every detail—cabinet—tube—cabinet—beautiful two color calibrated panel and all small parts—step-by-step pictorial diagrams and complete instruction manual make assembly a cinch even for novices. Why try to get along without a signal generator when you can have the best for less than a twenty dollar bill! Better order it now. Shipping weight 7 lbs. $19.50 CONVERSION KIT FOR G-1 GENERATORS Conversion kit for G-1 generators for vernier tuning and external modulation includes new high band coil for greater output. Gives all the features of new G-5 listed above. Order G-5 Conversion Kit No. 316 $4.50

The HEATH COMPANY •...BENTON HARBOR 20, MICHIGAN

RADIO-ELECTRONICS for
An electronic switch used with any oscilloscope provides two separately controllable traces on the screen. Each trace is controlled independently and the position of the traces may be varied. The input and output traces of an amplifier may be observed one beside the other or one directly over the other illustrating perfectly any change occurring in the amplifier. Distortion — phase shift and other defects show up instantly, 110V. 60 cycle transformer operated. Uses 5 tubes (1 6X5, 2 6SN7’s, 2 6J7’s). Has individual gain controls, positioning control and coarse and fine sweeping rate controls. The cabinet and panel match all other Heathkits. Every part supplied including detailed instructions for assembly and use. Shipping Wt., 11 lbs.

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

Build this high fidelity amplifier and save two-thirds of the cost. 110V, 60 cy. transformer operated. Push pull output using 1619 tubes. (Military type 6L6-3)., two amplifier stages using a dual triode (68L7), as a phase inverter give this amplifier a linear reproduction equal to amplifiers selling for ten times this price. Every part supplied: punched and formed chassis, transformers (including quality output to 3-8 ohm voice coil), tubes, controls, and complete instructions. Add postage for 20 lbs. 12” PM Speakers for above...$5.95
Mahogany Speaker Cabinet,...$8.75
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"Thanks for the Application for Employment you recently prepared for me. I found satisfactory employment. I submitted 57 letters, enclosing the resume you supplied. I received 17 letters indicating my application was filed for future reference; 3 telephone calls, and one letter requesting personal interviews." Student No. 4235 NB

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ELECTRONIC MAGIC

...Electronics—now man's most versatile tool...

By HUGO GERNSBACK

As each year passes it becomes more apparent that electronics is more versatile than any tool previously known to man. Electronics today reaches into practically every manufacturing process. Every industry can benefit from it.

From A to Z—from Atomics to Zymology (science of fermentation)—electronics plays a vital and leading part today. Yet, we are only at the earliest beginning. How far electronics will penetrate no living man can foresee.

Here are only a few random suggestions as to fields in which electronic research will pay big dividends in the future:

HYDROLOGY*. Underground streams, hidden minerals, and petroleum among other things, have been investigated electronically by engineers. These methods are becoming increasingly popular.

Yet, many of these methods are expensive, not only because of the necessary apparatus, but also in human labor, often requiring from three to ten men. There is no denying that the dowsor with his forked hazel stick has, in the past, achieved success. These so-called divining rods have had too many striking successes to their credit in the past to be dismissed as black magic or fraud. As far as we know, the dowsor has never been investigated electronically. If there is something in the human animal which, by means of a forked stick, can find hidden water, minerals, or oil, electronics should be able to do it much better with some simple machine or apparatus paralleling the Geiger counter now used to discover uranium.

It takes a bit of courage for an engineer to undertake this. Scientists have always looked with great skepticism on the divining rod. Yet it is certain that someone will in the not too distant future discover the actual mechanics of dowisg. It will be a highly profitable discovery.

PATEIOLOGY (the science of food—from the Greek patasthai = to eat). I suggest this new term because there is no inclusive scientific word so far to describe the science of food, cooking, etc. A tremendous amount of work remains to be done in the growing of food, and much more in its preparation. There is entirely too much spoilage and far too great a divergence in final results when two different cooks, even good ones, prepare identical foods. Identical steaks or roasts cooked by two chefs with the same ingredients and under parallel conditions will show considerable taste variety. Electronics can do the cooking automatically. Recently such attempts have been made. We all know of the radar range which cooks foods from the inside out and cuts off the electronic heat automatically when the roast or potatoes are cooked or boiled correctly. But much more work remains to be done here, because the radar range is not suited for many foods, such as stews, pies, etc. Much electronic research is needed in the aging processes of foods and beverages such as champagnes and wines, as well as liquors and cheeses and other similar foods.

Over a century ago in Germany, lightning struck a barrel of wine. It did not destroy the cask, however, and the owner was astonished that the green wine had been aged perfectly. From that time on inventors have occupied themselves with electric aging processes. At first platinum-tipped nails were driven into barrels and attached to a battery which treated the wine or liquors for months at a time. Some success was attained with this method. There are many patents on aging processes today, but the final answer has not been given so far. If more people work on these processes, we may get somewhere and the experimenters may enrich themselves, too.

GERONTOLOGY (the science of aging processes in humans). As people grow older, something happens in their biological processes. Exactly why people age, no one knows. We only see the result in the wrinkled skins, the general sluggishness, and the aging look on faces. Investigators suspect that the aging of the cells plays the important part in these processes. Scientists have already used electronics in an attempt to find the answer. So far it has not been forthcoming.

HORMONOLOGY (science of the human glands) is in a way linked with gerontology. We already know that during aging the body is deprived of certain hormones which it secreted when the body was younger. By feeding these hormones to the aged the body can be rejuvenated to a certain extent. Much remains to be discovered because not all hormones so far can be produced synthetically nor cheaply enough.

To give just one example. Recently sensational advances were made when a new hormone cortisone—the synthetic adrenal gland hormone—was discovered. This is now used with spectacular success in the control of arthritis and rheumatic fever. Unfortunately, it still costs $5,670 an ounce to produce it. Merck and Company, the big chemical firm, announced last month that it is now producing 200 grams a month—a pitifully microscopic amount compared to the needs of millions of sufferers. It seems certain that electronics will play a big role in new processes that must speed up the production, not only of cortisone, but all other hormones badly needed by humanity.

Most of the hormones today are out of reach of the average person because of high costs of production. Electronics may be the answer.

*Term specifically used by U.S. Geological Survey with reference to underground water sources.

October, 1949

www.americanradiohistory.com
Business Methods in Television Servicing

By CHARLES WIGUTOW*

How a successful contractor built a solid business

Any money saved by using cheaper materials.

Television is new. However much of a miracle it is that pictures can be pulled out of the air and be presented in almost anyone’s home, television’s possibilities are still oversold. Service calls for educational purposes, even though no repairs may be required, are costly to the service organization. The responsibility of displaying television to its best advantage rests squarely with the installation men. The reputation of the television set and the company behind it will depend on the manner in which it is first introduced to the customer in his own home by these men. Enough time must be given to the customer to instruct him in the use of his set.

Service calls on every set are inevitable. Twenty-five or thirty tubes are at work in a television set; many of these tubes operate within critical limits at extremely high frequencies. Defects which might not be discernible to the ear if in the audio system become glaringly noticeable to the eye.

There is also the problem of those service calls which can be classified as psychological. Set ownership becomes a matter of bragging to the Joneses. The pictures one receives are constantly compared to the neighbor’s pictures. A tactless technician, regardless of his technical ability, can do a lot of harm to a service organization.

The television set occupies an important position in the family’s leisure life. The whole family from junior to mother and dad finds programs which they follow day by day with undivided...
If you are contemplating doing contract work in the many new television areas which are opening up, our advice is tie up with only the most reliable manufacturers. The reliability of the company for whom you work will build your own reputation. The working relationship between the manufacturer and the service contractor is a close one. This relationship is best expressed in technical cooperation, availability of replacement parts, and suitable payment without kickback arrangements to enable the contractor to do a good complete year's service job on each set it installs.

The next step is to realize that you are actually embarked on an insurance venture. You may receive the full year's money at the time of installation. This sum can be temptingly illusory. Topmost in your mind and books must be the idea that this money must last for one whole year. A service organization that wishes to remain solid must provide its funds. We have arranged an escrow account with our bank in which we deposit all contract payments received by us. This money is withdrawn as we earn it, at the rate of once a month.

The most unfortunate thing that has happened to the television industry has been the business failures among those short-sighted enough to have spent during a comparatively short time all the receipts intended to cover one year's work.

We have tried to eliminate waste in every move we make. Waste in time means that much more bitten off the $35 received for installation and service. Service technicians on the road spending too much time locating addresses and long hauls between customer's homes are wastes to be eliminated. We keep each of our men within one area. They are then able to locate addresses more quickly. The time between calls is cut down, and, more important, they are thoroughly familiar with any specialized reception problems within their own service areas.

Our system of keeping records has been an important factor in keeping down waste. The information called for on our installation form (see figure) immediately tells us the type of antenna used, the size of ladder required, the type of reception of each channel at the time of installation. If we are called for antenna repairs, we have enough information on hand to be sure that the service technician will go out fully equipped for the job.

Our service forms, likewise, are complete with dates and descriptions of failures and work performed. As the work is completed, these forms are filed in their proper alphabetical designations. For alphabetical breakdowns,

### Installation Form

<table>
<thead>
<tr>
<th>ABINGTON TELEVISION SERVICE</th>
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<tr>
<td>224 7th St.</td>
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<tr>
<td>Garden City, N.Y.</td>
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<td>Model</td>
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| Dealer                     |
| Address                   |

| Date Installed             |

| Type of Roof               |
| Type of Mounting           |

| Type of Lead In            |
| No. of Lead In            |
| Hgt. of Mast               |
| Len. of Ladder Rep.       |
| Hgt. of Antenna from Ground |

| Type of Antenna            |
| Supplied By               |

| Quality of Reception (G.F.S.P.) |
| (2) (4) (6) (7) (9) (11) (13) |

| Customer's Signature       |
| Print Last Name            |

| Time Arrived               |
| Time Completed             |

| Service Engineers          |

| Misc. Info.                |

This form, filled out on each TV installation, is an aid if repairs are needed later.

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attention. Should something go wrong with the set, the speed with which the set can be restored to normal operating condition becomes most important. Our men are instructed to make every effort to repair the set in the customer's home. To that end, every man in the field carries some 150 tubes which include every type used in sets under our care.

Many breakdowns necessitate the use of precision test equipment. Such repairs can be made only in our shops. Just as the hospital is better equipped than a traveling doctor to perform operations, or the automobile repair shop is fitted to do work that no itinerant mechanic can hope to do, our shop is elaborately equipped to make the major repairs.

**Engineering needed**

The men in our shop have been thoroughly schooled in every phase of television work. Our shop service manager is forever planning new jigs and setups to make the servicing of chassis a more speedy and convenient process. In every case, these men have been with us from our earliest days. They have installed sets, they have been on the road making service calls, and they have been chosen to work in the shop because of their special ability.

Sets that are repaired do not go out of our shop until they have been set up on the "cooking bench" for at least 4 hours. If any further defects are to show, we want them to show up while the set is still on our premises. We try to keep our store perfect in this respect—as perfect as the nature of television design will allow.

We have had to cope with manufacturers' mistakes in design. We have also had to discover factory modifications for ourselves. There has been an almost universal conspiracy of silence among manufacturers about technical data on their sets. Sometimes we think the enemy must have had an easier time stealing our confidential electronic data than we have in getting ordinary service notes. A few manufacturers are exceptions. To them we are grateful, and they have been repaid by our undoubtedly having been able to do better work with their sets.

Manufacturers, by and large, have tried to divorce themselves from the service of their sets as far as is consistent with their sales needs. The potential size of a manufacturer's service organization in number of employees could well rival the size of the manufacturing body. However, some local distributors insist on keeping television installation and service under their strict control because it is an additional source of income. The price difference between what is paid by the customer to the distributor through the dealer and what the service contractor receives may run to as much as $30. That sum is pocketed by the distributor for various reasons, such as cost of an overpriced antenna, the use of which is made mandatory, and excessive insurance costs on parts.

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www.americanradiohistory.com
Mobile research truck houses 68-foot collapsible antenna tower, TV set, and test gear.

Reparis are made on individual service benches because of number of service technicians.

we use the three-letter card system. If a customer's file shows more than the average number of service calls, immediate attention is drawn to that fact, and the service manager personally goes to work to determine the reasons for the excessive number of calls. Usually, he will team up with our mobile research truck. This unit is equipped with a collapsible 68-foot tower and houses a set of measuring equipment as well as a television set. Thus far, when we have gone gunning for the trouble with our combined forces, we have not failed to come up with the correct answer.

Because television is so new and has become such an important part of the home, customers may seem to be unduly critical of a service company's best efforts. A service technician can too easily be irritated by seemingly excessive demands. Such an attitude can be a fatal mistake. If the customer complains, he has some sound reason for complaining. It is the job of our field service manager to either locate the trouble or, if the complaint is based on a customer's unfamiliarity with the limitations of television, to educate the customer to the latter's complete satisfaction.

Should the customer call on us personally, his first sight of our premises is not that of a disorderly shop. Quite the contrary; he steps into a nicely furnished office and is greeted by the switchboard operator, who in turn will show him to our service dispatcher or to the person who handles all installation matters. Far from attempting to hide our shop, we go out of our way to encourage visitors. We gladly demonstrate the methods used in handling their sets. Enough of the right equipment set up in a workmanlike arrangement is the surest road to customer confidence. He knows that his set is being taken care of by a responsible, well-organized service company. Responsibility is the keynote in all our operations.

The number of service calls each day has leveled itself off to a regular pattern. All service calls are funneled into the hands of our dispatcher who is conversant with the geography of our territory, and knows the particular capabilities of each of our men. This dispatcher assembles the calls and routes them the night before. In the morning each man is handed his group of calls and, after a short stop in the shop for parts or chassis, is off on his day's work. To meet any unscheduled emergency, each man is given a specified time to phone the office during the day. Each man handles 6 to 8 service calls a day.

Insurance is another of the little-thought-of phases in this business. We have found it necessary to be thoroughly, even though expensively, insured. For men on the road who operate their own cars, we carry nonownership insurance. This is in addition to the insurance each man is required to keep for himself. For antenna work and repairs in the customer's home, we carry contractor's liability insurance. To make sure that no falling antenna parts can ever result in damage to us financially through lawsuits, we carry products liability insurance. Of course, there is workmen's compensation, burglary, and fire insurance. It does not pay to be without any of these coverages, nor does it pay to underestimate the amount which must be spent to obtain them.

Abington Television Service has grown from a small service shop to an organization of over 40 employees. We feel that this growth is all the more remarkable because our work is specialized and is rigidly limited to television service alone. We do not sell anything to the consumer. In this way we avoid the suspicion of competing with the dealers for whom we do service. Dealer good will is a most valuable asset in this business.

What has been most responsible for our expansion? My partner, Sam Barriette, and I agree on one answer. We did everything we could to present a professional, businesslike appearance to the customer. Before the first television installation was given us, we tried to be ready with every tool needed for that installation. Haphazard and wasteful operation is strictly taboo for the business that has ambitious ideas in this competitive world. Our records system has been invaluable in this respect. Adequate financing at the start was another important factor. TV installation and servicing requires much more operating capital than radio servicing.

Television News
Replacing Picture Tubes in Television Receivers

Tube characteristics, basing diagrams, and special replacement hints are given in this inclusive article

By MILTON S. KIVER

The variety of different television sets on the market today exceeds 200—and this in an industry which is still in its infancy. While cathode-ray tube types have fortunately not appeared in equal profusion, there are enough brands to confuse the technician or set owner when replacement becomes necessary, especially when the desired tube is obsolete or unavailable, or some other tube possessing a screen of equal diameter appears to offer a more sharply defined or a brighter image. The problem in a nutshell is this: How interchangeable are cathode-ray tubes in modern television receivers?

To answer this problem, consider the internal construction of cathode-ray tubes. There are basically only two classes of image tubes in use—those which employ electrostatic deflection and those using electromagnetic deflection. It is the general practice to utilize the same electrical method for focusing as is employed for deflection. There are, however, four notable exceptions to this. The 5TP4 projection tube, the 7DP4, the 9AP4, and the 12AP4 all are electromagnetically deflected and electrostatically focused. Of these tubes, only one, the 5TP4, is used extensively today. The 7DP4 has appeared in only one receiver, an early postwar RCA set, which was quickly dropped from production. The 9AP4 and 12AP4 are prewar tubes, and it is doubtful that more than 1,000 working receivers in the entire country contain either of them.

Some important differences

1. Deflection of a beam electrostatically is accomplished by employing balanced voltages. Essentially, then, we require voltage amplifiers in the output stage of the horizontal and vertical sweep systems.
2. For electromagnetic deflection, the beam is subjected to the magnetic field established by a deflection coil, and this field, in turn, is developed by the current flowing through the coil windings. Thus, with electromagnetic deflection the vertical and horizontal sweep amplifiers must be capable of providing large amounts of current.
3. Electrostatic deflection tubes require extensive high-voltage bleeder networks to furnish the correct focusing and centering voltages.
4. Electromagnetic deflection tubes utilize relatively simple high-voltage power supplies, the energy, in many instances, being furnished by the horizontal sweep system.

While many additional differences exist between these two types of tubes, the foregoing points permit us to formulate the following rule:

Electromagnetic and electrostatic de
deflection tubes are not interchangeable without extensive circuit alterations.

In any consideration of interchangeability, whether it concerns ordinary receiving tubes or large television image tubes, we must start with a comparison of the electrical characteristics of the components to be interchanged. With cathode-ray tubes, the added features of physical size and screen diameter must be considered since these have a definite bearing on replacement. The Television Tube Table presents all this information in chart form.
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an octal base and the 6TP4 using a duodecal base. Finally, there is a difference of 7,000 volts in their second-anode potential requirements.

The 6TP4-40 is an exclusive product of the Philco Corp., and is found only in Philco projection receivers. The 6TP4 is employed more extensively, appearing in all projection receivers not utilizing the North American Philips system.

Of the four 7-inch image tubes listed in the table, the 7JP4 is used extensively now. The other three 7-inchers represent tubes which appeared since the war but which were subsequently replaced by the 7JP4. The 7DP4, listed first, employs electromagnetically controlled and electrostatic focusing and, as far as known, appeared exclusively in 7-inch RCA sets during the first year of postwar receiver production.

It is not known how many 7DP4 tubes were sold; if a technician ever has occasion to replace one of these tubes, he may order it direct from RCA if none are available at his jobber. The tube is not interchangeable with any other 7-inch tube listed.

The 7EP4 appeared for a brief period but was soon replaced by the 7GP4 which, in turn, was superseded by the 7JP4, the tube currently being used by all small-set manufacturers. The 7EP4 suffered from lack of brilliance, since only 2,500 volts were employed for acceleration. The 7GP4 was a step forward, producing a brighter image; and the present 7JP4, using 4,000-6,000 volts, gives satisfactory images and possesses higher deflection sensitivity. The 7JP4 and the 7GP4 are directly interchangeable without any circuit changes. This is not true of the 7EP4 and the 7JP4 for two reasons: First, any set designed to accommodate a 7EP4 has a high-voltage output of only 2,500 volts and the 7JP4 cannot be operated with this potential. Second, the sockets for the two tubes differ. If a change in tubes is desired by the set owner, determine first how much rewiring in the high-voltage supply will be required to provide 5,000-6,000 volts. If this revision can be readily accomplished, then changing sockets is a relatively simple matter. The table gives the base connections for each tube.

Not many television technicians will recognize the next tube listed, the 9AP4, because it is a prewar tube and does not appear in any postwar receivers. Utilizing magnetic deflection and electrostatic focusing, it is not interchangeable with any of the present tubes. It is not recommended that the circuit be rewired to accommodate one of the newer 10-inch tubes since the number of changes required would be too extensive. R.F. and flyback power supplies were not used in television receivers in 1950; they were subsequently followed by conventional lines. To modify these units to obtain the 9,000 volts required by a 10BP4 would entail an appreciable expense. If a set requires the replacement of a 9AP4, the tube can be obtained by RCA.

We come now to the 10-inch tubes—without doubt the most frequently encountered. Four such tubes are listed in the table, although only two (the 10BP4 and 10FP4) are used to any extent. The 10EP4 is similar to the 10BP4, possessing a slight modification in its gun structure and requiring 8,000 volts for acceleration; the 10BP4 uses 9,000 volts. There are no significant dissimilarities between these tubes to favor one tube over the other, except that 10BP4's are plentiful and used by practically all set manufacturers. Hence, if a set containing a 10EP4 requires an image tube replacement, it will probably be easier and more economical to use a 10BP4—the two being completely interchangeable. If the acceleration voltage is only 8,000 volts and a brighter image is desired, the voltage can be raised, as explained later.

10FP4 tubes are similar to and directly interchangeable with 10BP4 tubes. However, the 10FP4 does not require an ion trap. Thus, when substituting a 10FP4 for either of the other tubes, the ion trap, if electromagnetically controlled, is simply laid aside on the chassis; if a fixed or permanent-magnet type of ion trap is used, it is entirely removed from the set. It is not advisable to remove the electromagnetical type of ion trap because its coils are generally part of the low-voltage power supply.

The principal difference between the 10BP4 and 10FP4 is the extremely thin aluminum layer which is coated over the inside of the 10FP4 fluorescent screen. This layer greatly increases brightness, permitting an image to be viewed even when bright sunlight is streaming into the room. To many people this is a distinct advantage, but a word of caution should be given. There have been numerous reports that the use of screens has produced eye fatigue after a relatively short period of viewing; to counteract this colored or polaroid filters have been used.

The fourth 10-inch image tube listed is the 10HP4, a 10-inch version of the 7JP4 and completely interchangeable with this tube so far as electrical characteristics are concerned. Since electrostatic deflection is employed in the 10HP4, it is not interchangeable with any of the other tubes. Use of this tube was limited to Belmont television receivers and has lately been discontinued. The technician will therefore seldom, if ever, encounter a set having this tube. So far as is known, Sylvania is the only manufacturer of the tube.

In the 12-inch class, there is one prewar tube (the 12AP4) and four current tubes (the 12JP4, 12KP4, 12LP4, and the 12Q4P). The remarks made previously concerning the 9AP4 apply equally to the 12AP4. The 12Q4P, a product of Du Mont Laboratories, utilizes neither an ion trap nor a metal-backed screen. Note that nothing can be done to prevent ion spot formation in 12J4P tubes—if it does occur—because the electron gun structure in the tube is not designed with the external field of an ion-trap coil. It was perhaps because of the appearance of occasional ion spots that Du Mont began recently producing the 12Q4P, which has the same shape as the 12J4P, but contains a gun structure that requires an ion trap. The 12L4P (a big brother of the 10BP4) also uses an ion trap, while the 12KP4, having a metal-backed screen, does not. All four tubes can be used interchangeably (with the slight modification noted below) because all four possess similar electrical and physical characteristics and all use the same type of socket. If a tube which does not require an ion trap is replaced by one which does, then a permanent-magnet trap can be used. Both the 12J4P and the 12Q4P contain a second-anode bulb contact which is a recessed ball cap and therefore requires a female connector. (See Fig. 1-a.) On the other hand, the second-anode bulb contact of the 12L4P and 12KP4 is a recessed small cavity and a male connector must be used (Fig. 1-b). Thus, when interchanging these two sets of tubes, the second-anode connector must be changed. It may be opened when replacing a 12J4P by one of the other 12-inch tubes that proper focusing of the beam cannot be obtained. This is because the focus-coil current for the 12J4P is 140 ma while for the others it is only 11 ma. Actually this means that the 12J4P requires a stronger focusing field. If the set is originally designed for the 12J4P, there may not be sufficient resistance variation in the focus potentiometer to reduce the current through the focus coil to its proper value. If this is the case, paralleling a fairly high-value resistor across the focus coil will do the trick. The value of this resistor will depend...
upon the resistance of the focus coil. A good value to start with is 15,000 ohms; the technician can then either increase or decrease it as he sees fit.

The table reveals the deflecting angle in the 12JP4 and 12QP4 is 50 degrees while the angle in the 12LP4 and 12KP4 tubes is 54 degrees. If a 12JP4 or 12QP4 is replaced by either of the other two tubes, the image may not be wide enough to fill the screen. In most sets sufficient reserve power is available so that rotating the width control will widen the image the desired amount. However, in a few sets it may be necessary to increase the B-plus voltage fed to the horizontal sweep system. While each set presents a distinct problem in this respect, a useful procedure is to start with the B-plus voltage of the horizontal output amplifier. Where the output amplifier is a pentode or beam-power tetrode, the voltage on the screen grid rather than the plate should be increased. In such tubes amplification is controlled more by the screen-grid potential than it is by the plate voltage.

To illustrate this point more fully, the usual horizontal output circuit employed with 10-inch cathode-ray tubes is shown in Fig. 2. To obtain a greater horizontal sweep and at the same time increase the high-voltage output, the two screen-grid resistors of the 6BG6-G are replaced with a single 6,800-ohm, 2 watt resistor. Fig. 2 can be used by technicians who wish to replace 10-inch tubes with 12-inch ones.

Additional height, if required, can also be obtained by raising the plate and screen voltages of the vertical output amplifier.

The remaining tubes listed in the table (the 15AP4, 16AP4, and 20BP4) possess electrical properties which are very similar and which would permit interchangeability. There are, however, physical considerations to contend with, and in most instances expensive cabinet alterations would be required. Any set originally designed for a 15-inch image tube will properly drive the 16AP4 or the 20BP4 without any circuit change.

Tubes receive their numbering from the RMA in the order in which they are submitted. Thus, the first 10-inch cathode-ray tube submitted to the RMA received the designation of 10A4. The second 10-inch tube was labeled 10B4. The 10A4 now being obsolete, the 10B4 is the first 10-inch tube to be encountered. The 12-inch counterpart of the 10B4 (a tube which is similar in all respects to the 10BP4 except in physical size) is the 12LP4. It is not the 12BP4.

The lesson for the technician in this procedure is obvious: Never assume that cathode-ray tubes which possess identical lettering and differ only in screen diameter possess equivalent electrical properties. Check the physical and electrical characteristics to determine interchangeability.
NEARLY every service technician has had a request at some time in his experience for an unusual custom installation. Not knowing how to proceed, he has been compelled to turn such business away.

It wasn't so important in the days of AM radios and phonographs, but with the advent of TV custom building is really becoming big business. It is actually possible to do nothing but custom work and make a handsome profit. Many such installations will be made during the next few years. The fellows who get in the elevator now on the ground floor can ride to the penthouse on top in a few years.

Let's suppose a customer comes in and broaches the subject to you. Visit his place and look it over with him. Find out just what he wants. Some things can be done and some are impossible. If what he wants is impossible, have the courage to say "no" firmly. There are too many heartaches in trying to do the impossible. Then tell him what is possible.

The limitations on an installation are of many kinds, but some fundamental factors cannot be overlooked. There are the actual dimensions of the chassis to be installed; there is the placement of the TV tube or screen; there are the architectural aspects of construction and the problems of cabinetmaking; and there is the placement of the speaker.

Let's consider a single installation and some typical problems.

Selling the customer
Selling the idea is the hardest and most important part of the whole deal. Let the customer feel that he is buying something, not that he is being sold something. The era of high-pressure selling by out-talking and out-thinking your prospect is over. This is a buyer's market, and new techniques must be utilized. Always approach the customer as you would expect a salesman to approach you. You like to buy because you are the master of the situation; and you don't like to be sold.

Capitalize on that. Demonstrate your products and your wares so well that you leave it to the customer to choose what best suits his taste and his pocketbook. A good set of photos similar to the ones used to illustrate this article will do much to simplify the sales approach. I have sold some custom installations to people and despised myself later for the poor taste shown in the job. But there are different levels of taste. What I regard as poor someone else regards as good. So try to find out what the customer wants and give him that. Do not try to operate a school for art appreciation. Just sell custom installations. I do better selling a customer what he wants to buy. I sell monstrosities if monstrosities appeal to the buyer. They like me and send me more business.

One very important aspect of the selling campaign is giving the customer an exact idea of what the installation
is going to look like. Fig. 1 shows an installation in a simple but tasteful setting. Originally there was nothing there but a bare wall. The bookcase was built in extra because the client always wanted a bookcase; further, it balances the TV installation.

You soon find out in this custom-building business that, when the job is finished, it looks quite different from the picture the customer had built in his own mind. To forestall this I bring with me some pieces of plywood cut out to the dimensions the installation is going to occupy. For most of the installations illustrated here you require 20 inches of depth, 32 inches of width, and 48 inches of height. The height is easy. The 20 inches of depth causes the most trouble. Placing the plywood cutouts on the floor where the installation is going to be gives the customer an exact idea of what the finished job is going to do to his room, and a notion of how far out it is going to project.

I also have with me a piece of cardboard, cut out in the shape of a TV screen, with a picture in the insert. Several sizes of these will give a client a very clear idea of what size tube or picture he is going to want. This is very much worth while. When the subject first comes up, many people think of a 10-inch tube, or maybe a 12-inch one. But, when they sit down and see in their own living room how tiny one of these is, they often change to a 16-inch tube or to one of the 16 x 20 projection types. Fig. 2 shows the General Electric projection tube and mirror assembly. Generally speaking, projection setups are ideal for custom building because people are not likely to get them in any other way.

The technician should be impartial in his recommendations of the various receivers available. Make a client feel that you are interested in giving him a good custom installation, not that you are trying to sell him a certain set.

Brand names are important. If a customer believes that RCA is the best, let him have an RCA. When another customer wants a Scott, don't try to sell him a Du Mont. I know; I learned the hard way. When something goes wrong with the receiver you urged on him and service is necessary, the customer is sure he was sold a lemon.

If, in your contact with the customer in his own home, you can get the main details of where the unit is to be placed, where the screen is going to be and where the speaker will be located, plus the type of receiver he wants, that is enough. That's basic and absolutely essential for you to work on.

**Architectural considerations**

Architecture is a very important aspect of any installation. Every job is different and sets its own special qualifications. All you learn from your experience is that you can apply only general considerations. Specific things will depend on the individual job in hand.

In some instances it is desirable to use one part of a wall and build a bookcase on either side of the installation for appearance and balance. In the installation of Fig. 3 it was necessary to build a bookcase and match the paneling of the woodwork in the room. In another instance it was most satisfactory to build a new closet and have some shelving over the unit as in Fig. 4. Let me call your attention to a small item about the cabinet work on this job. In my own opinion and in that of the cabinetmaker whom the client engaged, the closet should have been built flush with the wall. The customer didn't want that. You can see he got what he liked. So long as you install the receiver and he lives with the installation, everybody can be happy.

In another case it might be wisest to take a complete corner and build it up so that it may be closed when the unit is not being used. Fig. 5 shows a very unusual installation. When closed, it is impossible for an outsider to know that a TV set and reproducer are cleverly concealed behind what seems to be a closet in a corner. If you examine Fig. 5 more carefully, you will note the break in the woodwork down the middle. The part on the left with the TV screen is on rollers and slides out for servicing. (Never forget when you make an installation that you may have to service it!)

Sometimes it may be necessary to break into a wall. Some knowledge of wall structure is of inestimable value. Most of the time you can help yourself to 4 inches of depth by cutting into a wall. Here's where this helps. The point selected for one installation had a corner post that projected 15 inches. The installation required 18 inches of depth. Knowing that we could cut into a wall and gain 4 inches, we did just that. But we had to do a little carpentry work and some plastering to make the wall strong and to get it back into shape.
the whims of the customers you manage to find. This is not too difficult. Cabinetmakers are used to fussiness. They are fussy themselves, or they would still be carpenters. You must always be ready to supply a cabinetmaker to do the necessary woodworking for any installation. He should be a man with a fine sense of balance and proportion and must be willing to go out of his way to match already established woodwork patterns. One cabinetmaker did all the installations shown in Figs. 1, 3, 4, and 5. The layout and arrangements in Figs. 3 and 5 were by architects, while Figs. 1 and 4 were according to the customer’s specifications.

Offer the customer the opportunity to choose his own cabinetmaker. It is safe in this business to let the customer choose his own workmen all along the line. But don’t let him tell you about the radio end of the installation. Here you know your stuff. But when he has some special ideas about cabinetry, let him work them out with the cabinetmaker.

Generally it is better to let the cabinetmaker do his part of the job up to a certain point. Then you make the installation of the chassis and cable leads to various parts of the receiver. It is better for you to drill the holes you need than to have the cabinetmaker responsible for this. Holes that you lay out in theory don’t always work out in practice. Sometimes circumstances dictate a different placement of the chassis which would necessitate new hole locations. When your part of the job is done, let the cabinetmaker put the finishing touches to make his part a work of art.

There are infinite possibilities in the design of a cupboard, bookcase, corner installation, etc., to conceal the finished product. The doors can just plain open and be there when the unit is being operated; they can be rolled back; or moved back to fit into a ready-made slide. These are the extras that make the installation a little more expensive, but in general add nothing to the pocket of the radio technician.

While the technician may not be a cabinetmaker, he must have sufficient understanding of the art and the possibilities of what can be done with little nooks to decide immediately whether what the customer is asking for is possible.

**Placing the speaker**

The problem of where to put the speaker is important in any custom installation. I am a firm believer in the Klipsch corner speaker because it makes use of the floor and walls as sounding boards, but few installations will ever present the possibility of such a genuinely high-quality installation. The only one I ever made is in my own home.

The speaker usually presents simple cabinetmaking problems because the speaker front can be covered with any one of a large variety of materials, including cloth and woven wood products like raffia. The speaker should be one of the large 12- to 15-inch-diameter units. It is foolish economy to have a good television installation and a little 5- or 6-inch speaker pushing out the accompanying sound. Don’t sell the customer anything that is going to make him unhappy with his installation in a short while. The dual commercial installation of Fig. 6 has two 12-inch speakers and two large-screen projection assemblies.

The speaker should be so positioned that it will face the viewers.

In connection with the speaker another little angle is important where there are small children. I always include in a good custom installation a couple of phone jacks and sell the customer a set of headphones for each child. Many times the mother doesn’t mind hearing the children listen to some story, but she wants no part of it. Unless there are headphones and connections, there is no simple solution to the problem. I have several letters of appreciation for these phone-jack installations. Incidentally the writers of these letters are the women who probably sell me to their friends on just such a little widget.

The placement of the controls for the receiver is optional. They may be hidden by the masking frame as shown in Fig. 7, or the receiver may be operated by remote control.

**Cost of the installation**

Cost depends on the character of the installation and the amount of work necessary. There are several ways of billing the customer for the complete job. You can sell it to him as a package, or you can itemize the unit costs for him. It is generally better to sell the whole deal as a package, which you can break down into component items only on request.

Roughly a TV chassis that includes AM and FM costs about $750 for a 16 x 20-inch picture of the projection type. The direct-view chassis will cost considerably less. (In today’s market, prices are tumbling daily like the walls of Jericho when Joshua “fit” that battle.) This is the fundamental cost and you bill the customer for it at the current list price. To this you add the cost of the cabinet work if you supply the cabinetmaker. If the customer makes his own arrangements with the cabinetmaker, let the customer pay him separately. Don’t even inquire into what that work costs. Do your part well and let the other fellow have his.

**Securing your prospects**

Building up a custom business is not easy, although conducting it is once it is built up. We used a postcard technique. In cooperation with a good printer we drew up an attractive two-color card with some snappy but distinctive copy. We sent it to a specially selected mailing list for which we paid a premium price. I know that many people have used such techniques with mediocre success, but they have used them only once or twice. We sent out four mailings before we got any nibbles. You have to keep everlasting at it or you won’t get enough response to keep you alive. We still send out a series of ten monthly mailings per year. This keeps our name before prospective clients and builds good will for us.

There is some serious stuff on the card about us and the services we are prepared to render. But there is some entertaining humor and inspirational stuff there, too. We believe you shouldn’t invade a man’s home via the mailman unless you give him something that will take the edge off your invasion. Giving a little entertainment is really what made those postcards and our business. They were go-givers which became after a short time go-getters.

![A good commercial dual installation.](image1)

![Controls hidden by the masking frame.](image2)

*Fig. 6—A good commercial dual installation.*

*Fig. 7—Controls hidden by the masking frame.*
Indoor Television Antennas

By EDWARD M. NOLL and MATTHEW MANDL

Occupyants of apartments where roof antennas are prohibited must use either an indoor or a window antenna to receive television programs. These antennas are satisfactory in areas where the signal strength is high, and with proper choice of type, dimensions, and positioning, can be made to work fairly well on weaker signals also. Occasionally they perform passably even in fringe areas, especially if the location is high or the receiver is located on an upper floor. Despite the type used, indoor or window antennas will not perform miracles, and at best they rarely come up to a well planned and erected outdoor antenna.

If he finds it necessary to install an indoor or window antenna due to housing restrictions, the television technician and dealer has the additional responsibility of making sure the customer gets a receiver with superior sensitivity. There are wide differences in the comparative sensitivities of commercial television sets. If an indoor antenna is used, best performance is obtained when receiver sensitivity is high and signal-to-noise ratio of the r.f. tuner above average.

The window antenna is preferable to the indoor type because it can be made more elaborate. Because it is usually placed in a less confined area, it can deliver a stronger signal to the receiver. An indoor antenna must be placed where the troublesome multiple reflections within a building do not cancel, but reinforce to give the best signal. There is also appreciable absorption and shunting of signal by the building structure before it reaches the indoor antenna.

OCTOBER, 1949

Outside antennas are not always necessary for acceptable television reception

Similar troubles, of course, often plague the window antenna—particularly if it must be mounted on the side of the building away from the transmitter. This condition is aggravated if an intervening structure blocks the signal path.

The window antenna is often subject to reflections when it is placed among structures as high as or higher than it is. Distant reflections put ghosts on the screen, while the multiple close reflections to which window and indoor antennas are especially liable disturb the resolution and sensitivity of the antenna. A window antenna on the proper side of the building and with a clear path toward the TV stations will give excellent performance.

Existence of the several variables mentioned above means that an experimental approach must be used. Location and orientation of the antenna is certainly every bit as important as the actual choice of antenna type.

Selection and installation

To obtain full benefit from the weak available signal, the importance of proper antenna dimensions and impedance matching cannot be over-emphasized. An adjustable type should be chosen which can be tuned to the various TV channels to be received. The weaker signals can then be “tuned in” exactly—which means a substantial increase in picture quality. The antenna transmission line should be ideally matched and of proper over-all length to deliver the signal to the receiver at maximum strength. In the weaker signal areas, a booster improves performance of a window or indoor antenna, particularly if the signal-to-noise ratio and sensitivity of the booster are high.

Orientation and positioning of the antenna are very important for best results. There are definite space patterns for the various stations in any locality. Position the antenna at various trial points while checking the signal strength by watching picture reception. The many reflections inside and near walls indicate that antenna loops are closer together and less intense than those encountered outdoors. Because of these multiple indoor reflections, correct orientation of an indoor antenna is not always truly broadside to the stations. Extensive tests must be made before the best placement is found.

Thus, the most can be secured from an antenna which has adjustable dimensions, can be moved about readily and mounted at unusual angles, and can be flexed into various positions after mounting. Trial and error alone can determine the best place within a room and the most satisfactory antenna-armor positioning.

Home-made indoor antennas

The television technician can use his ingenuity in constructing effective indoor antennas for customers who cannot use outdoor installations. Twin-lead, 300-ohm line lends itself well to indoor antenna construction because it can be concealed easily. It can be mounted on the molding or around the window frame, or even placed under the carpet because it lies flat. It can be cut to proper length (depending on the channel frequencies allocated to the area) and connected as a folded dipole. Harmonic relations usually make good reception possible on the higher channels even though the antenna is cut for a low channel. Channel 10, for instance, is the third-harmonic frequency of channel 3 and can be received well with an antenna cut for that channel.

When making a folded dipole from a 300-ohm, twin-lead transmission line, consider the velocity constant of the insulating material. Short each quarter-wave side of the folded dipole (Fig. 1), at a point obtained by multiplying the quarter-wave physical dimension of the antenna by the velocity constant of the dielectric material. Shorting at this point, although it does not change the over-all length of the folded dipole produces additional signal strength because of the effect of the velocity constant on the circulating current in the antenna.
For example, a folded dipole on channel 10 would have an over-all length of approximately 29 inches, this representing a half wavelength. Each side therefore, would be 14½ inches. The rapid fading of the picture—in and out.

The stacked array is much better, because of its elongated horizontal pattern and low sensitivity to pickup. Indoor or window antennas, however, do not lend themselves to stacking because of limited available space. If interference is severe, a loop antenna is recommended, for it is the only antenna which the authors have found to have the elongated horizontal pattern of a stacked array. This circular loop must be exactly a wavelength in circumference, must be absolutely vertical, fed at exact bottom, and critically oriented. The gain is high and the performance unusual. (See “Antennas for Television, Part VI,” RADIOTELEVISION, Part VI, June, 1949, for further details and channel dimensions.) This type can be made from No. 14 wire and easily concealed behind drapes or furniture.

**Commercial indoor antennas**

One of the most common indoor antennas is the simple dipole made of telescoping rods. This antenna can be adjusted to proper length and mounted on a stand. The antenna rods can also be swung to various angles for best reception. Typical examples are those manufactured by JFD Co. and Ward, shown in Figs. 3-a and 3-b. Another example of this type is the Jiffy-Junior put out by Delson (Fig. 4). It has a stand with rubber suction cups on the bottom to hold the base firmly to any surface. Occasionally this antenna can be used at the window simply by pressing it against the pane.

Tricraft Products manufactures two special antenna types, (Figs. 5-a and 5-b), one of which is flat and mounts under the carpet or behind drapes. The second indoor type is tunable with a selector switch which is set on the desired channel. This antenna is one-fifth the length of an ordinary channel-2 dipole, yet it is tunable to the low- and high-frequency television bands.

Another unusual antenna (Fig. 6) manufactured by Radio Craftsmen consists of a folded dipole which opens up much like a metal-tape rule. The various channel numbers are recorded on the metal tape so the antenna can be opened up into a folded dipole of the proper length for the channel to be received. The arms are fully retractable, just like a metal tape measure, which in a way it is.

**Airplanes and ignition**

Fig. 2 shows the relative patterns of a single dipole and a stacked dipole. This is an end view with the observer’s eye level with the antenna. The pattern is the same for both the dipole and folded dipole. Note that single antennas have pickup characteristics in the horizontal (the desired) direction and vertical (undesired) direction. The vertical pickup properties make this type of antenna sensitive to ignition noise from below and airplane interference from above. Ignition noise results in streaks across the picture, and airplanes cause

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**Fig. 3-a**—The JFD antenna, a broad “V” type.

**Fig. 3-b**—The Ward “V” antenna is inverted.

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**Fig. 4**—Jiffy-Junior is another “V” antenna.

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**Fig. 5-a**—This type can be concealed easily.

**Fig. 5-b**—Cylindrical antenna with tuning.

Jerrold Corporation manufactures a combination indoor antenna and booster. The antenna is a telescoping dipole which mounts directly on the back of the booster amplifier, and is an integral part of the whole unit. This is perhaps an ideal arrangement in the weaker-signal areas when an indoor antenna must be used.

The RCA tube department recently announced a new type of indoor antenna employing end-loading disks which reduce over-all length and still permit reception of low-band stations. Large spheres or flat disks at the end of an antenna increase the effective area at the end and thus increase the capacitive component of the antenna (referred to as “end effect”). Then, the inductive component, represented by the total length of the antenna, can be correspondingly smaller to resonate at a given frequency. This type of antenna functions well on the high-frequency channels because its physical length corresponds to a half-wavelength on these channel frequencies.

**A built-in antenna**

Philco has just announced that their latest receivers include built-in antennas, and it is likely that other manufacturers will have followed their example before this is printed.

The foregoing commercial indoor types are the result of much research and clever design by manufacturers, and often produce excellent results. But it should be emphasized again that, if the location is in a fringe area and near ground level, not much can be done to secure a completely satisfactory pic-
ture. For really long-range reception, of course, the indoor type of antenna is out of the question. A roof antenna is preferable; if it cannot be used, the window type is the one that must be installed.

Commercial window antennas

Many standard dipoles and folded dipoles commercially available for roof mounting have special mounting brackets which adapt them to window mounting also. There are a few special window-type antennas such as the Jiffy-Tennas manufactured by the Delson Manufacturing Co. (shown in Fig. 7) which can be mounted to the window frame by a screw expansion system which holds it firmly.

Fig. 7—Two easily-mounted window antennas.

One type consists of a folded dipole director or reflector combination with sliding rods and trombones to permit adjusting the length for optimum reception of a specific channel. The antenna can be readily moved and oriented for proper positioning. The small element can also be used as an independent high-band dipole and the folded element as an independent low-band folded dipole. The smaller dipole is individually adjustable as to positioning and can be set separately from the folded dipole for ideal reception of a high-frequency station. This is necessary in many locations.

A second type of window antenna consists of a high- and low-band dipole, also independently adjustable as to length and orientation. In this form the high-band dipole is stacked above the low-band dipole.

While there is less opportunity to position a window than a roof or indoor antenna, it can be tried on each side, below, and sometimes above, each of the available windows.

Many private home housing projects prohibit outdoor antennas. In such instances indoor antennas should be placed in the attic—if there is one—rather than in the room where the receiver is located. Height is always a dominant factor in increasing signal strength, and versatile antenna types can be mounted in the attic at the apex or some other convenient point underneath the roof. The antenna should, of course, be checked in various positions and adjusted for correct length and orientation to obtain the best possible performance.

Summary

All indoor and window types suffer by comparison with the high outdoor types, and installation precautions must encompass all possible means to secure the most from these devices. However, when an indoor or window antenna takes full advantage of installation, impedance match, orientation, and the other factors detailed in this article, it sometimes performs as well or better than an outdoor antenna poorly installed in terms of orientation, impedance match to receiver and position.

THREE NEW TV RECEIVERS


Meek portable. 7-inch picture tube, 5-inch PM speaker. Luggage-type case has front cover and space for portable antenna included with receiver. All-channel tuner has fine-tuning control, 18 tubes, 4 rectifiers. A.c. operation only. Weight, 28 pounds. (John Meek Industries, Inc., Plymouth, Ind.)

Hallicrafters T-69 custom chassis. 15-inch tube. 130-square-inch picture. Push-button tuning, 300-ohm antenna input. 8-inch PM speaker. Chassis furnished on wood frame for custom installations (no cabinet available). Height 19 1/4, width 23, depth (not including knobs) 21 3/4 inches. 19 tubes, 3 rectifiers. (Hallicrafters Co., Chicago.)
The video signals are corrected, mixed, and passed to the master control

By MORTON SHORE

The immediate output signal of each camera is usually below the quality standards of the station, or may differ from the exact needs of the particular program. To compensate for these differences a chain of electronic devices is employed. The first of these, the electronic viewfinder, is directly attached to the camera by plug and socket connections.

The camera operator looks into the viewfinder and sees a reproduction of the scene picked up by the target of the image orthicon. If it is out of focus or improperly sized he can make corrections immediately. He can also monitor the picture and more easily correlate the program director’s instructions with the actual scene.

Each viewfinder consists of a video amplifier which is attached to the camera’s video amplifier, vertical and horizontal sweep amplifiers, and a picture tube. The picture tube—unlike any mechanical optical device—can reproduce the televised scene accurately despite quick background changes or low light levels.

Camera control units

Each camera is more completely controlled by the camera control unit. There is one for each camera, and they are combined in a console, as in Fig. 1. The main functions of each unit are to amplify and regulate the camera signal, correct its focusing, and insert and set the amplitude of the blanking pulses for the composite signal.

Other purposes of the unit are to amplify and control the camera driving pulses; provide an accurate calibrated signal for comparison tests, and insert sync pulses into the composite signal when only one camera is used. Each one of the above functions has an external control. The camera operator uses these in conjunction with two monitor screens to enable him to regulate and correct the picture.

One monitor screen (10 inches for RCA and 12 inches for Du Mont) shows the actual picture, and another (5 inches for RCA and 7 inches for Du Mont) shows it in its original waveform. The operator can adjust the picture for maximum definition and detail by observing the two monitor screens.

The waveform monitor enables him to observe the closeness to the maximum black level (same as blanking pulse height) of the strongest video signal. By setting the black level to approximately 75% of the total composite picture amplitude, and keeping the darkest video signal just below this mark, a picture of ideal brightness and contrast will result.

Radio-Electronics for
The picture monitor enables the operator to correct and double check the adjustments made according to the waveform monitor, and adjust the focusing. An accurate combination of all these adjustments results in a picture of maximum definition and detail.

The program director usually sits directly behind and slightly above the camera control console. From this vantage point he or she is able to see all the camera monitors as well as the action in the studio. The director is then in a position to designate which of the cameras shall go on the air and also to direct any special effects such as dissolving or fading that may be desired.

The director uses a small sound system to transmit instructions to the cameramen, control operators and other operating personnel who wear headphones. Thus, full control is maintained over the lighting and placement of cameras and microphones. Actors and sound-effects men may receive instructions off-stage through headphones or speakers.

The actual component parts which supply the signals to the monitors and the other units regulated by the camera control unit are shown in Fig. 2. With few exceptions the circuits are very similar to those in a television receiver. One of the important ones not found in a receiver is the frequency-dividing circuit. It consists of a buffer amplifier connected to the output of the picture tube's vertical and horizontal scanning amplifiers, followed by a 2-to-1 frequency divider and a discharge tube.

The output of this circuit is applied directly to the vertical or horizontal plates of the waveform monitor. When it is switched in, two separate waveforms appear, which accurately show the complete blanking pulse and the very beginning and the very end of one complete picture frame.

**Mixing equipment**

The output of each camera is fed into a mixer (Fig. 3), which determines what is to go on the air. Externally it appears very similar to the camera control units, and many of its internal circuits, which include two monitors, are also very similar.

The outstanding circuit of this unit is the lap and fade dissolve and superimpose signal circuits. With these, one scene can be gradually eliminated, while the other is gradually brought in. Also, the outputs of two or three cameras can be mixed together, with emphasis given to any particular one. These methods make the system highly versatile, and television as a whole, more entertaining.

**Master control**

There are usually several studios in a large station. Therefore, a master control system (Figs. 4, 5) has to be used so that all the programs can be reviewed. Of course, only one program is sent out at one time, but simultaneously other programs have to be rehearsed, checked, and timed. Also, they have to be distributed to various monitors throughout the studio, especially to the executive offices and sponsor's reviewing rooms.

Other functions of the master control are to pick up and correct remote and network shows, and double-check all programs before and after they leave the transmitter.

Telephone and intercommunicator switchboards enable operators at master control to maintain contact with personnel in the studio, at the transmitter, and on remote locations. Provisions are made for feeding program audio into the head-sets of the cameramen and other personnel to enable them to hear the program when they are not receiving instructions or other

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**Fig. 3**—All pix signals go to mixer (second from right). This is a portable control set up.

**Fig. 4**—The master control operator is the distribution chief of the television station.

**Fig. 5**—Block diagram of master control unit.
Roof-Top Televiser

By ROBERT F. SCOTT

ORIENTING the TV antenna is a job which daily poses an ever-changing series of problems to installation crews. Since TV signals travel in a straight line from the transmitter, the receiving antenna must be exactly positioned if it is to pick up the strongest possible signal. This may be a fairly simple problem in areas where there is only one television station; where several are located at different points of the compass, it can be extremely difficult to orient the antenna for good reception from all of them.

Ghosts caused by multiple signal paths from the transmitter create another serious problem. In some locations it is necessary to orient the antenna for minimum ghost interference rather than maximum signal. Often the adjustment required to get a good picture on one channel will result in very unsatisfactory reception on another. Installation of a television receiving antenna is therefore frequently a compromise determined by the location of the transmitters, ghosts on one or more channels, and the direction of the weakest signal compared to the direction of the others. Interference from other receivers, automobile ignition, electric and electronic equipment, and transmitters outside the TV bands is another problem.

The installation crew makes the required adjustments by observing the picture on the receiver. Standard installation procedure demands at least one man on the roof with the antenna and another at the receiver. Portable telephones or intercom systems are used for communication. Using this method, the average crew may take several hours to orient the antenna for optimum all-channel performance.

We have found that one man can take a portable TV receiver to the roof and orient the antenna in approximately half the time required by a two-man crew with telephone communication. Since no battery-powered TV receiver is available at this time, a Pilot TV37 portable television receiver was modified for the purpose.

This set is just one of a number that can be so modified. Almost any small chassis with an electrostatically deflected and focused picture tube can be used. Since most sets of this type have a 7-inch tube, weight and size can be reduced considerably by replacing the picture tube with the 3-inch size. Some of these are currently available on the surplus market for less than $3.50. It

C-R tube is in a hooded adjustable mounting.

Fig. 1—How to lay out the sheet of plywood.

Fig. 2—This completely dimensioned drawing may be used to duplicate case made by author.
may be necessary to replace or rewire the picture-tube socket.

If a suitable set is not available, you may find it worth while to build one especially for this application. Its size

![Diagram](https://example.com/diagram)

**Fig. 3—Working drawing for C-R-tube holder.**

... can be held down to a minimum by omitting the audio channel.

The chassis of our Pilot TV37 was removed from its cabinet and installed in a lightweight plywood case designed to stand up under hard usage. Construction of the case is shown in the photographs and drawings. A reel holding approximately 100 feet of a.c. line cord is fastened to the back of the case. Additional line cord can be carried on another reel for use when more is required.

The case was constructed from a sheet of 1/4-inch plywood 48 inches wide and 36 inches long. Fig. 1 shows how the plywood sheet can be laid out to avoid excessive waste. Note that only the shaded areas are wasted. A bench saw is recommended for cutting the sheet. If one is not available, use a saw with fine teeth and support the sheet between two chairs or sawhorses to avoid splintering.

Plywood was selected to keep weight at a minimum. Unfortunately, 1/4-inch wood is too thin to hold nails or screws in its edges. Therefore, fillets were made from lengths of 3/8-inch quarter-round molding. These are shown in the exploded view, Fig. 2. The case was constructed in two parts: One consists of the front, right side, and top; the other, the left side, bottom, and back. The pieces of each section are held together with wood glue and brads through the plywood into the quarter-round fillets. The halves are held together with 3/8-inch wood screws.

The chassis of the receiver is turned on its side and screwed to the right side of the case with its controls projecting through 3/8-inch holes drilled in the recessed front panel, as shown in Figs. 2 and 4 in the photographs. The C-R tube is mounted in a hinged lid set into the top of the case. The lid is adjustable so it can be raised to nearly 90 degrees, making it easy to see the picture when working directly above the set as one is likely to do when making installations. In the first case we built, the controls projected through a straight panel and the C-R tube was behind a piece of safety glass located approximately in the spot where the speaker is in this design. We soon found that the projecting knobs are likely to catch on the rungs of a ladder and cause a serious fall or damage the set. Further-

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Back, bottom, and left side of case are removable in a single unit for adjusting receiver.
TV ANTENNA SWITCH

STORE demonstrations of TV sets require that several receivers be connected to the same antenna. It is also convenient to be able to switch a booster in and out of the circuit at will to show its effect on the picture. To avoid the oscillation troubles and mismatch which invariably occur when several sets are connected together haphazardly with random lengths of 300-ohm line, we built an antenna change-over switch which enables a salesman to choose any one of several sets for store demonstration and to use the same antenna without having to worry about the possible effects of overloading or oscillation.

There is a small amount of capacitance transfer of signal within the switch, but results in actual use have proved quite satisfactory. Occasionally it is necessary to move one of the lines going to a particular receiver to stop feedback between sets, but otherwise no trouble has been encountered with the switching arrangement, which saves a lot of time that would be wasted in moving antenna connections from one set to another. The switching arrangement also makes an excellent impression on prospective customers.

Standard Mallory switches were assembled on a Masonite panel as shown in the photographs and drawing. All internal wiring was done with short lengths of 300-ohm line. Connections were made as short as possible, with a definite plan followed so that both sides of the twin line were kept exactly the same length. This last point is important. Avoid sharp bends in the internal wiring.

The middle switch was made from two stock switches. The frame from a Mallory No. 1511 "Hamswitch" was used with the contact assembly taken from a Mallory No. 1326L switch. The resulting combination has a wide (2 1/4-inch) spacing between sections to separate the booster input and output lines more. Booster input goes to one section of this switch, and the output to the other section. Thus it is possible to connect and disconnect a booster at will.

Standard antenna terminal strips of bakelite were used as input and output connectors. Ten of these strips are required. The TV antenna goes to the top left strip, and the booster input and output to the middle and right strips.

By LYMAN E. GREENLEE

The other connections numbered 1 to 5 go to TV sets on the floor, while strips 6 and 7 go direct from the antenna to other sets, boosters, etc. Strips 6 and 7 are never connected through the booster circuit. By manipulating switches, the booster may be cut in or out at will to from one to five sets selected by the five-position switch, while two other sets or a matching stub may be connected to positions 6 and 7 for direct connection to the TV antenna.
Counters For Prospectors

Some typical commercial instruments

By RICHARD H. DORF

Nuclear 2610 offers three sensitivity ranges.

Before the war the Geiger counter was a laboratory instrument. Comparatively few people had ever heard of it. Today manufacturers are putting out counters in large quantities for adventure- and fortune-minded prospectors. The new instruments are small, efficient, and thoroughly portable. They're easy to operate, in general, requiring no technical skill on the part of the user.

Geiger counters are available in models from the very simplest—no vacuum tubes at all—to the most complex—several tubes, automatic scalers, calibrated meters, and so on. The most common type consists of the tube, one or more amplifier tubes, a headphone circuit for counting the clicks, and a meter for reading the amount of radiation in more or less accurate terms of milliroentgens per hour.

The term milliroentgens (abbreviated mr), by the way, has been used for years mainly by the medical profession in measuring radium radiation. It is not especially suitable for the ordinary prospector, and at least one counter manufacturer has calibrated his meter in counts per minute. Many of these instruments are used in atomic plants and laboratories, however, to make sure workers do not absorb more radiation than they can stand. The Bureau of Standards gives 12.5 mr per hour as the maximum health tolerance level, and of course the scale markings in mr/hr are vital there.

A typical instrument

The Model 2610 portable survey meter, made by Nuclear Instrument & Chemical Corp., Chicago, is typical. It...

**Fig. 1**—Pulses furnished the meter deflect it in proportion to the frequency of the pulses.
C5, or C6 to the grid of V2, which, with this positive voltage on its grid, begins to conduct. The V2 plate current passing through R4 makes its top end more positive, pushing V1 further toward cutoff, increasing its positive plate voltage, and making V2 conduct more heavily. The action builds up very quickly until V1 is completely cut off and V2 is conducting heavily.

As soon as V1 has reached cutoff, it no longer furnishes a rising positive voltage to the grid of V2. The V2 grid then falls to its resting value of zero volts, the current through R4 causes a voltage drop sufficient to bias V2 to cutoff, and the charge on C1 from the changes in radiation intensity would not be registered quickly.

C4, C5, and C6 are the range-selecting capacitors, providing ranges of 0.2, 2, and 20 mR/hr. They are part of a time-constant circuit including R9 and R10. When the pulses are few and far between (on the 0.2-mR/hr scale) a fairly large capacitor (C4, .005 µf) is needed to transmit them. Use the analogy of a low audio frequency.

When the pulses are practically continuous (in a strong field), a very small capacitor (C6, 40 µf) serves to attenuate them and keep the meter from rising above full scale. Here again an analogy—high audio frequencies. R10 therefore, the lamp is effectively an open circuit and no blocking capacitor is needed between the two stages.

When a positive pulse appears at the plate of V1, it is large enough to make the lamp conduct. V2 is normally biased to cutoff by R10 in series with the negative end of the B-supply. When the lamp conducts, the positive plate voltage of V1 is placed across the voltage divider R5-R7-R8-R9. The switched-tapped portion of the voltage is applied to V2, which amplifies it and applies it to a meter integrating circuit similar to that of the instrument described first.

When radiation is in the order of 20 mR/hr, the frequency of the pulses is great enough to keep the meter integrating circuit charged even with fairly low values of voltage. On the lower ranges, however, the pulse rate may be too low to keep the meter still enough to read. For radiation intensities on the 0.2- and 2-mR/hr ranges, therefore, the feedback in V1 raises the V1 output and transfers more voltage through the neon lamp to the voltage divider. Section e of the range switch also taps grid voltage for V2 from a higher point on the divider. The neon lamp insures that the voltage at the top of the divider does not greatly exceed 67 (its striking potential) and blocks the d.c. resting plate voltage of V1.

High-voltage supplies

The obvious solution to the problem of securing 900 volts for the Geiger tube in a portable instrument is to use three 300-volt, miniature dry batteries. Many manufacturers, including the makers of the two instruments described, have done this. The dry batteries are fairly heavy, however, and are expensive.

The next most obvious solution is the use of a vibrator operating from

![Fig. 2-The neon lamp in the Eltronics SM-3](image)

limits the amplitude of the pulses reaching V2.

adjusts the time constant so that the meter can be recalibrated.

It is often more convenient when prospecting to wear headphones and listen for a sudden increase in radiation. Connected across R4, phones are provided for that purpose in this instrument.

Another type of counter

Another instrument which does the same job is model SM-3 made by Eltronics, Inc., Philadelphia. The circuit, shown in Fig. 2, is typical of a number of counters. A neon lamp is used to perform the function of the one-shot multivibrator which appears in the circuit of Fig. 1.

The negative pulse from the Geiger tube strikes the grid of V1, which is zero-biased as an amplifier. The amplified pulse, now positive, appears at the plate. On the 0.2- and 2-mR/hr positions of the range switch, the amplified positive pulse at the V1 plate is rectified by the self-contained diode. The rectified negative pulse is larger than the original input pulse; it appears across R3 and R2 in series. Since the input pulse also appears across R2, this is effectively a regenerative feedback arrangement, giving extra amplification. The amount of feedback is determined by the capacitances of C1 and C2.

On the 0.2-mR/hr range, there is no feedback. The B-supply and the zero bias on V1, with the value of R5, set the plate voltage of V1 at 50, 17 volts below the breakdown potential of the neon lamp. In the absence of radiation, the lamp is effectively an open circuit and no blocking capacitor is needed between the two stages.

When a positive pulse appears at the plate of V1, it is large enough to make the lamp conduct. V2 is normally biased to cutoff by R10 in series with the negative end of the B-supply. When the lamp conducts, the positive plate voltage of V1 is placed across the voltage divider R5-R7-R8-R9. The switched-tapped portion of the voltage is applied to V2, which amplifies it and applies it to a meter integrating circuit similar to that of the instrument described first.

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![Fig. 3—Relaxation oscillator feeds the 1L4 flashlight cells. A number of counters take this way out, including the home-made job described in the September issue and the Sniffer shown in one of the photographs (Nuclear Instrument and Chemical Corp., Chicago). An ingenious high-voltage supply using a relaxation oscillator (possibly inspired by television circuits), en-
The Precision 105 has only a single battery. Energizes the Geiger tube in some counters. Fig. 3 shows the high-voltage section of the M-Scope, model C-11, made by Fisher Research Laboratory, Inc., Palo Alto, Calif. C1 and R1, with the neon lamp, form a relaxation oscillator powered by three 45-volt batteries in series (These batteries are also used to power all the vacuum tubes. A pair of flashlight cells lights the filaments.) The output of the oscillator is applied to the 1L4 grid, which is amplifier-biased by a 10-megohm grid leak.

The plate load of the 1L4 is a 4.5-h audio choke. Because the oscillator produces a sawtooth wave instead of a sine and because of the inductive load, the a.c. voltage across the choke is in the neighborhood of 1,000. It is passed through C2 and rectified by the diode section of a 1S5. The 1S5, by the way, has no other function in the instrument, and none of its other electrodes are used.

R2, R3, C3, and C4 form a filter circuit which is adequate because of the very low current drawn by the Geiger tube. Fifteen neon lamps in series across the output of this supply regulate the voltage. The potentiometer across the first two furnishes the voltage for the Geiger tube anode. The control adjusts the voltage to the point at which the tube operates on its plateau. A small positive voltage taken from the top of the lower neon lamp is used to bias the grid of the first amplifier tube in the conventional portion of the counter.

One of the very simplest Geiger counters on the market is model 105 of Precision Radiation Instruments, Inc., Chicago. Containing no vacuum tubes and using a single 300-volt battery, it is claimed to be more sensitive than most instruments.

It is diagrammed in Fig. 4. A single crystal earphone is connected directly across the Geiger tube's anode load resistor; there is no amplification. But the striking feature of the 105 is its power supply.

A single 300-volt dry battery and two polystyrene capacitors with very high leakage resistances give the requisite 900 volts—very nearly a case of getting something for nothing.

In the normal position of the four-pole, double-throw switch (as shown in Fig. 4) the battery and the two capacitors are in series, with the negative battery pole on the Geiger tube's cathode. The spring-operated switch places the capacitors in parallel with the battery, so that each is charged to 300 volts. When the switch is released, battery and capacitors are again in series. Since the latter are charged to 300 volts each, the total voltage from the negative pole of the battery to the end of the string is 900 volts, and this is applied to the Geiger tube.

The insulation of the capacitors is so good and the current drawn so low that a single flick of the switch suffices to charge the capacitors for as long as 15 minutes of operation. When the operator fails to hear the background count in his headphone, he knows the charge has dissipated and flicks the switch again.

This type of instrument, along with the others which have no meter, is very satisfactory for prospecting but will not give accurate quantitative measures of the amount or quality of a uranium deposit. Accuracy is hardly necessary in most cases, however, since a high click rate is sufficient to indicate that samples of ore should be sent to an assay office.

Although counters suitable for prospecting are entering the market in increasing numbers, no presently available model is yet offered for a few dollars. Prices vary from about $55 to $300. For that reason, the prospective buyer should look over the field thoroughly and purchase the instrument best suited to his need. The radio-electronic technician and hobbyist is in an especially good position to pick and choose.

The counters described above represent only a fraction of those on the market. A list—as nearly complete as we can make it—will be sent to any reader who requests one.

NEW MINIATURE PRINTED CIRCUIT

A new lightweight printed circuit is being introduced in the Telex model 200 hearing aid. The major portion of the three-stage amplifier circuit is contained on a 0.025-inch-thick polystyrene plate approximately 2½ inches by 1½ inches. The weight of this plate, complete with resistors, capacitors, and conductors is ¼ ounce.

Conductors are of a colloidal silver compound which is deposited by a silk-screen process. The material etches into the plastic plate assuring positive adhesion.

Resistors of a colloidal graphite compound are deposited in a thin film; the plate may be bent without damage to the resistors. An acetate-film covering hermetically seals the resistors and provides protection against damage.

All the components are on polystyrene plate. Thickness of the printed circuit plate is reduced by inserting the capacitors into punched holes. The capacitor discs are ¼ inch in diameter and are made of a new high-K barium titanate material. Die-formed capacitor leads are connected to the printed circuit with a riveted connection on the plate. A special tube socket (not shown in photo) provides electrical connections to the printed circuit and makes tube replacement a simple matter.
MICROWAVES

Part VI—Some equipment used for measuring frequency, and crystals for receiver frequency conversion

By C. W. PALMER

Correct operation of microwave equipment depends on many factors, one of which is accurate frequency adjustment of transmitters and receivers. A slotted waveguide with a calibrated probe (Radio-Electronics, May, 1949, page 56) is probably the most common frequency-measuring device but there are occasions when it is better to use a direct-reading wavemeter.

Wavemeters for microwave work are of three general types: co-axial, cavity resonator, and transition. The first type consists of a section of co-axial line small enough that only (the \( T_{m,n} \)) mode can function. Resonance is then found at odd quarter-wavelength points (\( \frac{1}{4}, \frac{3}{4}, \frac{5}{4} \), etc.). Wavelength is found by measuring between successive resonances with a centimeter scale, an extremely handy method in microwave setups. The instrument needs no calibration, of course.

Loop coupling to the co-axial line is commonly used, with the loop located near a short-circuited end of the co-ax where it is always in a position of maximum magnetic field.

Resonance can also be obtained at even quarter-wavelength points (2/4, 4/4, etc.) if the line is short-circuited at both ends. Several types of co-axial wavemeters are shown in cross section in Fig. 1. A commercial unit is shown in Fig. 2.

The cylindrical or cavity wavemeter has a distinct advantage over the co-axial type in that it has a much higher \( Q \) and, therefore, the points of resonance are more distinct and sharply defined. Its disadvantage is that it is not self-calibrating. In fixed-frequency cavities used as frequency standards it is desirable to use the lowest mode to avoid confusion resulting from other modes of operation. In adjustable wavemeter cavities with an adjustable plunger at one end, a higher mode having a zero surface current where the plunger and the sides of the cavity meet is necessary.

When a higher mode is used, lower modes are attenuated or rejected with absorbing materials placed behind the plunger, with grooves filled with absorbing material and parallel to the surface currents on the end plate, by the method of coupling, and by damping wires. Cavity wavemeters have \( Q \)'s that approach a theoretical limit of about 15,000.

Connecting Wavemeters

A wavemeter is called a transmission instrument if it is used in the main line, and a reaction or absorption instrument if it is in a side arm of the waveguide or transmission line.

A transmission wavemeter in use is shown in Fig. 4. It is coupled to a co-axial line with coupling loops projecting into the wavemeter cavity. A crystal detector and d.c. microammeter complete the indicating circuit. Two reaction wavemeter circuits are shown in Fig. 5. At \( a \) the distance \( L_1 \) is such that the side arm presents a high impedance at the junction to the main guide when the wavemeter is off resonance. At resonance the impedance drops so that less power reaches the crystal and meter. At \( b \) the same action takes place, except that the indicator crystal and meter are placed in the branch circuit at a point of normally high impedance. Length \( L_2 \) is independent of \( L_1 \), which is adjusted to present a high impedance at off-resonant frequencies. Fig. 6 shows two examples of commercially available wavemeters. One is the transmission type for a frequency range of 22,950 to 24,950 mc. Second is an absorption-type wavemeter for a frequency range of 8,500 to 9,400 mc.

In all the absorption-type wavemeters the current in the crystal varies as shown in Fig. 7. If the coupling is too tight, this curve becomes distorted and it becomes necessary to reduce the size.
of the loop or rotate it so that it cuts fewer lines of force.

The accuracy of a wavemeter depends on the "loaded Q" and the size of the scale. For example if an accuracy of ±0.001 cm is desired, the scale must be fine enough to read to three decimal places and the resolution (sharpness of tuning) great enough to indicate a wavelength deviation of .001 cm. In other words, the frequency-response curve of the wavemeter must drop to its "half-power" points on each side of resonance in a space of not more than .001 cm.

Microwave crystals

It may seem strange to the radio man to find that the ancient crystal detector has found wide application in microwave work as a converter for superheterodyne receivers in conjunction with a vacuum-tube (often a Klystron) oscillator, as an output meter with a d.c. microammeter (as in the wavemeters described above) as a clamping device to hold the d.c. potential of a circuit at definite values, as a rectifier of small alternating currents of both low and high frequency, as a bias rectifier in vacuum-tube circuits, and last but not least as a transistor or crystal oscillator and amplifier (see issue of September, 1948).

Because of the frequency limitations of vacuum tubes due to the finite capacitance between the grid and plate, the transit time of electrons, and other factors which we discussed in Part III, early explorers in microwaves turned to the crystal detector. Intensive development work resulted in silicon and germanium crystals having all the stability of vacuum tubes and much better signal-to-noise ratio and much higher cutoff frequencies.

These crystals are illustrated in Fig. 8, which shows two examples of American manufacture. The units are adjusted in the manufacturing process and sealed so that no fusing with cat-whiskers is necessary as in the early radio days.

Naturally, a crystal detector in a superheterodyne type of receiver produces a conversion loss instead of gain. But because the extremely low capacitance in such a unit permits operation on higher frequencies than those at which normal vacuum tubes will work, plus better signal-to-noise ratios than can be realized with vacuum tubes at these ultra-high frequencies, it is preferred over a tube converter. Loss in the converter stage is easily compensated for by additional amplification in the i.f. amplifier, which operates at a lower frequency where amplifier tubes are effective.

These crystals are also used as rectifiers for obtaining small amounts of d.c. for the operation of a.v.c. circuits, biasing circuits, locking circuits in multivibrators, etc.

Crystal Mounts

A crystal connected as shown in Fig. 9 rectifies r.f. energy transferred to it by the probe. Current in the meter circuit is proportional to the square of the r.f. current at the probe (square-law detector).

A somewhat more complicated method is to use a modulated r.f. source and amplify the crystal current, which can then be rectified, the output of the rectifier being connected to a meter. This system is more sensitive than the probe-microammeter arrangement and permits the use of smaller probe projections so that less effect is produced on the current in the main guide. If the amplifier and rectifier have a linear characteristic, this setup is also proportional to the square of the current in the probe, because of the square-law characteristic of the crystal.

Such crystal mounts are used in the construction of crystal mixers for superheterodyne reception.
By GEORGE W. SHUART, W4AMN, Ex-W2AMN

Part 1—What hamdom offers the hobbyist

YOU too can be a ham! That sounds like an advertising slogan, but unlike some advertising slogans, it's absolutely true! Being a licensed radio amateur requires neither a great amount of money nor any more time than you want to give it. You needn't be a mental Superman or a junior Edison. You can even be deaf or blind—yes, many amateurs have earned licenses despite handicaps. All you need is to want to make friends by the dozens in faraway places, to be able to have a party in your parlor at the click of a switch, to be part of a message-handling system relaying radio messages to and all over the world, or to make with your own hands electronic equipment capable of sending calls around the block or 7,000 miles.

Radio transmission and reception is one of history's most fascinating inventions. It enables a single man or woman, alone in a room, to reach out and make contact with others at will, unfettered by wires, routes, or previously charted ways. The contact may carry news or instructions of major importance or a random conversation. Radio today is big business. Radio broadcasting and communication systems employ many thousands of people and spend millions of dollars. But unlike most big businesses, this is some-

thing the lone hobbyist can get in on just as easily as the big financier. The expenditure of a few dollars and some time may allow him to transmit just as far as the "big fellows" by the same methods and at the same time. Except that he cannot broadcast entertainment programs, he may say just about what he wants, and talk to anyone he chooses in any place he is able to reach. The only limit on the enjoyment the ham can get is his own enthusiasm.

Ham radio has so many enjoyable aspects that amateurs divide themselves into several groups. The ham, for instance, whose greatest pleasure is in contacting other hams who are far away calls himself a "dx man." For him the thrill of sitting in his own familiar home and exchanging conversation with someone thousands of miles away is the fulfillment of the spirit of adventure. Dx men proudly display on their operating room walls QSL cards—postcard-size confirmations of radio contacts—from like-minded men and women in Zanzibar and Cape Town, London, Berlin, Paris, the cities and hamlets of all the world. They compete for awards offered by radio societies for working (ham language for contacting) a station in every state of the 48 or one on every continent.

Some amateurs get their greatest pleasure from working traffic, handing together in "traffic nets" for the purpose of relaying messages. No money may be accepted by any amateur for this service; he does it simply for the sense of accomplishment he derives from being a member of a smooth-working system. A man in California, for instance, may want to send a message to a friend in New York. He gives the message to an amateur friend, who transmits it as far east as he can, perhaps only to Chicago. The receiving amateur in Chicago then passes it on to another ham. Finally, a New York amateur receives it and gives or telephones it to the addressee. Sometimes the California station can reach New York directly; at other times, when the message must be relayed from one station to another, it takes a day or so. But every member of a traffic net follows a strict procedure which as-
sures that he will get the message straight and then pass it on. Any ama-
teur with a desire to do so may join a traffic net, and he may handle mes-
sages even if he does not.

Because amateur radio requires technical knowledge, many hams are avid experimenters. They may build a new transmitter, use it for a day or two, then tear it apart again to try some newly conceived improvement. When a new tube or component is intro-
duced, the experimenter eagerly tries it out in as many unusual circuits as he can think of. His conversations on the air indicate his branch of the hobby, for he is always discussing new developments or asking for reports on whether some new addition to his rig (ham-
mesh for transmitter) makes a differ-
ence in how it sounds. The amateur experimenter is one of the prime rea-
sons for the amateur's being; for the development of the country has pioneered, his spirit of "I know it won't work but I'm going to try it anyhow," has con-
tributed toward many of the most im-
portant advances in radio. The higher
frequencies, for instance, were first ex-
plorers by the who refused to be
lieve the dictum of the "experts" that
only the low frequencies could be
useful.

Some hams just like to get on the
air and talk about anything and every-
thing—transmitters down the block or
in the next county. These are the "rag-
cchers." Dx, traffic, experimentation,
and rag-chewing are the major spheres of interest in hamdom. But each of
these is further divided into two sub-
groups, code and phone. Though many
transmitters provide for both voice and
radiotelegraph transmission, almost
every amateur has his preference for
one or the other. Offhand it might seem obvious that phone is the better. You
just listen to the microphone and listen to the loudspeaker or head-
phones. But c.w. (code) men have
strong arguments in their favor. A
code transmitter need have nothing in
it but parts contributing to better trans-
mission, while a phone rig must
have an audio section just to build up
the speech power to the point where
it can be used to control the trans-
mitter's output. Code can be under-
stood clearly even if even a trace of
the transmission can be picked up by
the receiver, whereas a comparatively good signal is necessary if it is carrying
speech. Code can be read through noise and is much more of an international language than speech. Code and
phone men argue through the nights
about the merits of their favorites, but
you will have an opportunity to try
them yourself, which is, after all, the
best way to make any decision.

Some people wonder how hams get
into contact with each other: you can't
ring a bell as you can with a tele-
phone. It's a very simple, though, a ham who decides to go on the air
first
turns on his receiver and tunes around
his own frequency, listening for other
hams calling "CQ." The CQ call indi-
cates that the caller is ready for a
conversation with anyone who may hap-
pen to hear him (or if he calls "CQ
California," for instance, he wants to
speak to anyone in California who can
hear him). Our ham then turns on his
own transmitter and calls the man who
has been sending CQ's. The latter tunes
around, hears our friend calling him, and
replies. From there, the conversa-
tion may carry on for an hour or more
and cover as many subjects as the two
can think of.

The amateur setup

The Federal Communications Com-
mission, which regulates all interstate,
communication, is the authority under
which amateurs operate. It conducts
examinations, awards licenses, assigns
call letters, sets minimum technical
standards, specifies operating frequen-
cy bands, and polices the air for viola-
tions of regulations. An FCC operator's
license as well as a station license must
be procured before anyone operates a
transmitter of any type. There is abso-
lutely no loophole for getting around
this requirement, despite the efforts of
the thousands who have tried to find
one.

The amateur examination, given at
all offices of the FCC (or under certain
circumstances at the applicant's home),
requires the applicant to show a certain
technical knowledge and ability to send
and receive radio code. Amateur ac-
quaintances and books are good sources
of technical knowledge. Some especially
useful books are listed in the bibliog-
raphy at the end of this article.

A licensed amateur is assigned call
letters for his station. These begin with
the letter W or K (in the U. S.) fol-
lowed by a number. The number indi-
cates the section of the country in
which the station is located. There are
10 radio districts, as indicated on the
map. (The cancelled zero (0) is the stan-
dard method of indicating the num-
eral zero rather than the letter O.

The Federal Communications Com-
mmission has assigned certain por-
tions of the radio spectrum exclusively
to amateurs. Within these bands, any
amateur may operate on any frequency
and may change frequency as often as
he likes. There are, however, certain
frequencies restricted to amateurs who
have passed more demanding examina-
tions, so the FCC regulations should be
consulted.

What you must do

To become an amateur, there are
certain steps to be followed. First, you
must acquire some technical radio
knowledge. Try to get several books
(see bibliography) at the public library
if you cannot buy them. After you have
absorbed the fundamentals, locate near-
by amateurs (you will find them all
listed in the Radio Amateur Callbook
Magazine, or at most radio parts
stores) and call on them. Say you want
to become a ham and ask their advice.
If you have acquired enough back-
ground by reading to understand what
the general idea is, you will find that
most hams are anxious to initiate you
into the fraternity. There is very little point in trying to
give you a technical course here. You
will find that consulting the Radio
Amateur's Handbook (see bibliography)
will show you what information you
need. What you cannot quite grasp from
that manual you will find explained
differently in other books. Reading this
and other magazines is very helpful.

You will also do well to join one of
the large radio societies and one of
the local ham clubs about which any ama-
teur will tell you.

In addition to learning technical
facts, you will have to absorb some
code and memorize some FCC regula-
tions. When you are ready to take your
examination, you will go to the nearest
FCC office at an appropriate time and
try to prove to the inspectors that you
are worthy of a "ticket."

One of the biggest headaches for
the prospective ham is learning the Inter-
national Morse Code. It isn't hard; it
just takes a little application of the
proboscis to the grindstone. But there
are ways and ways of pounding the code
into your head. So next month we'll take
up the subject in detail, outlining some
of the do's and don'ts and trying to
build up a few of the stones from your
path toward the dots and dashes.

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Learning the Radiotelegraph Code

O C T O B E R, 1949
During wartime, man's inability to see in the dark can often mean the difference between life and death. This is particularly true of scouts, patrols, night drivers, and flyers. Since visible light makes an excellent target for the enemy, military forces began experimenting with infra-red rays as aids to nocturnal vision when visible light is not permitted for reasons of security. Many types of infra-red telescopes were developed as the direct result of this need for invisible illumination.

The sniperscope (an infra-red light source and telescope mounted on a carbine to permit the soldier to locate and shoot the enemy while both are in total darkness) and the snooperscope (an infra-red light source and telescope used for short-range observations) are perhaps the most well known of these developments. Other infra-red instruments include helmet-mounted driving and flying binoculars, and blackout signaling devices.

The infra-red telescope is designed around an infra-red image converter tube which transforms invisible infra-red rays to visible light. Several types of image converters were developed. The American forces used equipment built around the RCA 1P25 infra-red image tube. This tube has a cathode which emits electrons in proportion to the amount of infra-red light falling on it. Additional electrodes within the tube focus the electrons on a fluorescent screen. Thus the image falling on the cathode is focused on the screen without scanning devices. This tube, described in detail in the September, 1946, issue of RCA Review, requires voltages of 15, 100, 600, and 4,000 for proper operation.

The British developed a simplified infra-red/image converter tube requiring a single source of 4,000 to 6,000 volts for its operation. This tube, type CRI 143 or CV 147, is currently available on the surplus market and is used in this experimental snooperscope.

The parts for this snooperscope—a CRI 143 or CV 147 infra-red image converter tube, a 4,000-volt, low-current power supply, two infra-red filters, and a light source—are easy to obtain.

The power supply

For indoor operation, a 4,000- to 6,000-volt neon-sign transformer operates the tube satisfactorily. Rectification is not necessary unless the objects under observation are in motion. (Application of the image tube as a stroboscope is the subject of a patent application made by the author.)

A portable 4,000-volt power supply designed for use with this snooperscope is shown in the photograph and in Fig. 1. This efficient supply needs to be turned on only momentarily to charge the 0.1-uf, 6,000-volt capacitor. The snooperscope works for several minutes on the charge, and thus it can be operated for long periods without noticeable battery drain.

The high voltage is supplied by a model-airplane ignition transformer with a vibrator to interrupt the primary current. The vibrator, not visible in the photograph, was removed from a small buzzer and mounted just above the core at one end of the transformer. A small buzzer can be inserted in series with the primary of the ignition transformer if desired.

The rectifier tube is a 1B3-GT/8016. When the power supply is turned on, the current drain drops the voltage of each cell to approximately 1 volt; therefore the 1B3 was connected in series with a 1-ohm resistor across two cells. (A 3Q5, with its plate and screen grid tied together and control grid floating, might do the job just as well and would use less filament current. See the battery-operated, high-voltage supply described in the article “Build This Geiger Counter,” in the September issue of Radio-Electronics—Editor.)

Fig. 1—Miniature high-voltage power supply.

The power supply was constructed in a plastic ice-box dish and fitted with insulated binding posts. Avoid contact with the output of this power supply or a rather uncomfortable shock may result. The capacitor remains charged for some time after the supply is turned off, so be careful. (It might be wise to shunt the output terminals with two or three 47,000-ohm resistors in series when the supply is not being used.—Editor)
Assembling the snooperscope

The snooperscope is constructed as shown in Fig. 2. The image converter is mounted in a plastic drinking cup 3½ inches high and 2½ inches in diameter. The optical system depends on the requirements for the snooperscope. We used a double-lens, fixed-focus jeweler’s loupe (engraver’s glass). It has a focal length of approximately 3 inches and objects 1 foot away from the observer’s position are focused sharply.

The light source

The required intensity of the light source is determined by the distance from the target to the lens. Heat lamps, flashlights, and ordinary bulbs will work well for most indoor applications. Our model is equipped with automobile parking light housings on both sides. These supply a limited amount of illumination. The intensity of the parking lights is insufficient for many applications and a heat lamp is used. Outdoor applications involving greater distances require a bulb with a sharply focused reflector. The snoiperscope used a 30-watt, 6-volt bulb operated on a small rechargeable storage battery. Good substitutes are auto headlamps, the sealed-beam type being preferable for this purpose. The heat lamps mentioned are of course those sold for infra-red treatment.

Snooperscope experiments

A number of interesting and entertaining stunts can be devised around the snooperscope’s ability to look through any opaque material which passes infra-red rays. Crime-detection laboratories use parallel equipment for reading through certain types of material. Since the infra-red reflection of pigments in paints and inks is different for white light, it is possible to detect forged paintings and checks by the way the colors appear. Demonstrate this by writing a message with India ink and then painting it over with a coat of ordinary fountain-pen ink. The eye will only see the blackened spot but the snooperscope will peer through the top layer of ink and reveal the writing just as clearly as if there were no top coating. This type of inspection can be made photographically if infra-red film is used in a camera. The electronic method permits instantaneous examination, which is often a great convenience as well as an interesting experiment.

Driving in fog has always been a great hazard. An infra-red beam will display the road with 30% more clarity. This increase may be the difference between a safe situation and a very dangerous one. Snooperscopes for this purpose require very good lenses and powerful headlights. It would probably be difficult for an experimenter to construct one and dangerous to use it.

The image-converter tube can be used as an infra-red phototube. Reduce the voltage to 250 or 300, and insert a 470,000-ohm to 1-megohm resistor in the B-plus lead. Connect a two-tube amplifier and relay across this resistor. The relay operates when infra-red rays strike the converter tube, changing the voltage across the resistors.

A modified snooperscope has been used in biological laboratories to study the behavior of rats and other small nocturnal animals in total darkness. The converter tube has been used with a microscope to study bacteriological and botanical specimens under infra-red rays. They have also been used in measuring temperatures of materials below visible red heat.

For additional reading on this subject, see:

The high-voltage power supply, with its batteries, is built into a plastic food container.
Neon Blinker Saves Batteries

Blinking neon lamp warns user that battery receiver is still turned on

By RALPH W. HALLOWS

W E’VE all done it, and the odds are that we’ll do it again. Done what? Why, leave a battery-operated radio or some other piece of apparatus using a high-voltage dry battery switched on when we thought that we’d switched it off. The result is that, the next time we urgently need to use the thing, we find a dead battery and curse ourselves for the carelessness which means spending hard-earned money to replace it with a new one. In my experience the discovery that the B-battery has so expired invariably occurs when the shops are shut and there is no way under the sun of replacing it until they open again.

What has long been wanted is some kind of indicator which calls attention to itself so compellingly that its warning just can’t be disregarded; something, for example, to make you realize that a radio is silent, not because it’s been switched off, but because the transmitter has closed down. Easy enough, if you can afford to use a good deal of current; but that is just what you can’t take from the high-voltage dry battery. It is about the most expensive form of power supply used by mankind—a watt from the B-battery costs as much as several score from the electric mains. And that is where the difficulty lies. Any effective warning device apparently would need appreciable power to operate it, and power means watts. That brought me up short some years ago, and only lately have I run into something which provides the answer: the miniature neon tube. These tubes have a number of interesting features:

1. If the applied voltage is gradually raised from a low value, they offer infinite resistance until a certain voltage—depending on the type—is reached.

2. When the applied voltage reaches this figure (the striking voltage), the tube instantly lights up.

3. If the applied voltage is now reduced, the tube continues to glow until a value (the extinction voltage) much below the striking voltage is reached at which time the light goes out.

4. Miniature neons give a brilliant light for a very small expenditure of current.

You can, if you like, use a miniature neon connected straight across the B-battery through several thousand ohms of resistance and cut it in or out by the on-off switch. But why keep the tube going continuously when the apparatus is switched on? Why not make it flash briefly, about once per second? If that can be done—and it can very easily—there are two big advantages. First of all, you use far less current, since the tube is out about nine-tenths of the time; secondly, winks at roughly 1-second intervals are far more attention-compelling than a steadily glowing lamp.

The time-constant circuit (Fig. 1) provides the means of doing this. When the switch is first closed, the voltage across the capacitor (and therefore across the neon as well) is zero. As the neon offers infinite impedance, all the current through R flows into the capacitor C, charging it and causing the voltage between its plates to rise. This voltage increases exponentially, the formula being

$$V_C = V_e (1 - e^{-t/CR})$$

where $V_C$ is the voltage across the plates of C, $V_e$ is the applied voltage, e is the exponential function, t is the time in seconds, and CR is the capacitance in farads multiplied by the resistance in ohms and is the time constant of the circuit.

Suppose we make CR = 1, as we can by using a capacitor of 1 μF and a resistor of 1 megohm; let’s also make $V_e$ = 100. Then in 1 second $V_C$ equals 100 (1 – 0.368) = 63.2v. ($e^1$ is equivalent to 1/2.1718, or 0.368.)

With the same values $V_e$ in 2 seconds = 86.5v; in 4 seconds; 95.1v; and in 6 seconds, 98.2v. From this it can be seen that, for any values of V, C, and R, $V_C$ in CR seconds = 62.3% of $V_e$; in 2 CR seconds, 86.5%; in 3 CR seconds, 95.1%; and in 4 CR seconds, 98.2%. Using these four “fixes,” we can plot voltage and current charging curves for any capacitor in any time-constant circuit as shown in Fig. 2.

Those curves are actually for a time-constant circuit in which C = 0.1 μF and R = 1.5 megohms, used in conjunction with a 100-volt battery and a neon whose striking voltage $V_e$ is 72 and extinguishing voltage $V_C$ is 48. The method of incorporating the circuit in a receiver is shown in Fig. 3. Look again at Fig. 2 and see how the device works. When switched on, current flows into the capacitor through R. At no instant can it exceed 67 microamperes since 100 volts are driving it through 1,500,000 ohms. Actually it falls away exponentially as indicated by the vertical scale on the left in the time shown by the horizontal scale at the bottom. Meanwhile the capacitor voltage $V_C$ rises as shown by the vertical scale on the right. When $V_C$ reaches 72v, the neon strikes. C now discharges through the tube until $V_C$, the extinction voltage, is reached. The tube then closes down, and C starts to recharge. This time, however, the initial $V_C$ is not zero but 48 volts. So long as the apparatus is switched on, C alternately charges from 48 to 72 volts and discharges from 72 to 48 volts. The discharge is also exponential; it is extremely rapid since, once it has struck, the neon offers very small resistance to current.

As the curves show, the average current $I_C$ taken from the battery is about 28 microamperes, an amount which is a negligible additional load for any battery. This device comes nearer to giving...
ing something for nothing than any other I know. For a current drain so small that its effect on the battery can be ignored, it gives a brilliant and arresting flash about once per second when the plate-supply battery is new and at full voltage.

Fig. 3—How blinker is added to the receiver.

As the battery ages and its voltage falls off, Vs becomes a greater and greater fraction of its total voltage. To supply the striking voltage the capacitor must charge for a longer and longer time. Fig. 4 shows what occurs with a neon of the characteristics mentioned when an original battery voltage Vb of 100 falls to 90 and 80. When it has fallen to a trifle over 72 volts, the neon will not flash at all. It packs up as a warning device? Well, not quite! By not striking it goes on warning you that it is time to purchase a fresh battery.

Fig. 4—Frequency falls with aging battery.

Vs and Ve have been taken as 72 and 48 volts, respectively, not because these are the round figures for all miniature neon tubes, but because small neons are scarce in Britain and the only kind I could get hold of had those characteristics. In the U.S.A., I believe, small neons are readily obtainable with rather low striking voltages. The winker, therefore, can be adapted for use in apparatus using voltages well below 100 volts.

My method of installing the winker in a battery portable radio was to find a place for it on the chassis as near as possible to the switch. A %-inch hole was then drilled through the panel close to the switch and tidied up with a brass escutcheon. (If the switch is a single-pole type, it must be replaced with a double-pole unit.) The tube was mounted with its end actually in the hole. The result is a warning which just can’t be disregarded. I’ve had the winker in use for over 3 months now, and it has never given me the slightest trouble.

Incidentally, C must be a high-grade capacitor, not of the electrolytic type, for if it has any appreciable leakage it acts simply as a resistor in series with R. The neon in that case may remain glowing continuously, or may not glow at all, depending on the volts dropped across the resistance provided by the leaky capacitor.

OCTOBER, 1949

Tubeless Oscillator Uses A 1N34 Crystal

By RUFUS P. TURNER, K6AI

A tubeless oscillator may be obtained by utilizing the negative-resistance characteristic of a 1N34 crystal diode. This characteristic, which is a property of germanium (not silicon) crystals, appears at a relatively high value of negative applied voltage. The negative-resistance point is revealed by a backward loop in the reverse-current curve of the crystal (see Fig. 1) and is located at a different voltage (E3) for different crystals. Individual 1N34 crystals show the negative-resistance point somewhere between —60 and —175 volts.

When the high negative voltage required to make the crystal oscillate is furnished by a selenium-type power supply, the tubeless oscillator circuit becomes an intriguing combination of dry rectifiers.

Fig. 2 is the complete circuit schematic of the crystal-diode oscillator. Negative voltage is supplied to the 1N34 crystal by a voltage-doubler circuit consisting of the two selenium rectifiers, a filter choke, and three electrolytic capacitors. The 50,000-ohm rheostat serves as a voltage control and permits the d.c. voltage to be adjusted to the negative value at which a particular crystal exhibits negative resistance and oscillates. The 0.1-mf capacitor and the inductance of the primary winding of the transformer set the frequency of oscillation. If the builder employs the particular transformer used by the writer, a Thordarson T-29A99, oscillation is an approximately 700-cycle sine wave. A higher capacitance will produce a lower frequency, and vice versa.

Oscillator circuits of this type have been operated at frequencies as high as 1 mc. At radio frequencies, however, the transformer must be replaced with a transformer or coupler having either an air or powdered-iron core, and the capacitor must be a high-Q air, ceramic, or mica component with a capacitance between 20 and 200 µf, depending on the desired frequency of the oscillator.

When wiring the tubeless oscillator, care must be taken to insure correct crystal polarity as indicated in Fig. 2. The positive high-voltage output must be applied to that terminal of the crystal which is labeled with a minus sign or the abbreviation “cath.” A reversal of polarity, even though the high voltage is applied only momentarily, is apt to burn out the crystal.

Operation of the circuit is simple. Before inserting the power plug into an a.c. outlet, set the voltage-control rheostat to its maximum-resistance (lowest-voltage) position, and connect a suitable signal indicator (headphones, electron-ray tube, a.c. vacuum-tube voltmeter, oscilloscope, or audio amplifier with loudspeaker) to the oscillator output terminals.

Insert the power plug into an a.c. outlet and close the on-off switch. Advance the rheostat slowly. When the negative-resistance voltage of the crystal is reached, the circuit will break suddenly into oscillation. Some crystals require very careful handling of the rheostat in order to find the exact spot where oscillation starts.

The crystal-diode oscillator is a fertile territory for the experimentally inclined electronic technician. Its operating characteristics, as well as its possible applications, open interesting avenues of investigation.

MATERIALS FOR OSCILLATOR

1—10,000-ohm, 10-watt, wire-wound resistor; 1—50,000-ohm, wire-wound rheostat; 3—20-µf, 400-volt, electrolytic; 1—0.1-mf, 400-volt, paper capacitor; 1—1N34 crystal; rectifier; 2—100-ma selenium rectifiers; 1—10-a, 55-ma filter choke; 1—2:1 interstage audio transformer; miscellaneous hardware.

Fig. 1—Crystal voltage-current curve shows negative-resistance point. Fig. 2—Oscillator.
FUNDAMENTALS OF RADIO SERVICING

Part VIII—Transformers—How they work

By JOHN T. FRYE

VARY few drivers do not understand why there is a gearshift in a car. You know it provides a choice between speed or power. Where the highway is smooth and level, high gear hustles the car along at a good gait without the application of much torque to the rear wheels and without racing the motor; but when climbing a hill or plowing through sand, low gear sacrifices speed to provide the driving wheels with increased rotating power.

What the gearshift transmission does for the automobile designer, the transformer does for the electrical engineer: it enables him to transform a given a.c. voltage to a higher voltage at a lower current, or to a lower voltage at a higher current. Notice that voltage and current act like two kids on a seesaw: when one goes up, the other goes down.

This handy device for stepping voltage up or down is really very simple in construction. It consists of two coils so arranged physically that the magnetic field produced by passing an alternating or pulsating current through one of them (called the primary) also surrounds the turns of the other (called the secondary). The medium through which the magnetic field passes in coupling the two coils together is called the core of the transformer.

Fig. 1 is a diagram of a simple air-core transformer. When we apply an a.c. voltage across the 2-turn primary, the variations of current produce an expanding and contracting magnetic field about the coil. The lines of force of this field will be constantly swishing back and forth through the 6 turns of the secondary coil. We know that when moving lines of force are intercepted by a conductor, a current is generated in that conductor. The frequency of the current generated in the secondary is the same as that applied to the primary, but the voltage and amount of current available depend upon other factors.

Note in Fig. 1 that only some of the primary lines of force are intercepted by the secondary. Not much can be done to correct this without introducing other more serious losses in transformers which operate at radio frequencies. But, at audio and power frequencies, winding the two coils upon a common core of iron insures that practically all the magnetic field produced by the current through the primary acts upon the turns of the secondary.

This is true because a magnetic line of force feels very much “that way” about soft iron, and it never passes through air if a soft-iron path is available. Consequently, as is shown by the dashed-line path of Fig. 2, practically all the magnetic field produced by the primary is confined to the iron core, which it threads through to act upon the secondary. What is more, the intensity of the magnetic field produced by the current flowing through the primary is greatly increased by the use of the iron core, as we learned when studying inductance.

Transformation ratios

When a dog scratches fleas, he scratches himself as well as the fleas. The magnetic field produced by the primary of a transformer does about the same thing. Not only does it act upon the turns of the secondary, but it acts upon the turns of the primary as well and produces a back-e.m.f. (voltage) that is nearly equal to the applied voltage producing the field. In fact, if there were no losses, it would equal the applied voltage, and no current would flow.

Watch closely now, we are going to do a little tricky but true reasoning. If we applied 10 volts across a 2-turn primary, and if the magnetic field produced developed a counter-e.m.f. of nearly 10 volts, would it not be safe to say that every primary turn cut by this magnetic field produced nearly 5 volts of back-electromotive force? Suppose, then, we have a 6-turn secondary. Since the same magnetic field that produces the counter-e.m.f. in the primary is also working on the secondary, it is not logical to expect to find close to 5 volts per turn, or 30 volts across a 6-turn secondary? Well, that is exactly what we do find; and all of
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This leads up, after a little reflection, to a general statement: the ratio of primary to secondary voltage of a transformer is practically equal to the ratio of the number of turns of wire in the two windings.

For example, if we have 100 volts across a 100-turn primary, we will find 10 volts across a 10-turn secondary and 300 volts if the secondary has 300 turns.

Without the resistor in place across the secondary of Fig. 2, we should find our ammeter in series with the primary showing very little current, for the counter-e.m.f. would keep much current from flowing. But if we insert a low resistance across the secondary so that considerable current flows through it, we find our primary current greatly increased. Why is this? With no actual conducting path between the two windings, why does the current in the primary rise in sympathy with the increase in secondary current?

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Fig. 1—How an r.f. transformer looks in radio diagram. Note that while the primary is supposed to have 2 and the secondary 6 turns the schematic does not show the exact number.

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Fig. 2—Step-up transformer with iron core.

The answer lies in what happens to the magnetic flux passing through the core when no current is being drawn from the secondary, this flux produces a bucking e.m.f. (electromotive force or voltage) that holds the primary current down to a very low level.

Don't hurry past this bucking e.m.f.—it's the important part of the story! The magnetic field which produces an e.m.f. of nearly 5 volts per turn in each turn of the secondary also produces a voltage of almost 5 volts per turn in the primary, the current in the secondary goes down as the voltage goes up. Suppose we input 50 watts to the primary of our transformer and ignore losses. That means that we have 50 watts available in the secondary. We can take our 50 watts in any combination of volts and amperes whose product is equal to 50. For example, we can have 10 volts at 5 amperes, 50 volts at 1 ampere, 100 volts at 0.5 ampere, and so on.

Evidently, any increase in the power taken from the secondary results in an increase in the current flowing through the primary. The actual d.c. resistance of the primary is seldom great enough to hold the current down to the current-carrying capacity of the wire, and the counter-e.m.f. or self-inductance of the primary is depended upon to prevent the current from rising too high. If such a heavy load is placed upon the secondary that the counter-e.m.f. is lowered too much, the wire of the primary will overheat and the transformer be destroyed, in spite of the fact that the secondary winding is heavy enough to carry its current safely.

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Transformer losses

We have been ignoring transformer losses about as long as we can, so we may as well take them up here and now. Outside of the small loss due to the resistance of the windings, transformer losses usually take two forms: hysteresis losses and eddy-current losses. When an a.c. voltage is impressed across the primary of a transformer, it produces in the iron core a magnetic field which reverses direction at twice the line frequency. Under the compulsion of this field, the atoms of the core have to keep shifting their position through 180 degrees to have their individual fields lined up with the reversing polarity of the primary field.

Now magnetic substances possess a quality that might be termed magnetic inertia, for they tend to retain any magnetism they have once acquired, and it takes energy to get rid of it. The magnetism in such a substance—because of this inertia—always lags behind the magnetic force trying to change it. This resistance to magnetic change is called hysteresis, and the energy expended in overcoming it is called hysteresis loss. This loss appears in the form of heat developed in the core material.

In some materials the molecules permit themselves to be flipped around with comparatively little resistance, while others are harder to change than bad habits. Hard steel has a high hysteresis loss, while annealed silicon steel has a comparatively low one. This explains why silicon steel is the favorite transformer core material.

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Eddy currents

If we used a solid steel core like that of Fig. 2 for our transformer, the closed core would act as a single-turn secondary and have a low voltage induced in it by the varying magnetic field passing through it. This would produce circular currents—which would flow at right angles to the main magnetic field—in the core, as shown in the cross section of Fig. 3. These currents would be very large because of the low resistance of the large cross section of the core material. They would heat the core and waste energy. Such core currents, because of their circular direction, are called eddy currents.

To reduce eddy currents, the core is built up of thin sheets of metal insulated from one another, as shown in Fig. 4. Eddy currents still flow in each separate lamination, but because the cross section of the lamination is small and the silicon present adds to the resistance to current flow, the eddy currents in the individual laminations re-
main comparatively puny—so puny, in fact, that the sum of all the little eddy currents does not add up to anything like the big papa eddy current we had with the solid core.

As the frequency is increased, eddy-current and hysteresis losses go up; that is why we find air-core transformers being used at radio frequencies. In some cases a special form of powdered-iron core—made up of very minute particles of iron insulated from each other and glued together—is used as the core for radio-frequency transformers. If the core is adjustable, it can be slid in and out to vary the inductance of the coil and tune the circuit.

The radio engineer can do almost as many things with a transformer as a woman can with a bobbin pin. He uses it to step voltages up and down, to transfer an a.c. voltage from one circuit to another without disturbing the d.c. components in the two circuits, to provide a low-loss coupling between two different impedances. Isolation transformers are becoming popular for providing the radio technician with a 117-volt line current that does not have one side grounded, as is shown in Fig. 5. This is very useful in working on a.c.-d.c. receivers which employ one side of the line for B-, since it reduces the chance of shock. (Sometimes, however, you will get oscillation in an a.c.-d.c. receiver thus isolated from the power line.)

A common requirement in a radio receiver is to have two separate low voltages for heating the filaments of the tubes and a high voltage for use in supplying the B-voltage. Instead of using three transformers, we can use a single transformer with three separate secondaries, as diagrammed in Fig. 6.

Transformer troubles

The main troubles encountered in transformers are open windings, shorts between windings, shorts between turns of the same winding, and shorts between a winding and the core. If a single turn is shorted out, very heavy current flows through it and quickly develops a great deal of heat, damaging the insulation of neighboring turns and producing more shorted turns. However, if a well-built transformer is not subjected to overload; if voltage surges, such as are produced by lightning, are not allowed to enter the primary; and if insulation-destructing moisture is kept out, a transformer is a highly efficient, trouble-proof electrical device.

Do not touch or move anything in a transformer without first shutting off the line. When we have touched on several different phases of transformer action, the subject is by no means exhausted. We will return to it later when studying such special cases as i.f. transformers, in which both the primary and secondary windings are tuned to the a.c. frequency being passed. In the next chapter, though, we are going to see what happens to this electron we have been hounding through coils, capacitors, and resistors when it enters the vacuum tube. Do not miss this special attraction!
The Motorola VT73, a 7-inch 33-pound television receiver

The Motorola model VT73 portable televsion may be the answer to the TV receiver problems of apartment house dwellers and others who have neither space for a larger receiver nor facilities for erecting an outdoor antenna. The receiver is designed to receive eight of the 12 TV channels. It is 9¹⁄₂ inches high, 18¹⁄₂ inches deep, and 17⁷⁄₈ inches wide. Its weight is only 33 pounds complete with its plug-in adjustable dipole antenna. Having only four front-panel controls, it is easy to operate. The controls are: channel selector, vernier tuning, contrast, and volume control and on-off switch. It has a 7-inch picture tube which produces a 4 ⁵⁄₈ x 5 ¹⁄₄-inch picture. A transformerless voltage-doubler-type, low-voltage power supply which operates from 117-volt a.c. lines is used.

The circuit in detail

The circuit of the VT73 is shown in Fig. 1. Input connections are provided for 75- and 300-ohm antenna systems. C2, L51, and a length of 75-ohm coaxial cable form a highpass filter designed to reject signals within or close to the i.f. passband.

The permeability-tuned antenna coils connected between S3-a and S3-b match the impedance of the antenna to the input of the r.f. amplifier on channels 1 through 6. Since the input impedance of the amplifier varies inversely as the frequency, the impedance of the circuit is low on the high-band channels and no tuning is required.

The coils connected to S3-c and S3-d are in the plate circuit of the r.f. amplifier V1. Capacitor C85 is inserted in series with L30, L31, L32, and L81 to provide a suitable load for the high-band channels. L60 through L63 are tuned to the video carriers and L64 through L67 to the audio carriers of the low-band stations. This results in a flat-top r.f. response. L81 is tuned to the center frequency of channel 9 or 10. The output of the r.f. amplifier is capacitance-coupled to the grid of the converter V17-a.

The high-frequency oscillator V17-b, half of a 12AT7, is coupled to the grid of the converter through C7, a 2-µuf capacitor. The oscillator coils are connected to S3-e and S3-f.

The intercarrier system is used for sound. The i.f. amplifier has three stages common to video and audio channels. The converter output transformer T1 is over-coupled to provide the same bandwidth as the stagger-tuned i.f. stages. The video i.f. carrier channel is 26.2 mc on channels 2 through 6, and the audio carrier is 21.7 mc. The carrier frequencies are 22.9 and 27.4 mc, respectively, on the high band.

The first and second i.f. stages are biased by a voltage developed by the detector. This voltage is filtered by R145 and C13. These stages are connected in series between B-minus and 250 volts positive (the B+ terminal) to balance the current drain between the 150-volt (B-+) and 250-volt buses. Note that the d.c. bias is applied directly to V2. As the grid of this tube goes more negative the cathode of V3 goes more positive, thus effectively biasing its grid more negative.

The third i.f. stage is connected in an unusual manner. Its plate and screen grid are supplied from 250 volts positive, and its cathode is returned to a point 125 volts positive. This connection also helps to stabilize the loads on the low-voltage power supply.

The detector is a 1N34 germanium diode, capacitance-coupled to V5, a 6AU6 video amplifier. The output of the detector consists of the video signal complete with sync pulses and the frequency-modulated 4.5-mc heterodyne produced by the beating between the video and audio carriers. L38, L39, and C24 form a low-pass filter which removes the i.f. harmonics.

An amplified replica of the detector output appears on the plate of the video amplifier. A 4.5-mc audio i.f. limiter amplifier is capacitance-coupled to the video amplifier plate through C170, L43, and C31, which constitute a bandpass filter. The grid circuit of the limiter V6 is peaked at 4.5 mc by adjusting the slug in L43.

The audio detector is a conventional ratio detector using a 6AL5 duo-diode. Its bandwidth is approximately 180 kc. This stage feeds a two-stage audio amplifier consisting of one triode of a 12SN7 and a 25L6-GT power amplifier working into a ¾-inch PM speaker.

Electrostatic picture tube

The picture tube is a 7JP4, a type using electrostatic deflection and focusing. The output of the video amplifier is positive. Its signal is therefore applied to the cathode of the picture tube for correct polarity of the picture. L70 and R156 form a peaking circuit to provide uniform gain at video frequencies. The video response is 3 db down at approximately 3.7 mc.

Instead of using the d.c. picture component to control the average illumination of the picture, a special stabilized brightness circuit is used. The C-R tube cathode current returns to B-minus through R124 and a part of the brightness control R100. This develops a bias which corrects for variations in line voltage and the high-voltage supply. Some of the output of the video amplifier is tapped off at a point on the plate load and applied to the first of a pair of cascade-connected clips. It is these tubes which remove the sync pulses from the composite signal so they can be used to control the sweep oscillators. The first clipper V10-a is biased to cutoff under normal conditions. When a positive sync pulse reaches the grid of V10-a, it drives it positive and into the grid-current region. This charges C44 and builds up a charge that keeps the tube from conducting except on positive sync pulses. The second clipper V10-b operates in much the same way.

A low-pass filter (integrator) consisting of R44, R45, C47, and C48 separates the vertical sync pulses from the horizontal and applies them to the grid of V18-b, one triode of the multivibrator-type vertical sweep oscillator. The multivibrator consists of V18-b and one triode of V8, the vertical output tube. (Continued on page 54)
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Note that the plate of V18-b is capacitance-coupled to the grid of one triode of V8. The plate of this triode is coupled back to the grid of V18-b to produce a free-running sawtooth oscillator. A part of the output of the oscillator section of V8 is tapped off and fed to the remaining triode which is a phase inverter producing a sawtooth with polarity opposite that of the oscillator. Both plates of V8 are capacitance-coupled to the 7JJ4 vertical deflection plates.

The horizontal sweep voltage is generated by triode V11-a connected as a blocking oscillator. The output transformer T10 has two windings, one of which is in series with the plate and the other in series with the cathode of V11-a. The voltages across the windings being equal and opposite, they can be used to drive the horizontal deflection plates of the C-R tube in push-pull.

The horizontal oscillator is controlled by an automatic frequency control (a.f.c.) circuit which reduces the effect of noise and poorly shaped sync pulses. Instead of triggering the oscillator with each received sync pulse as in the vertical oscillator, the a.f.c. circuit controls the frequency and phase of the oscillator by comparing the phase of the incoming sync pulse with the retrace pulse from the horizontal sweep. The sync pulse appears across the primary of T9 where it is distorted into an a.c. wave by C163. This sine wave appears across the secondary of T9 and on the plate and grid of the diode-connected triode V11-b. R128 damps the secondary. R133 in series with C169 differentiates the horizontal sweep voltage (appearing across C158) into a sharp negative pulse and applies it to the cathode of the a.f.c. diode V11-b. This negative pulse on the cathode is equivalent to a positive pulse on the plate. The effect of the sync and negative retrace pulses on the plate-cathode potential of the diode is shown in Fig. 2. The time at which the sync and retrace pulses coincide is determined by the speed of the horizontal oscillator. If it is fast, the retrace or firing pulse moves up the slope of the sync sine wave as in Fig. 2 and the diode forces more current through R133 and R154, thus increasing the bias on the oscillator and slowing it down: If the oscillator is slow, the firing pulse moves down the slope of the sync wave (Fig. 2-b) and the diode passes less current through R153 and R154, thus reducing the bias on the oscillator. With the diode in this way, C154 does not charge to its normal value and the oscillator speeds up.

The high voltage is supplied by a conventional r.f. power supply using a 2SL6-CGT as a 140-kc oscillator and a 1B3-GT/8016 high-voltage rectifier.

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Jumping to conclusions is bad business, but sometimes it pays

By GUY SLAUGHTER

I'm leaning lazily on the counter wondering whether Pedro is going to show up this morning, when I see him come bounding across the street at a dead run. He shoots through the door, slides to a stop in front of me, and stabs me with a burning glare.

"You're late," I say casually, ignoring the look.

"What a dirty trick!" he gasps, glaring harder.

"Huh?" I query, surprised. "Dirty trick?"

"You know what I mean," he pants. "That filter capacitor."

"What filter capacitor?"

"The one you gave me last night."

"What about it?" I demand.

"It's no good," he snaps. "As if you didn't know."

"News to me," I say calmly. "What makes you think it's no good?"

"I put it in my girl's set, and it still hums," he accuses.

"Pedro," I say pleasantly, "you jump to too many conclusions. You told me you needed a filter, and I gave you one. To the best of my knowledge it's good."

"How come the set still hums?"

"Apparently it wasn't filter hum in the first place."

"Listen," Pedro says darkly. "I've watched you fix a thousand a.c.-d.c. sets. You turn the volume way down, and if the hum is still there, you change the filters."

"Uh-uh," I reply. "First I check the plate voltage. If it's way below normal, then I change filters. How was the voltage on your girl's set?"

Pedro stares at me a minute, and then his attitude changes. He drops his hands to his sides, bunches his shoulders up to rub his chin, looks at his feet, and clears his throat embarrassedly.

"I don't know," he says in a small voice. "I didn't check it."

"Fine," I purr pleasantly. "So you jumped to that conclusion, too."

"Like I said," he mutters, "you always jump to conclusions."

"Sure, Herk," Pedro declared fervently. "No more conclusions."

I stare at the floor pointedly until he starts for the broom, and then I head for the bench in the back room. There are just three radios in the "to be repaired" rack, and I dive into them, wondering how I'm going to meet my bills with business so bad. Pedro comes back while I'm finishing the last one.

"Herk," he says, and I can tell there's something on his mind.

"Yeah, Pedro?"

"Now that I've got a girl," he begins, rubbing his ear with his shoulder, "I need more money."

"Sure, kid," I agree sympathetically. "I could use more myself."

"I mean I want a raise," he adds, his face twisting. "He looks me in the face, and stops squirming.

"Oh," I say. "Like that, huh?"

"Okay, Herk," he agrees, and something in his voice tells me he's got one of his ideas. "Maybe business'll pick up, huh?"

"Yeah," I grunt, reaching for the iron and diving back into my chassis. "If it doesn't, we'll both be looking for jobs."

I finish the repair, load the sets into

(Continued on page 58)
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the truck, and start on my rounds. When I get back, Pedro is sitting at my
desk behind the counter. There is a
whole stack of 6-inch paper recording
discs in front of him.

"Hi, Herb," he greets me, self-con-
sciously.

"Hi, Pedro. Where the devil did those
come from?"

"We bought 'em."

"Who did?"

"We did," he asserts. "The salesman
just left. Got a good buy."

"That's fine," I reply, trying to keep
the old plate current from rising. "How
much?"

"Seven cents apiece," Pedro says
proudly. "He wanted eight, but I fi-
nagled him down to seven."

"How many did WE buy?" I manage,
hoping I can keep from choking me a
boy.

"Two hundred," he says calmly.

"Two hundred!" I echo. "That's
fourteen boxes. The last twenty-five
recording discs I had to sell for a
nickel apiece to get rid of them. Now
you buy two hundred at seven cents."

"The thing is," he avows confidently,
"we got a use for 'em."

"We got a use for fourteen bucks,
too," I growl. "Who sold you those
things? Call him up and tell him we
want our money back!"

"Can't," Pedro says laconically.

"Traveling man. Wouldn't know where
to find him."

I go back to the service bench to cool
off, and spend an hour or so trying to
make my eyes focus on the print in a
magazine. When I finally give up, it's
quitting time. I flip off the big switch
and go out front to find Pedro asleep
at my desk. I shake him awake.

"Okay, Pedro," I say quietly. "Time
to go home."

"Good," he agrees. "This is Satur-
day.

"Yeah. Payday." I dig deep and pay
him off, and then I do a very difficult
thing. "Pedro," I say gently, "I'm afraid
you better look for another job."

His eyes get very big, and he stares
at me a full minute. Then he clears his
throat before he speaks.

"If it's about the records, Herb, I
bought them to ... ."

"No, kid," I interrupt him. "It's just
that ... I can't give you a raise, and
things are tough ... and I've got some
obligations to meet, and ... well ...
I just can't afford any help, that's all.
"I see," he breathes slowly. He ex-
tends his hand with his pay still
clutched in it. "I ... I don't really
need this, Herb," he offers. "Want to
borrow it for a while?"

"Keep it, Pedro," I say gruffly.

He gets up, turns on his heel, and
walks out of the door without a back-
ward glance. I blink my eyes a couple
of times, and then lock up and go home.

Monday morning I come down to the
shop feeling sad. I notice the stack of
home-recording discs is gone, and figure
idly Pedro must have picked them up
on Sunday. I make a mental note to
call him one of these days, and get the
shop door key from him. I spend the
rest of the day dusting off my merchan-
dise and feeling blue. I get just two
service calls and four store customers;
three of them have tubes to be tested,
and one wants to sell me a used radio.

Tuesday morning is the same old
story: no business. I just sit around
and listen to soap operas and feel
blotto.

Tuesday afternoon a pleasant-looking
lady comes in haggling a table model
combination. She sets it down on the
counter and smiles broadly.

"I'd like this fixed, please," she says.
"The phonograph sounds fuzzy."

"Sure, lady," I answer, making out
a repair ticket. "Pick it up tomorrow?"

"Fine," she says. "That was a very
clever advertising idea." She puts the
ticket in her purse and leaves, and
while I'm pondering over her remark,
the phone rings. It's a fellow who wants
his record changer picked up, and he,
too, says something about "good adver-
tising."

The phone rings constantly after that,
and people begin to swarm in and out
in a steady stream; about 90% of them
want record changers repaired.

At closing time I count forty-
three service jobs on the books since
noon, and I wonder whether Pedro has
found another job yet.

I call him up, first thing next
morning, and his mother tells me he's
not home. I hang up, and just then he
walks in the door, looking embarrassed.

"Hi, Herb," he greets me. "I forgot
to leave you your key."

"Pedro," I ask, "how'd you like your
job back?"

His face lights up like a 117Z6.

"With a staff."

"Not right away," I demur. "But if
business keeps up like it was yesterday,
yes."

"It's started already, hunh?" Pedro
nods thoughtfully. Where's my broom?"

The phone starts to ring again, and
between it whirring in and out, it be-
comes a very busy day. I find
myself whistling at the bench whenever
I take time to listen to me, and Pedro
keeps shouting back that he's getting
writer's cramp from making out repair
tags. Things are still going strong when
three o'clock comes, and I gather up
the phone-in cards and start off on my
rounds.

"Hi, Herb," Pedro hails me, smiling
pleasantly when I get back. "Oodles of
business."

"Yeah," I drawl thoughtfully. "Pedro,
a lot of people have complimented me
on my clever advertising stunt. Know
anything about that?"

"A little." He blushes, and looks at
the floor.

"Come on," I encourage. "Give."

"Well," Pedro begins, solemnly. "I
started to tell you why I bought those
record discs, and you wouldn't let me."

"Okay," I say testily. "Now I'm let-
ing you tell. What's the gimmick?"

"Simple," Pedro answers, staring at
the floor. "I bought two hundred discs,
and spent all day here Sunday, cutting
them on one of the recorders."

"Yes," I murmur blankly. "And?"

"Well, I put band music on one side
of them, and a commercial on the other.
Yesterday I delivered them door to
door."

"Yeah," I say admiringly, as a light
begins to flash inside my head. "I get
it. People find phonographs on the
porch, and they get curious. Most every-
one has a record player, so they play it
and it's music. Then they play the num-
ber two side, and it reminds them that
in case their set isn't in perfect con-
dition, Valley Radio, Herb Newton,
Prop., is ready, willing, and able to
make it perfect. For a small fee, of
course."

"That's it, Herb," Pedro acknowled-
gedly, and I say, at me hopefully.

Two hundred discs, two hundred poten-
tial customers. Whenever business slows
down, we'll make some more."

"Not too hard, Herb," Pedro pro-
tests, scratching his chin smugly. "Only
three hundred and seventy-five like that.
The other twenty-five, . . . ."

He's interrupted by the jangle of the
phone. He picks it, then hands it to me.

"For you," he says. "Personally."

"Herk Newton," I say. I listen for
a moment and say a few words. Then I
hang up. "Johnson's jewelry store," I
tell Pedro. "Johnson's coming over.
Wonder what he wants to see me about?

"The other twenty-five," Pedro lets
out casually. "He's one of 'em."

"One of 'em?" I echo.

"Yeah," Pedro says. "The other
twenty-five discs went to store owners.
One side carried music, and on the other
recorded a different kind of com-
mercial; I said if they wanted the latest
thing in advertising, they should con-
tact Valley Radio, Herb Newton, Prop.,
and find out how to get their own mes-
sages onto phono discs and distribute
them to the public at small cost."

"Yeah," I vocalize thoughtfully. "But
Pedro, cutting discs for store owners,
probably thousands of discs, is out of
our line. We're in the radio business,
not the disc-cutting business."

"Trouble with you," Pedro pronounces
complacently, trying to hide his smile,
"is you jump to conclusions."

"Meaning?" I query.

"Meaning we don't cut discs for 'em.
We sell 'em each a recording outfit and
let them cut their own."

"Yeah," I breathe reverently, men-
tally multiplying my mark-up per re-
corder by twenty-five. "Yeah, Pedro.
That's wonderful."

"I thought you'd like it, Herb," he
says casually.

"And Pedro," I continue softly.

"Yes, Herb?"

"As of now, Pedro, you got a raise."

Pedro raises his hand to his mouth
to stifle an imaginary yawn.

"Raise?" he says nonchalantly. "Oh,
sure. I had already jumped to that con-
clusion. When do I get the next one?"
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Inserting dry rectifiers in place of tubes is simple and profitable

By JOHN B. LEDBETTER

HE miniature selenium rectifier first became popular in the radio service field as a replacement for the 35Z5 in a.c.-d.c. receivers. Its adaptability and ruggedness soon made it a universal replacement item in industrial and electronic fields as well as in radio servicing. This miniature has made possible the design and manufacture of extremely compact, efficient, and transformerless power supplies, built around one selenium cell operating as a half-wave rectifier, or around any number of such rectifiers connected in full-wave, full-wave bridge, doubler, tripler, or quadrupler circuits. For special circuits requiring high voltage and extremely low current (such as television and oscilloscope sweep circuits), the voltage multiplication can be carried even further.

In addition to the features just mentioned, the selenium rectifier has the following six advantages over the vacuum-tube type: instant operation, better voltage regulation, low ripple output, lower heat dissipation, higher efficiency, and increased ruggedness and adaptability to rough handling. When the rectifier is used to replace the power transformer, it adds the advantages of low cost and elimination of a.c. hum fields. The latter reduces power supply filtering and solves the problem of eddy currents in television receivers and other high-quality receivers. Installing a selenium rectifier, particularly in small receivers and amplifiers, increases the life expectancy of such components as tubes, bypass capacitors, and batteries by eliminating the hot rectifier tube and allowing the surrounding parts to operate at a lower temperature.

The ingenuous service technician can adapt or rearrange existing power-supply circuits to obtain many of the above advantages. The following typical circuits can be altered or improved to meet special or individual requirements.

Half-wave applications
Replacing the 35Z5 in a.c.-d.c. receivers with a 100-ma selenium rectifier requires two additional resistors (see Fig. 1). These replace the 35Z5 pilot-lamp section and maintain proper filament voltage on the remaining tubes. R1 is a 15-ohm, 2-watt resistor (preferably wire-wound); R2 is a 200-ohm, 10-watt, wire-wound unit, or (much better) a negative-temperature-coefficient type with a cold resistance of about 1,400 and a hot resistance of 200 ohms. Such a resistor eliminates the initial current surge, thus reducing tube and pilot-lamp failures. These resistors may be either permanently wired into the circuit or mounted with the selenium rectifier on a standard octal plug (or tube base) and plugged directly into the rectifier socket.

The same measures may be employed to replace 35Y4, 35Z4, 46Z3, 12Z3, 117Z6, 50X6, 50Y6, 25Z5, and other full-wave types when connected as half-wave rectifiers. In the latter case, be sure the current drain of the receiver does not exceed the rated output current of the selenium rectifier. If the current drain is slightly over 100 ma, for example, use a 200-ma replacement. In the majority of these tube replacements, except possibly the 50Y6, the pilotlamp resistor R1 will not be required. R2, in any case, must equal the resistance of the replaced tube's filament.

In some receivers employing a 117Z6 or 117Z3 rectifier, the filament voltage is derived from a dropping resistor across the B-supply. Since the internal resistance of a selenium rectifier is much lower than that of a vacuum-tube rectifier, the output B-voltage, and consequently the filament voltages, will be correspondingly higher. To prolong tube life, a series resistor equal to the tube resistance must be inserted, either in series with the rectifier and line, or in the B+ lead (at the rectifier). The sim-

Fig. 1—Replacing 35Z5 in a.c.-d.c. receiver.

In many new applications, the selenium rectifier not only takes the place of the usual high-vacuum rectifier tube, but also eliminates the power transformer. Obviously, these two features alone permit a much smaller power supply with a resultant sizeable reduction in cost, weight, and current drain. New television receivers with selenium rectifiers in both the low and high-voltage supplies have been designed so compactly that the total weight of the receiver is less than that of the power transformer alone in similar receivers using a conventional power supply.
pleat way of determining the proper resistance for any particular receiver is first to measure the B-filament and voltages with the old tube rectifier and then note the amount of voltage increase with the selenium rectifier. The needed resistance can then be computed, since the tube and B-current drain are known or can be found quickly.

The following series resistance values are for the specific receivers named, but can be used in similar circuits: Motorola Playmate, model 61L1 -27 ohms (in series with a.c. line); Zenith model 6G001 -20 ohms; Zenith 8G005 -33 ohms. (These receivers all use a 117Z6 rectifier; the difference in

Fig. 3—Operating a portable from a.c. line. (Resistance values are due to variations in current drain for individual receivers). The Motorola model 5A5 (and similar receivers which use a 117Z6), require a series resistance of about 150 ohms.

**Typical 3-way receivers**

A number of a.c.-d.c.-battery portable receivers use a 35Z6 or 45Z6 rectifier. A typical circuit, after being adapted to a selenium unit, is shown in Fig. 2. This circuit is like that used in the Belmont 5P19 and similar receivers. In Fig. 2, the 35Z6 and its filament dropping resistor (or line cord) have been removed and a 15-ohm, 2-watt, wire-wound resistor installed across the pilot-lamp terminals; R2, C1, and C2 have also been added to the circuit. R2 is a 1,000-ohm, 1-watt, surge-limiting filament resistor; C1 is used to bypass modulated hum voltages and to reduce the possibility of common coupling between the 1A7 and the 1H6. In most cases, C1, a 50-volt electrolytic condenser, is needed to filter the remaining hum from the filament circuits. (Capacitance of C1 should be at least 20 µf; in some instances a higher value may be required.) Grid bias for the 1A5 is developed by the voltage drop across the rest of the tubes.

The power supply circuit in Fig. 3 is suitable for the operation of small battery portables using a 1R5, 1S5, 1T4, and 3S4, or equivalent line-up. For power-line operation, the filaments must be connected in series, and arranged as indicated in the diagram. In this particular sequence, the bias for the 3S4 is a function of the voltage drop across the tube filaments. Additions to the circuit are C1, C2, R1, R2, and R3. The 150-µf, 25-volt filter capacitor C2 is necessary for removing a.c. ripple from the filaments. The constants shown in Fig. 4 may be substituted in receivers using the equivalent of a 1A7, 1N5, 1N6, and 1A6 in the tube line-up and requiring a 90-volt B-supply.

In many sets, particularly battery portables, it may be feasible to supply only the B-voltage, allowing the filaments to operate from their regular 1.5-volt batteries. Where B-power alone is required, the filament circuit can be eliminated without making additional changes. If the resultant B-voltage is higher than desired, it may be reduced by using a larger filter resistor or by using a 4,500 to 15,000-ohm bleeder from B+ to ground. With the basic B-circuit of Figs. 3 and 4, an extremely compact arrangement is possible. Where space permits, an a.c.-d.c. type filter choke (50 ma, 200 ohms) can be substituted for the filter resistor (see Fig. 5). A 15,000-ohm bleeder resistor, or wire-wound potentiometer where current drain is very small, can be added to vary the B-voltage where desirable. This feature is very helpful in experimental setups or when the supply is used as power for test instruments.

**Voltage doublers**

Two selenium rectifier stacks can be used to replace full-wave rectifier tubes such as the 50X6, 50Y5, 2526, 117Z6, etc., in a.c.-d.c. circuits, and in transformers for test instruments for low-voltage tests. A basic voltage doubler circuit employing two Federal 403D2625 rectifiers is shown in Fig. 8. The output voltage and current are dependent to some degree on the capacitance of filter capacitors C1 and C2. In a typical circuit, for example a d.c. voltage of 235 (at 100 ma) is available with filter capacitors of 20 µf, while an increase to 40 µf increases the output voltage to 280 volts. A capacitance no appreciable increase in voltage output or regulation is noted.

**Triplers and quadruplers**

A voltage tripler, capable of 300 to 350 volts output, is shown in Fig. 7-a. A selenium version of familiar doubler, 5). A 15,000-ohm bleeder resistor, or wire-wound potentiometer where current drain is very small, can be added to vary the B-voltage where desirable. This feature is very helpful in experimental setups or when the supply is used as power for test instruments.

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When the basic quadrupler circuit in Figure 7-b is used, output voltages exceeding 600 at very low current and approximately 350 at full 100-ma load can be obtained. A circuit of this type can be used in any number of applications, such as a voltage-breakdown tester for capacitors, power supply for test equipment, bias supply, universal power for the shop bench, etc.

**Vibrator power supplies**

Selenium rectifiers are rapidly gaining popularity as rectifier replacements in vibrator power supplies. Many of the new auto receivers, for example, feature 100- or 200-ma selenium rectifiers as standard equipment. The circuits in Figs. 8 and 9 represent two popular arrangements for selenium-powered supplies. The half-wave circuit in Fig. 8 is suitable for use in low-cost applications in which the vibrator life expect-
tancy is not too great. Efficiency of this type of circuit is approximately 50%. The full-wave supply in Fig. 9 is more suitable where high efficiency, long vibrator life, and dependability are important. This circuit is also used when two selenium stacks are used to replace existing full-wave rectifiers. Efficiencies of up to 70% are normally obtained with this circuit.

For highly specialized circuits in which long vibrator life is absolutely essential and where efficiencies exceeding 70% are desired, the full-wave bridge circuit in Fig. 10 is recommended.

**D.C. filament supplies**

In many cases, the design of precision or high-quality equipment can be simplified greatly by employing d.c. for the filament. In the past, design and production costs, not to mention the size and weight of a selenium unit capable of delivering the necessary filament current, were prohibitive. Now selenium rectifiers are available which deliver output currents up to 4 or 5 amperes at d.c. voltages up to and above 24. These rectifiers not only are suitable for d.c. filament and bias supplies, but also make efficient battery chargers.

The circuit in Fig. 11 is suitable for most filament or bias circuits. (In some instances the addition of an r.f. or filter choke may be desirable.) The output voltage and current of such an arrangement depends on the input voltage, the turns ratio and current-carrying capacity of the transformer windings, and the current rating of the selenium rectifier.

**Battery chargers**

Selenium rectifiers may be used in battery-charger circuits by connecting in the half-wave (Fig. 12) or full-wave (Fig. 13). By selecting a transformer having the proper turns ratio and current rating (or winding one yourself), an efficient battery charger can be built to handle either the 2-volt storage batteries used in some battery-portable receivers or regular 6-volt auto receiver batteries.

The author's thanks are due to Federal Telephone and Radio Corp., Clifton, N. J., for assistance with the diagrams and some of the information, as well as the photographs which appear with this article.

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OTBBER, 1949

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The Super-Instant soldering iron offers a new design in quick-heating irons by employing a quick-heating element to bring the tip to soldering temperature and a "bucking coil" to maintain the temperature at a preset overheating and scaling. Unlike thermostatically controlled equipment, the iron is maintained at constant heat as long as the switch is on.

The iron works directly from the 117-volt line, using no transformer either in the tool or independent of it. Weight is under 1/2 pound. In this specimen tested, wire solder was melted in 12 seconds from the time the switch was operated.

CODE-PRACTICE SET
Martin Mfg. Co.,
Brooklyn, N. Y.
The Duplex Practicode is a somewhat more substantial version of the familiar code-practice device long sold to children and beginners. A standard telegraph key is mounted on a small board with a 4-inch PM speaker and a tone producer. A flashlight cell furnishes power. Terminals are provided to connect similar sets for two-way practice.

R.F. POWER SUPPLY
Spellman Television Co., Inc.,
New York, N. Y.
This completely enclosed r.f. power supply furnishes 30 kv for use in dust precipitation, electrostatic painting, insulation breakdown tests, and projection television. Up to 100 sec may be drawn. Output may be varied down to 15 kv. The supply includes a focus control and voltage tap variable from 4 to 6 kv for use with STP4 projection tubes.

MICROPHONE STAND
Electro-Voice, Inc.,
Cleveland, Ohio
New desk-type microphone stands are supplied with a momentary on-off foot-tapp switch built in. The switch may be locked in the ON position by pressing a locking button. The switch is a self-contained unit which may be removed from the base; it is available separately.

TV PATTERN GENERATOR
Hickok Electrical Instrument Co.,
Cleveland, Ohio
A test pattern is provided by the model 620 linearity-pattern generator. The output of the generator is connected to the antenna terminals of the receiver and a switch set for horizontal or vertical lines or crosshatch. The pattern is said to be more accurate in most cases than broadcast pattern. The principal advantage of the generator, however, is that it allows the technician to align the receiver when no pattern is being broadcast or when a fringe area location may make broadcast patterns unavailable.

D.C. POWER SUPPLIES
Opal-Green Co.,
New York, N. Y.
A new series of power-supply kits for producing 24 to 28 volts d.c. from a 117-volt a.c. line is announced. The supplies are designed primarily for testing and ground operation of aircraft and marine equipment. Supplies are available with capacities of 2, 5, 10, 15, and 20 amperes each. Equipment is approved for the transformer permits adjustment of voltage.

TV TURNTABLE
Kroenke Mfg. Co.,
Chicago, III.
The Tele-Turn is a metal turntable on top of which a television receiver may be placed so that it may be faced in any direction. Heavy-gauge steel is used in the construction, and the top plate is self-covered. The bottom has rubber suction cups to prevent slipping. The heaviest receivers can be supported on the turntable, but only a light touch is required to revolve it.

KILOVOLTMEETER
Bradshaw Instruments Co.,
Brooklyn, N. Y.
The Kilovoltmeter is a two-range non-electronic voltmeter. Ranges are 0.25-5000 and 0.25-10000 volts d.c. The meter has a 20 ohm movement, input impedance on either range is 1,250 megohms.

DISC CAPACITORS
Sprague Products Co.,
The new ceramic disc capacitors consist of a dime-sized or smaller ceramic capacitor with high dielectric constant and silvered electrodes fired on both faces of the disc. Each capacitor is coated with an insulating resin.

PA AMPLIFIER
Allied Radio Corp.,
Chicago, III.
The new version of the Knight 20-watt amplifier is flat within 2 db from 30-20,000 cycles and has less than 5% distortion at full output. Hum is 80 db below rated output. A built-in equalizer and antireverb circuits are included. The low cost of the unit makes it suitable for club use.

TV ANTENNA
Word Products Corp.,
Cleveland, Ohio
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OCTOBER, 1949
European Report

By Major Ralph W. Hallows

Radio- Electronics London Correspondent

TV Program Exchange

For a long time France's only regular television transmitting station, situated in the Eiffel Tower, has been working on a 455-line system, while in Britain 405 lines is used. Both countries have interlaced scanning with 50 frames (25 complete images) a second, and with positive modulation. The French station suffers from lack of revenue, since its income is derived from TV receiving license receipts; hence its transmissions have hitherto been rather scanty, and it has not been able to pay for some of the very fine talent potentially available. And there you have the perfect vicious circle: small number of listeners = inadequate funds for TV transmissions = few program hours and not very good entertainment = small number of listeners.

We in Britain, on the other hand, are rather differently placed. To use a radio receiver we require a broadcast license costing £4; for a TV receiver the license costs £8. The government collects all the license fees (a total of about £45,000,000), takes its own percentage for collecting them, and hands the rest to the BBC to spend as its council decides. The result is that the TV expenditure is far greater than receipts, but this is counterbalanced by spending a bit less on sound broadcasting than its own license fees bring in. Now that France is to be given some of our programs to Paris at little cost to ourselves and to the considerable gain of the French listener. Paris, having saved by using our relays, will be able to splash money on a certain number of programs by French star artists. These will be relayed to us and we shall benefit accordingly.

I'm not maintaining that the 405-line system is perfect. All I can say from a good many years' practical experience of it and of systems using fewer lines and more lines is that it does provide a steady, well-defined, and enjoyable picture, so long as the transmitters have genuine bandwidth of not less than the 2.7 me for the visible channel and the response of the televiser is equally good. We shall eventually have a 1,000-1,100-line service and France is going ahead with 819 lines. But such things are very much in the future. Until some means is found of producing very-priced televisers really capable of handling the enormous bandwidths involved in definition of this order, I'm all in favor of using any system of lower definition which gives real entertainment in the home at reasonable cost to the ordinary man and woman. So far there are no signs of our being able to solve the problem of transoceanic TV relays, but it is possible to "pipe" transmissions over the whole of Europe, the American or the European Continent by coaxial or radio links.

Everyone of us wants to see television succeed in gaining the place it deserves as the finest of all sources of home entertainment. To me it seems that the surest way of bringing this about in the quickest possible way is the adoption throughout North and South America of the most highly developed system existing there (525 lines) and all over Europe that of the best developed system existing there (405 lines). Do just that and two things follow: relaying slashes program costs, though increasing entertainment value; prices of televisers come down since manufacturers can plan real mass-production schedules. And those two things are probably the most vital factors tied up today with the progress of television.

Marine Radar For All

The British Decca firm has just placed on the market what it claims is the world's lowest-priced marine radar equipment. As this sells complete for £6,000, I think they must be right, for I know of no other set made in any country at anything like the price. Don't imagine that the low price means a set of indifferent performance, or that costs have been cut by omitting some of the more complex—but very useful—features.
He finds trouble by ear

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UNITED SURPLUS MATERIALS

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Foreign News

tures of modern radar equipment. Neither of those things is possible, for no radar set can receive the certificate of the Ministry of Transport unless it complies in every detail with a very exacting specification as regards both design and performance.

All British marine radar must operate on a frequency of between 3,520 and 5,900 mc (the "C"-centimeter type). The range accuracy must be ±5% and the beaming accuracy within 1 degree of angle. The Decca apparatus is fully up to standard in both range and bearing measurements. Perhaps its most remarkable feature is its minimum range. The official specification lays down that a small object, such as a buoy, shall remain visible at a range of 50 yards. Several of our radar equipments have minimum ranges of 35 yards; but Deca has them all beaten with its minimum range of less than 20 yards—a most valuable feature for the navigation of narrow waters amid very dense fog.

This is accomplished by employing separate transmitting and receiving antennas and by cutting the duration of the pulse to 0.1 microsecond. Let that out and see whether you can discover why this should mean a short minimum range before you read further.

First of all, what is the length from front to rear of the train of waves making up a 0.1-microsecond pulse? Radio waves travel 1,000 yards in 3.05 million microseconds. Hence in 0.1 microsecond they travel 1,000/3.05 or nearly 33 yards. That, then, is the length of the train of waves composing the pulse. While the transmitter is sending out a pulse, the receiving antenna must be out of action in order to prevent damage to the receiver. It turns out that with a 0.1-microsecond pulse the receiving antenna must be cut out while the pulse is traveling 33 yards. But radar range measurements are made by timing the double journey—the time going to and the time coming back. Perhaps if the range that can be dealt with by a 0.1-microsecond pulse is one half of 33, or 16½ yards.

But that's not quite all the story. Most not all, other marine radar equipment uses a common antenna for the transmitter and the receiver, the switch-over being made electronically. Such a switch takes a small but definite time to bring about the changeover—and at very short ranges even fractions of a microsecond count. With a common antenna the minimum range for a 0.1-microsecond pulse would probably be well over 20 yards. By using separate transmitting and receiving antennas the time required for the receiver in and out can be reduced and a minimum range of under 20 yards becomes possible.

There is, of course, one other very important factor: the vertical polar diagrams of both antennas must be of the right shape and the antennas cannot be mounted so high that the skip distance between them and the surface of the water is too great.

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OCTOBER, 1949
Taking Care of Test Equipment

by H. LEEPER

Illustrated on this page are some hints on caring for your test equipment. While any single one of them may seem unimportant, the aggregate can make a difference in both the accuracy and life of your instruments. Included also are a couple of kinks which may be helpful in using test equipment.

Photo 1. If meter pointer is stuck due to static charge, blow on glass. If still no results, remove from case and blow lightly on pointer.

Photo 2. When moving pointer by hand, use a very light object such as a peg of wood or a strip of cardboard so you can judge force exerted.

Photo 3. Don't use a soldering iron over a tube tester or other instrument. A drop of solder may get into a tube socket or a jack.

Photo 4. Detachable lids of many common testers may be used to mount small parts which may be needed while using the instrument.

Photo 5. Small loop-type antenna kept with signal generator can be used for coupling signal to sets with loops. Bring two loops near each other till signal transfer is sufficient.

Photo 6. Lead container made from discarded flashlight case and fastened to side of tester keeps test leads out of way when not in use.

Photo 7. Small spring clip carried with tube tester makes easier connection to some grid caps. Tester's clip can be attached to auxiliary.

Photo 8. Metal feet obtained from dime store and fastened to bench eliminate danger of tripping over dangling leads and pulling tester to floor.

Photo 9. Wooden rack holds meters conveniently. One shown is 35 inches high, 17 inches wide. Discarded radio cabinet with few changes also makes good rack.
VACUUM service applications. Featuring exceptionally high accuracy and linearity, this quality VTVM is recommended for all laboratory and service applications. 5% accuracy on all ranges, 10 different ranges. Kit forms.

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Two separate sets of tuning capacitors for the low band and high band respectively, with automatic switch-over by means of the attached detent mechanism.

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OCTOBER, 1949

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New Patents

DIRECTION FINDER
Patent No. 2,468,109
Avery G. Richardson, Boonton, N. J. and
Arbor G. Everhart, Great River, N. Y.
(Assigned to Federal Tel. & Radio Corp.)
Practically all direction finders employ a vertical "sensing" antenna and a loop to obtain a unidirectional reception pattern. This d.f. (direction finder) has an improved visual indicator for accurate results.
The antenna A and the loop L feed energy to the receiver. The output is a varying voltage with alternate maximum and minimum amplitudes as the loop rotates. The fundamental of this output—the frequency of the loop rotation—is passed through a filter. After amplification and clipping, the signal is differentiated to obtain sharp pulses. The positive pulses trigger a gas tube circuit, which in turn excites a circular neon lamp (see small figure). The neon lamp glows once during each rotation of the loop.

Sweep Generator
Patent No. 2,469,289
Joseph G. Beard, Haddonfield, and
Leo W. Born, Collingswood, N. J.
(Assigned to Radio Corp. of America)
A masking disc rotates in front of the lamp. Where the lamp glows, light is observed at one point (through a narrow slit in the disc). The disc and the loop are synchronized, both being operated by asynchronous motors.
The disc can be calibrated in degrees corresponding to the instantaneous position of the loop. The position of the loop which gives maximum signal pickup (and therefore the direction of the transmitter) can be read off directly at the point where the glow is observed.

SWEEP GENERATOR
Patent No. 2,469,289
Joseph G. Beard, Haddonfield and
Leo W. Born, Collingswood, N. J.
(Assigned to Radio Corp of America)
Rapid TV and FM servicing requires the use of a sweep generator in conjunction with an oscilloscope. The Generator should be rugged and easy to use, and it should be capable of constant sweep, regardless of the channel in use. The mechanical sweep of this generator is both simple and effective.
The schematic shows a triode oscillator with various capacitors C to cover the different channels. An auxiliary capacitor C1 has one plate fixed and the other connected to the armature of a vibrator V. When the C1 plate vibrates, it frequency-modulates the oscillator to produce the required sweep. The motion of the vibrator can be synchronized with the horizontal sweep of an oscilloscope by generating the sync voltage with auxiliary pickup coils on the vibrator.
The maximum sweep should be about 6 mc, regardless of channel; therefore, the ratio of sweep to center frequency must be less at the upper channels. This requirement may be met by progressively reducing the voltage applied to the

TELEVISION SCOPE
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The vertical response of this economy TV scope is usable to 5000 kc, not 50 kc. Response is flat to 750 kc, down 3 db at 1000 kc. Amplifier supplies a voltage gain of 20 at 5000 kc.
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The RSE, AR-3 Scope has been built by Ross Armstrong to our rigid specifications. It's a complete unit that embodies standard horizontal amplifier and sweep circuits with normal sensitivity.
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vibrator at upper channels. Another method is to use series capacitors (C2 in the figure). These are controlled by S2, which is ganged to S1. Each of the C2 capacitors is adjusted to give equal sweep for any channel switched in.

**NEON FLASHER**

Patent No. 2,467,472
Robert B. Goshorn, Cincinnati, Ohio

(Assigned to Armstong Elec. Devices Co.)

A flashing neon lamp consumes so little current that it may be powered from dry batteries. It has been found, however, that, if the lamp is a long one (for example, 15 inches or more), the first flash generates a static charge along the glass envelope. This may prevent further flashing.

The diagram shows a flasher operated from a high-voltage dry battery. The .01 uf capacitor is charged through the high resistance, and when a critical potential is reached, the U-shaped neon lamp flashes. Then static accumulates on its glass envelope.

If a coil of wire is wound around the long lamp, the static charge induces a voltage drop along the coil and the 500-uf capacitor is charged. When the voltage is high enough, the capacitor discharges through the small neon lamp and the static charge is removed.

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We have seen, over a period of three years, a number of articles describing conversions and modifications designed to improve the BC-312 and BC-342 receivers for amateur reception. One of the most interesting of these is G3AAK's description in a recent issue of Short Wave Magazine (London) of the broadband 10-meter converter he incorporated in his BC-312.

Fig. 1.—Converter precedes BC-312 front end.

The circuit of the converter is shown in Fig. 2. The unit is constructed on a 1 x 3½-inch chassis which is mounted on the local oscillator compartment of the receiver. The converter coils do not require shielding if the r.f. coil is mounted above the chassis and the mixer coil below. One side of the chassis is fastened to the side of the oscillator tuning capacitor and the other fastens snugly against the side of the oscillator compartment. Bolts and small angle brackets are used to fasten the chassis to the capacitor.

The grid of the 6AK5 mixer is coupled through a 20-mu capacitor to the fixed plates of C24 (the 14-18 mc oscillator trimmer in the BC-312). Because this connection detunes the oscillator, C24 must be reduced until calibration is correct.

The heaters are shown in series. They may be connected in parallel if the set has been rewired for 6.3-volt heater operation. Heater voltage can be taken from the pilot lamps or any convenient source. The 6AK5's drain current total of 20 ma at 160 volts, the value of resistor R1 will depend on the available supply voltage.

The variable antenna align capacitor was replaced by a 200-mu fixed unit and a d.p.d.t. rotary switch installed in its place. This switch is used to cut the converter in and out of the circuit.

The coils are wound on ¾ -inch forms with adjustable, powdered-iron cores. L1 and L3 have 10 turns of No. 21 enamel wire. L2 is 5 turns of No. 20 wire wound around the grounded end of L3. A thin layer of insulating paper should be used between the windings. The 10,000-ohm resistors load L1 and L3 so they are substantially linear between 28 and 30 mc. The cores should be adjusted to peak the coils at 29 mc.

Fig. 2.—The 10-meter converter is a broad band r.f. amplifier. Receiver acts as variable i.f.

**MOBILE BATTERY-SAVER**

A run-down storage battery is a frequent source of trouble and inconvenience to operators of amateur, emergency, and police mobile radio stations. Installing heavy-duty storage batteries and generators does not help the situation if the equipment is used for any length of time with the motor off—as it is likely to be under certain conditions.

A solution to this problem was devised by E. W. Lindfield, chief radio technician of the Sacramento, Calif., Police Department, and described in the May issue of The APCO Bulletin. In this system, an extra storage battery is suggested for operating the radio and auxiliary equipment. This battery, installed as shown in the diagram, carries the load of the radio equipment, leaving the regular car battery in condition for quick starting. The extra
battery is automatically connected to the generator when the motor starts. It is then charged in parallel with the regular battery. A standard 60-ampere generator is adequate for charging both.

**60-CYCLE HUM**

A customer brought us the other day a little receiver of the standard 6A8, 6K7, 6Q7, 25L6, and 25Z6 type. The radio hummed. We changed the filter capacitors, which had apparently dried out. Everything sounding O.K., the chassis was put back in the cabinet after aligning the circuits. It was hardly in the cabinet before hum started again. Everything in the detector section (Fig. 1) appeared O.K.

![Fig. 1](image)

The next step was to try all the soldered joints and contacts with a screwdriver. On touching the cathode contact of the 6Q7, the hum stopped suddenly. Yet this electrode was connected to chassis with but a scant 1/4 inch of bare wire. We checked the soldered joint to the rivet which held the socket to the chassis and which was used as the chassis ground (see Fig. 2).

![Fig. 2](image)

Everything looked all right and checked zero ohms with the ohmmeter. Yet soldering a piece of wire direct from the lead of C2 to the chassis stopped the hum completely.

We deduced that the contact between the rivet and chassis was defective for the voltages and currents it was called on to carry, though it tested perfect with the ohmmeter. Thus the detector was imperfectly grounded. The set was repaired with an inch of wire. But how much time it took to determine that the piece of wire was needed!—R. B. in *Le Constructeur et Dépanneur* (France).
Question Box

CONVERTER FOR AUTO RADIO

? Please design a two-band converter covering the 200-400- and 3,000-6,000-ke bands when used with a standard automobile radio tuned to approximately 550 kc. Keeping the circuit as simple as possible I want to use factory-wound coils.—R.J.R., N. Hollywood, Calif.

A. Your needs should be met by this one-tube converter. Operating voltages can be taken from the receiver. T1 and T2 are antenna coils, and T3 and T4 are oscillator coils for the 140-425- and 2,100-6,300-ke bands, respectively. These coils should have variable power-rated iron cores for easier tracking.

C1 and C2 are 36-muf tuning capacitors which may be ganged if desirable. However, in view of the fact that the oscillator frequency must be shifted so the i.f. is 550 instead of 456 kc, it may be advisable to use separate capacitors.

INTERPHONE CONVERSION

? I have several surplus type AM-26A/AIC interphone amplifiers which I would like to convert into small PA amplifiers with a.c. power supplies. One of these is to be used with a T-17 carbon microphone and the other with a crystal microphone and pickup. Please include a simple tone control in the circuit of the high-gain amplifier.—E.A.P., Dunkirk, N. Y.

A. Fig. 1 shows the interphone amplifier as it may be converted for use with the carbon microphone. Terminal P2 on the input transformer is disconnected from ground at X and connected to the cathodes of the 12A6’s as a source of voltage for the microphone. A 50-μf, 25-volt cathode bypass capacitor must be added. The microphone jack should be a Mallory type SCA-2B or Signal Corps type JK-33-A.

Fig. 2 shows the speech amplifier and phase inverter for the high-gain amplifier. The 12J5’s are replaced with a 12SN7 and a 12SJ7. Inverse feedback is provided between the cathodes of the phase inverter and the secondary of the output transformer. While no specifications are available on this transformer, it is believed that the low-impedance terminal L is approximately 300 ohms and the high-impedance terminal H approximately 5,000 ohms. Lead A should be connected to the terminal which provides the best results. It may be necessary to experiment with the values of the resistors in the feedback network to get maximum feedback without oscillation.

The plate supply voltage should not exceed 250. A higher voltage may break down the bypass and coupling capacitors or damage the 12A6’s. The power supply should deliver 70 ma or more for low-gain amplifier and approximately 100 ma for the high-gain circuit. If the output voltage is lower than 250, you can bring it up by adding an input filter capacitor of approximately 16 μf with a d.c. working voltage of 450.

A small 0.3-volt filament transformer
SPRAGUE DISC

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These new ceramic units—no bigger than a dime—find dozens of bypass and coupling uses in both standard and FM as well as television equipment. They have higher self-resonant frequencies than conventional capacitors and fit neatly across miniature tube sockets. They’re covered with a tough, protective coating which guards against moisture and heat. Sprague Disc ceramics are available in both single and money-saving dual capacitors.

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See these remarkable new capacitors at your Sprague distributor today! Write for bulletin M 431.

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is added in series-aiding with the 6.3-volt winding on the power transformer to provide 12.6 volts for the heaters of the tubes.

The heater string will have to be rewired in both circuits.

The response of the amplifier may be improved by replacing the output transformer in the interphone with a high-quality, 15-watt output transformer having a 10,000-ohm center-tapped primary and a universal secondary. When this is done, lead A should connect to one of the low-impedance windings on the voice-coil side of the output transformer.

SURPLUS CONVERSION

? I purchased a surplus BC-603 receiver after being informed that it could be converted to receive standard FM broadcasts. The dealer could not supply conversion instructions and I was unable to obtain them elsewhere. Consequently, I ran into no end of trouble. Can you supply a conversion diagram and instructions?—K.A.P., Bronx, N. Y.

A. Before receiving FM broadcasts on the BC-603, you will have a job of rebuilding rather than converting it. This set was designed for narrow-band FM (20-kc average deviation) reception in the 20 to 27.9-mc band. The tuning components are so much larger than those required for the FM broadcast band that they will have to be replaced with units for 88-108-mc operation.

The low intermediate frequency (2.65 mc) means that image rejection will be practically nil on the FM broadcast band. Furthermore, the i.f. transformers not being designed to pass the 150-kc total deviation of the standard FM signal the over-all fidelity would be poor. It is possible that you can modify the i.f. transformers in a manner similar to that described by Robert C. Paine in his article "FM Receiver From War Surplus BC-624," in the June, 1948, issue of RADO-CRAFT. A job such as this requires lots of experimenting and patience. Good luck!
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Just attach, tighten and adjust.

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Wood screw-in type.

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An inexpensive electronic time-delay relay can be made from parts found in the junk box or purchased on the surplus market. The relay should be built with a 90- to 115-volt d.c. coil andcontacts as needed to control external circuits. We used one with a 6,500-ohm d.c. coil and p.d.p. contacts. Excitation voltage for the relay coil is developed by a small power supply using a 6X4 rectifier. This tube can be replaced by any diode having an indirectly heated cathode and capable of developing 115 volts at 20 ma or more to furnish power for the relay.

NEW USE FOR WELLER GUN

The tip of a Weller soldering gun works nicely as an electromagnet for picking up small iron or steel parts that have dropped into some inaccessible part of a chassis or cabinet. The magnetic field around the tip is strong enough to lift small objects as long as the power is on. The iron may also be used to place bolts and nuts in hard-to-reach places. Remove all excess solder from the tip and avoid smearing the part to be picked up.

FALL SPECIALS

Electrolytic Condensers
8 Mfd 450 Volt tubular $1.00 each
25 mfd 25 volt tubular w/gidgets .50 each
3 s 10 volt 400 dc cv can common neg. for 1.60
30-35-15 80 volt 30 mfd @ 30$c each
500 mfd 500 volt...$1.25

Hook-up Wire
We will ship you 5 100 ft spools of 5 colors of #20 stranded hookup wire of superb quality with 1000 volts insulation (weights about 390 lbs.) for 2.00
600 ft #14 stranded 1000 v ins. (6 lbs.) for 3.50

Oil-filled Condensers
2 mfd 600 vdc .35 each
10 mfd 600 vdc .40 each
10 mfd 1000 vdc .50 each

Write for quantity prices, on other types

Chokes (filter)
10 H max .75
300 m, $15.00 max .35
10 100 ma. .90
10 75 ma. .75

Transformers 117 volt Pri.
790 vco 5 @ 3 amps 6) v 4 amp will supply 300 vdc @ 150 ma after filter. 2.95
3000 volts ct tapped at 2500 & 2000 volts, will supply up to 1300 vdc @ 500 ma after filter. 11.50
3000 vco @ 350 ma, 1250 vdc after filter. 14.00
3000 vco @ 350 ma, 4000 vdc @ 15 ma. 4.95
2000 vco @ 40 ma at 3000 vdc. 29.00

Ordering instructions: minimum order $3.00 on our warehouse. Send 25% down, balance 30 days. Over payments will be refunded, or we will REASSURE.

ATLANTIC INDUSTRIAL CO.
Box 50, Ozone Park, L. I., N. Y.

PEN-Oscil-Lite
Extremely convenient test oscillator for all radio servicing. Ignition + small size (1-1/2" x 1-1/2") + Battery Operated + Range from 500 cyles to 2 cycles + Perfect for the home. Just plug in and work. No batteries, no trouble. + Low in cost. + Used by Signal Corps + Write for information

GENERAL TEST EQUIPMENT
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If you don't receive our FREE BARGAIN BULLETINS you're losing money!

WALKIE-TALKIE
Complete 2-way intercommunication system NO BATTERIES! NO LINE CURRENT!

$2.95 each

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WORTH 2-6121
Open daily 9 to 6-Saturday 2 to 5

FREE! MAIL TODAY!

RADIO-ELECTRONICS f or
TWIN PHONO TURNTABLES

If your record player has a heavy-duty driving motor, you can use it to drive an extra turntable for quick manual changing and for producing seventy effects.

The extra turntable should be exactly the same diameter as the original and should be as light as possible to reduce drag. It should be mounted on a free-running spindle placed so a small rubber-rollerd idler wheel will touch both turntables. Mount the idler on a slotted center so a tension spring will hold it firmly against both turntables.

W. GIBSON,

St. Catherine's, Ont.

CORRECTION

There is an error in the diagram of the Forty-Niner G-M counter shown on page 20 of the September issue. There should be a vertical line along the right side of the diagram to connect the end of the 185-1200 volt high-voltage lead and the open end of the 35-megohm blinder resistor to the lead from the bottom end of the 1-megohm resistor going to the anode of the 1B85 G-M tube.

(Write for quantity prices on all WARD TV antennas shore)

Famous-Make Model 50 ANTEenna CHIMNEY MOUNT

Sturdy all-metal mounting fits any antenna chimney. No extra wires required. Complete with hardware and instructions. Save over $50 on this unit.

MA-312S $1.75

-300-Ohm Twin Lead-in-

Don't make this great loss! Standard 300-ohm lead-in for TV and FM. Buy in quantities and save.

100 ft. $13.25

$1.40 per foot

Ceramic Condensers

Made to close tolerances, rated 500 VDC. Small size with parallel leads.

10, 100 or 500 per pkg. $1.50

Famous-Make RECORD CHANGER

And $95

Rock-bottom Prices! Takes twelve-inch turntable 35-8 inches. Perfectly balanced. 360 to 4500 r.p.m. Complete with high-quality crystal cartridge and interconnecting wires. A real deal at nearly $100. Complete with high-quality crystal cartridge and interconnecting wires. A real deal at nearly $100.

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OUTSTANDING TELEVISION VALUES

A completely factory wired and tested RCA type 630 television chassis, complete with 29 tubes, ready for installation in cabinet. Will operate 16" picture tube or smaller. Price (Less picture tube) $157.50

SPECIAL G. E. 9" TELEVISION TUBE
White screen electromagnetic deflection and focus. Brand new, type MW 22-2. Price $13.95

TELEVISION TRANSFORMER
115V/60 cycles, secondary 2500 volts at 2 MA., 6.3V at .6A. 2.5 volts at 1.75A. Price $3.85

HIGH GAIN X TELEVISION ANTENNAS
Covers channels 2 to 13 without separate section. Complete non-varying center impedance. Better than 120B front to back ratio. Can be used with 72, 150 or 300 ohm line. Works well in weak areas and gives a sharp coaxial beam. Price $6.95 each less cost. Extra for 6 ft. mast $1.35

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Stacked X Antennas for extra gain in fringe areas including heavy 10 ft. mast. Price $16.95

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Dual Speed, AC/DC. U. S. government surplus, used but reconditioned. 33 1/3 & 78 R.P.M. fully adjusted speed control, embodies a 3 tube phono amplifier with electrodynamic speaker, housed in portable, black leatherette case. Price $16.95

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"Green Flyer G. I." type reconditioned and guaranteed. Complete with 12" turntable. $8.95

AC PHONO MOTOR
33 1/3 RPM

MODEL NFRO—RADIO NOISE FILTER
Made to U.S. government specification will eliminate all line noises when properly connected to radio television, motors, and electric appliances. Will carry up to 12 amps. Price $1.95

SPECIAL
Mammoth assortment of radio & electronic parts of such items as transformers, chokes, condensers, resistors wire, coils, hardware etc. of not less than 10 pounds. Price $1.25

ESFTA TV COURSE
Empire State Federation of Electronic Technicians (N.Y.) is launching a state-wide television course in the fall and spring of 1949-50. A series of 16 lectures by representatives of manufacturers will be held in New York City, Binghamton, Rochester, and the Binghamton-Endicott area. Lectures are scheduled from September to May, with the concluding session an examination.

WARD RECEIVES AWARD
Harry E. Ward, chairman of the board of the Long Beach, Calif., Radio Technicians Association, Inc., received the Archie J. Mooney award recently from Carleton E. Webb, representing the Bureau of Apprenticeship Standards of the U. S. Department of Labor. The Technicians Apprenticeship Committee voted Mr. Ward "the most outstanding, aggressive, and valued member" in the Long Beach and harbor area for the past year.

AN OPEN LETTER
Television receiver manufacturers were addressed last month in an open letter to the industry by Max Liebowitz, writing as president of the Associated Radio Service Technicians of New York City. Pointing out that the manufacturers had been at considerable expense to finance the "Town Meetings" last year, he stated that some of the increase in television sales following this campaign was attributable to it.

No small part of the recent slump, which has hit television so much harder than other industries, may be traced to the manufacturers' turning away from the principle of "Town Meetings," says the ARSNY president. Instead of continuing to encourage the independent technician, they have, in effect, attempted to monopolize the service industry through setting up their own service organizations or dealing exclusively with large service contractors.

Their predetermined fixed fees for all installation and service discourage the special and sometimes expensive antenna installations needed in many cases. In addition, sets with overrated components were put on the market, causing breakdowns and unnecessary service calls. The television service contractor lost money on these "sour sets," and the customer lost confidence in television.

The remedy is, according to Liebowitz, for the manufacturer to quit trying to kill the golden goose and to restore the confidence in the independent technician that was expressed at the Town Meetings. The independent technician proved more than 25 years ago that radios could be serviced more efficiently, cheaply, and satisfactorily in the independent shop than in the manufacturer's service department. The same independent technician is prepared to furnish similar efficient service in the television field.

ENDORSED BY THOUSANDS!
The Instructograph Code Teacher literally takes the place of an open-air instructor and enables students to learn and master the code without the cost of instruction.

Over 300 successful cases have "acquired the code" with the Instructograph System. Write today for convenient rental and purchase plans.

WANTED
The following old N.C. citizens:
O. E. C., Fixed condenser (In wooden box with 3 bind ing posts)
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K. I. K. Plastic radio stand condenser 0.06 mm. 20 binding posts
K. I. K. Double-bit tuner with black molding All above were made between 1905 & 1910
Phonograph musical with
H. G. ABINGDON
25 West Broadway, New York 7, N. Y.

Get Your License!

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A separate book for each element of the study code formulas pertaining to the various classes of commercial F.R.C. and radio operator licenses. You need buy only those elements required for the license you want.

The F. C. C. is expected henceforth to revise questions inserted by element. Now, to keep up to date, you need buy only new element, not a complete new book!

NOW READY:
Element 2: Basic Theory and Practice
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Please do not order elements not yet announced. They will be mailed and annotated soon after the F.C.C. completes revision.

85¢
BUY FROM YOUR FAVORITE RADIO PARTS DEALER. He cannot supply EACH 1Y only pay, we will ship straight at $1 for one, or $9 for two or more.
OPPORTUNITY AD-LETS

Advertisements in this section cost $2.50 a word for 25 words or less; extra words must be included at the above rate. Cash should accompany all advertisements. Inquiries should be directed to an accredited advertising agency. No advertisement for be sent without a return card. Two recent discount issue issues, twenty percent for twelve issues. Other than the above, no advertisements not for discount. Advertisements for November, 1949, issue, must reach us not later than September 24, 1949.

WANTED TO RENT-BLUEPRINT ROOM IN HOME OF A local amateur interested in becoming a ham. Anywhere in Chicago or suburbs. Please write P. O. Box 291, Chicago, Ill.


AMATEUR RADIO LICENSING. COMPLETE THEORY preparation with printed questions and answers for radio examination. Have study and resident courses. American Radio Institute, 111 North 40th St., Oklahoma City. See our ad in Page 95.

MAGAZINES (back dates)—FOREIGN, DOMESTIC. Arts, books, subscriptions, phil-o-psy, etc. Catalog, 5c. Cicerone's. 80 First Ave., New York 17, N. Y.

RECORD CHANGER PARTS for building makers. We ship anywhere. Friends Wholesale Distributors, 106 North Sixth Street, Philadelphia 6, Pa.


BARGAINS: NEW AND RECONDITIONED ALL-\r\nRECEIVING, Hammsaudier, Melinex, etc. Other receivers, tuners, television receivers, transmitters, etc. Wholesale prices. Terms. Shipped on trial. Subject to trade-in allowance. Write, Henry Radio, Butler, Missouri. Also, 1255 Folsom, San Francisco, California.


TELEPHONE DIALS, N.E.-Type 1 Rebate $2.50. Rebate $15. All units postpaid in U. S. Kinsel Electric Products, 431 C. Sherman, Galion, Ohio.

15 TENTED ONE TUBE CIRCUITS 1c. Labora-

tories, 1223 13th Street, San Francisco.

Lancaster, Allwine & Rommel, 436 Bowen


RADIONIK, SERVICEMEN. BEGINNERS—MAKES


FREE LIST, TUBES, PARTS. METRO RADIO. 605 N. 130th St., N. Y.

TECHNICIANS & ENGINEERS! Interested in a top-

position with Raytheon? Send your letter of interest to Raytheonグ COMPANY, 500 Massachusetts Avenue, Cambridge 42, Mass.

SUREPLUS: H201 FREQUENCY METERS, clear and in perfect condition. $20.00 each. Send orders to Motion Electric Company, 411 Wood Street, Pittsburgh 22, Pa.

BRITAIN'S BEST radio month. PRACTICAL WIRE-

LINE AND PRACTICAL TELEVISION, embossed leatherbound throughout United States. Latest British-European radio telegraphy developments; exclusive articles by leading experts; newest transmitters and receivers fully described. Annual subscription (12 consecutive issues) direct to your address from London) only $2.00 from Greene News Letter Ltd. 12, Subscription Office (P.O. 463, 51 Madison Avenue, New York 17, N. Y. Two Years $4.75.

PHONOGRAPH RECORDS 15c. Catalogue. Paramount-78 and others. 715 Market St., Wilkes-Barre, Penna.

ALUMINUM TUBING, ETC. BEAMS FOR AMATEURS TV, FM. Lists free. Willard Rudder, Ohio, Ohio.

27 years experience radio repairing. Simplified system. No noise. All work guaranteed. Total price $2.00 material or COD. Mountlake station, Rose River, 3101 Grand,

DEALER-SERVICEMEN—RAYNIK Has 50% or more. No rip-off deals possible. Send us 1000 words you want to sell in an article or price sheet of typewritten material, 4105 5th Avenue, Chicago 16, Ill. 5c. Send for complete information. TELEVISION and other apparatus. House of Choice, 1049 P. O. Box 216, Gracie Square Station, New York 17, N. Y.

GEIGER COUNTER KITS, COMPLETE PARTS LIST


OCTOBER, 1949

ZENITH 9H881

The dial cord starts to slip after the set heats. If tightening the springs and applying various dial cord dressings does not help, a sure cure is wrapping three turns of the dial cord around the control shaft and tightening the springs.

HOMER L. DAVIDSON,
Fort Dodge, Iowa

SILVETONE 6405

A number of boxes have come in with C12, the .05-uf line bypass capacitor, missing from the circuit—probably an oversight on the assembly line. Although omission of this capacitor may cause hum or buzzing on some stations, this is not always the case—it all depends on the condition of the a.c. line in different locations.

Connect a .05-uf, 600-vp capacitor from the No. 3 pin on the 8252 to the negative bus for trouble-free operation.

L. E. VOIGT,
Rockford, Ill.

FORD 6MF870

A common cause of intermittent operation is a bad coupling capacitor between the plate of the 7A7 r.f. amplifier and the grid of the 788 converter. Replace this capacitor with a high-quality mica having a capacitance of approximately 100-uf (not critical). Adams Radio Service, Cleveland, Ohio

DEWALD A-503

If, when hum is present and cannot be traced to power filtering or power-line pickup, check leads to the pilot light. These leads may be long enough to touch the built-in antenna, thus producing hum. Shorten these leads to keep them from touching the antenna and eliminate hum from this source.

PETER HICKLY,
Hoboken, N. J.

SILVETONE 8052

If the volume drops intermittently and distortion sets in, check the 100-uf mica capacitor between the plate and cathode of the 756. This capacitor shorts intermittently causing the trouble. Replace it with a high-voltage 100-uf mica capacitor value.

CARL R. THORNROSE,
Chicago, Ill.

QUALITY TUBULAR CONDENSERS

MONEY BACK GUARANTEE

An example of value, the 20/20-150V condenser listed below is made for us by a standard manufacturer, sells at $1.30, and

PER HUNDRED

.001 — 600V . $ 3.95

.002 — 600V . $ 3.95

.003 — 600V . $ 4.40

.005 — 600V . $ 4.40

.01 — 600V . $ 4.40

.02 — 600V . $ 4.95

.03 — 600V . $ 4.95

.05 — 600V . $ 7.20

.1 — 600V . $12.00

EACH

.25 — 600V . $ 12.00

5 — 600V . $ 17.00

10 — 50V . $ 12.00

15 — 150V . $ 18.00

20 — 150V . $ 24.00

20 — 200V . $ 26.00

30 — 150V . $ 28.00

40 — 200-150V-25V . $ 44.00

40/40/20-150V-15V . $ 1.00

40/55 — 150V . $ 44.00

8 — 450V . $ 27.00

10 — 450V . $ 36.00

16/16 — 450V . $ 49.00

20 — 450V . $ 49.00

30 — 450V . $ 47.00

40 — 450V . $ 59.00

80 — 450V . $ 99.00

.005 — 1700V . $ 17.00

.008 — 1700V . $ 17.00

.01 — 1700V . $ 17.00

.02 — 1700V . $ 17.00

NEW LOW PRICES ON TELEVISION CONDENSERS

.05 — 2500V . $ 52.00

.1 — 2500V . $ 57.00

.25 — 2500V . $ 72.00

.05 — 3000V . $ 54.00

.003 — 6000V . $ 49.00

.005 — 6000V . $ 52.00

.001 — 6000V . $ 58.00

.0005 — 7500V . $ 48.00

.003 — 7500V . $ 52.00

.0005-10000V . $ 54.00

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Beginners, or Old Timers who want to get up speed.

A Complete Code Practice Oscillator . . .

Operates from 115v-60-cycle—Built on a small compact chassis—Variable tone control. With Kay and 11979 Tube, for near phone or small speaker. Plug in and $3.45

GREENWICH SALES CO.
59 Cortlandt St.,
New York 7, N. Y.
William Dublier, Technical Director and founder of the CORNELL-DUBLIER ELECTRIC CORPORATION, was awarded two of the highest honors of France at a ceremony held in the French Embassy in New York City.

The awards were made in consideration of his services to France both recently and during World War I. They consisted of the Honorary Medal of the Association des Engineers-Docteurs de France and the Diploma of the Officer of the Academy and the Order of Academic Palms.

Mr. Dublier's most recent service to France has been to provide—through the Cornell-Dublier Electric Corporation—emergency relief for the serious French power shortage. His service in World War I was the development of a submarine detector for the government of France. He volunteered his service to France without compensation, and carried on his work at Cherbourg. His electrical method of detecting submarines was a factor in turning the tide in the French struggle against the German submarines.

Dr. Allen B. Du Mont and Earl W. Muntz were among the recent recipients of the Horatio Alger Awards presented annually by the American Schools and Colleges Association. The Horatio Alger awards are given to leaders in American industry and government selected in a nationwide poll of school and college students on the basis of outstanding character and leadership.

Dr. Du Mont, president of ALLEN B. DU MONT LABORATORIES, conducted television experiments in the basement of his home before becoming head of "a television empire." Mr. Muntz, president of MUNTZ TV, INC., was a door-to-door radio and automobile salesman before attaining his present position.

AUSTIN C. LECARBOURNE, well-known radio journalist, publicist, and advertising man, who heads his own advertising agency at Croton-On-Hudson, New York, completed his year's term as governor of the 174th District, Rotary International.

James H. Carmine, vice-president in charge of distribution for the past two years, has been elected executive vice-president of PHILCOR, Philadelphia.

F. B. Atwood, formerly supervisor of industrial engineering and production control, has been appointed manufacturing superintendent for the radio tube plant of SYLVANIA ELECTRIC PRODUCTS, INC., Huntington, W. Va.
HEAT GUN

Stream-lined plastic grips, heat tongs, delivers full 1500° F. heat. Lightweight, counter-balanced, modern design, 6' insulated cord. "P.M. SPEAKERS"

Pair, $2.49

11 tube crystal controlled super-sensitized receiver that covers the FM band. The silvery tubes (including 2 minature 6BY5's) don't heat, and in addition make perfect interphone receivers.

RT1655

Only $14.95

FLEXIBLE CABLES:

100 feet $5.95

1000 feet $45.95

COMPRSSED AIR

Instantly Anywhere

Portable air compressor for use in all shops. Lightweight, handy-toting, on the job portable. Lifetime service-able hand-pumped on the job—no oil. Use compressed air to operate small hand tools. Indoors or outdoors. $19.95.

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The Ideal Hotel for Rest and Relaxation - Beautiful Rooms - Salt Water Baths - Glass inclosed Sun Porches - Open Sun Decks atop - Delightful Cuisine - Garage on premises - Moderate Rate Schedule.

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HOW TO GET THE MOST FROM YOUR BASIC TEST EQUIPMENT

S-55S tells HOW — in simple, direct language.

New 9th edition now off the press. 100 pages of valuable information.

Available from all leading radio parts and equipment distributors or directly from factory at only 40c per copy.

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TOP TRANSFORMER BUYS!

| Power Transformers—135V/50-60 cps input |
|-------------------------------|-------------------|
| Volts Out | AMP. | Filaments | Each |
| THTV | 110V & 220V | 6.8V/2 | $1.85 |
| 2x240VCT | 6.2V/2 | $1.95 |
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| 2x120VCT | 6.2V/2 | $2.12 |
| 2x100VCT | 6.2V/2 | $2.17 |
| 2x80VCT | 6.2V/2 | $2.20 |
| 2x60VCT | 6.2V/2 | $2.24 |
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| 2x20VCT | 6.2V/2 | $2.29 |
| 1x100VCT | 6.2V/2 | $2.30 |

Plate Transformers—115V/50-60 cps input

| Volts Out | AMP. | Filaments | Each |
| 105V | 500 | 6.2V/2 | $1.53 |
| 250V | 500 | 6.2V/2 | $1.83 |
| 400V | 500 | 6.2V/2 | $2.15 |
| 450V | 500 | 6.2V/2 | $2.30 |
| 500V | 500 | 6.2V/2 | $2.45 |

Plate Transformers—115V/50-60 cps input

| Volts Out | AMP. | Filaments | Each |
| 105V | 500 | 6.2V/2 | $1.53 |
| 250V | 500 | 6.2V/2 | $1.83 |
| 400V | 500 | 6.2V/2 | $2.15 |
| 450V | 500 | 6.2V/2 | $2.30 |
| 500V | 500 | 6.2V/2 | $2.45 |

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PROJECTION OSCILLOSCOPE

When lectures and demonstrations on electronic subjects involving oscilloscope patterns are given before large groups, making the oscilloscope traces visible to the whole audience is a problem.

Betta Electric Corp. of New York has produced a portable projection oscilloscope especially designed for large-group use. The instrument, model 701, contains a standard-type scope in a carrying case 13 x 16 x 19 inches, weighing about 60 pounds. For use, the cabinet is opened and the self-contained projection screen set on the front. The trace is bright enough to be seen in a normally lighted classroom. The screen is 16 inches wide and 12 inches high.

All the usual oscilloscope controls are present. Sensitivity is 60 mv per inch vertically and 0.65 volt per inch horizontally. Vertical amplifier response is good to 50 kc and usable to 100 kc. Horizontal sawtooth sweeps are good to 2 kc and usable to 5 kc.

FITS for your BEAM ANTENNA

Spool the building of a neat, fully adjustable, all aluminum job.
Type HASL aluminum bracket attaches half inch tubing to 1/4" osiloscope tube. 4 for $3.75.
Ask for circular showing fittings for TV, FM, and 20 meter beams.
D. H. HARRELL COMPANY
315 Fourth Street, Logansport, Indiana

SIX TUBE SUPER Three Gang Condenser

$33.30 NET
Crowe Panel Kit Extra $4.50

Ponal kit to fit most all makes (Please specify makes of car and year model). New sp-parts latest prices. Catalog available.

Bill Sutton's<br>Wholesale Electronics<br>5th at Commerce<br>Fort Worth, Tex.
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Television... Short-Wave Craft...
Television News...
Wireless Association of America...

In the October 1915 issue of ELECTRICAL EXPERIMENTER

Marconi Heads Wireless Corps of Italian Army
Tufts College Professor Devises New Wireless Control Scheme
A New Audion Receiving Circuit
A Unique Chemical Radio Amplifier
Telemeters or Control, by Radio Waves
Efficiency in the Amateur Radio Station by Thomas W. Benson
An Almost Human Wireless Receiving Set
The "Brodie" Detector, by Thomas W. Benson
Window Screen Serves as Antenna, by Donald Palmer
Dr. Cohen's New Navy Type Radio Set, by Harry Y. Higgins, R.E.
Spiral Indoor Aerials, by Irving Byrnes. Hiram Maxim's Radio Station

But ALL Prefer TWIN-TRAX*
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When it comes to high fidelity sound equipment, it's the specifications that count with engineers. And that's why they're buying TWIN-TRAX—the popular-priced tape recorder with professional specifications. Extended frequency response, wide dynamic range, low hum level, easy operation, trouble-free performance! And two tacks means twice the playing time on standard tape reels, with tape costs cut in half—a saving you don't have to be an engineer to appreciate.

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First quality—fully guaranteed.

Type 
TJ54 7" $15.95
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SPEAKER SPECIALS
3", 4", or 5" PM, less output, Alnico No. 5, each 97¢

Indoor Antenna for Television Sets
Provides excellent reception on channels 2 to 13. Handwound, solidly constructed. Smashing low price. Each 1.49

This offer expires October 31, 1949. This publication must be mentioned as your order for you to buy at these special low prices.
Dear Editor:

I read with interest the letter from Mr. William Krider in the July issue and your reply thereto. I agree with Mr. Krider in all but one instance. In my opinion RADIO-ELECTRONICS was a good magazine. Granted that television is new and radiomen should learn about it, suppose, as in the case of Mr. Krider, they don't want to learn about it. In my opinion, in selling magazines, the situation is definitely a buyers' market, which would indicate that the tastes of the readers must be considered rather than feeding them large doses of what the editors consider good for them.

The people who bought your magazine before this flood of television articles were interested in it for its contents then, and I doubt that their tastes have changed. You can lead a horse to a bar, but that doesn't necessarily mean he is going to be interested in the television there.

My interests in the magazine were in the fields of amateur radio and audio work, and as I considered that RADIO-ELECTRONICS was doing the best job of covering these fields of any of the general-coverage radio magazines, I subscribed to it. However, such is not now the case. I am inclined to believe that your version of the percentages of television articles does not tell the complete story. While there may have been the stated number of articles, in almost every instance each television article was considerably longer than articles devoted to other subjects, giving a much larger percentage of total reading matter devoted to television.

Mr. Krider and I are only two of your readers who have been moved to write you concerning this—to us—distasteful state of affairs. There are undoubtedly many more who feel the same way but have not troubled to write. A friend of mine, Mr. Wayne Brown, a radio maintenance technician with the CAA at Skwentna, Alaska, also a subscriber, has reached the point where he glances through the magazine and throws it away without reading it. Obviously the editors have one opinion as to the value of television to the magazine and no small segment of the readers have another. A poll of your readers conducted through the pages of your magazine wouldn't cost you a dime and might prove rather interesting.

Unless the magazine undergoes a drastic change and reverts to the former editorial policy, my subscription will not be renewed. I seriously doubt that Mr. Brown will renew his.

Carl L. Shute
Gulkana, Alaska

The matter of television articles in RADIO-ELECTRONICS has come up repeatedly in the past and probably will keep recurring until television has reached a density throughout the country similar to that of sound radio broadcasting.

No publication is worth its salt if it does not keep up with trends. At the
present time the television trend is on
the up-curve and will continue so until
a saturation or near-saturation point
has been reached.

It is a fact that television already
reaches between 50 and 60% of the
population in the U. S. This is a big
percentage; if Radio-Electronics did
not keep this trend in mind, it would
not stay in business very long.

It is true that the complaints on tele-
vision articles—which, frankly, have
increased during the past year in Radio-
Electronics—come exclusively from
readers who are not now located in a
television zone. But, certainly, these
readers should know and appreciate
that sooner or later they too will have
television and that now is the time to
get acquainted with it and not wait un-
til broadcasting starts.

Our present correspondent is located
in Alaska, where, of course, there is no
television at the present time. We can
readily understand his displeasure with
television articles, which at the mo-
ment do not seem to do him much good.

But, sooner or later Alaska too will
have television and we are certain that
our correspondent does not wish to be
a back number then. If there were no
television articles in Radio-Electronics,
our correspondent would then have
to start from scratch to learn television,
which, at that time would certainly
prove a handicap to him.

Contrary to the views of our corre-
respondent and others similarly minded,
Radio-Electronics' editors have no
opinions as to the value of television to
the magazine—they are only interested
in serving the majority of the readers.
And, the majority of the readers in the
United States today overwhelmingly
want television.—Editor

U.S. HAS RADIO AMBULANCES

Dear Editor:

I noticed in the April "European Re-
port" that British ambulances are now
being equipped with two-way radio. An
editor's note said this would be a good
idea for American cities.

I agree with the editor but would
like to point out that his proposal is
several years late. For the past seven
years, the Sheriff's office radio division
in Alameda County, Calif., for which I
work, has made use of such an arrange-
ment, and all major California cities
have radio-controlled ambulances, either
municipally owned or operated on con-
tact.

ARTHUR E. ALLAN, JR.,
Hayward, Calif.

CORRECTION

Dear Editor:

I noted an error in the formula given
in Step No. 4 in the calibrating in-
tuctions in my article "Frequency Bridge
for Audio" in the August, 1949, issue.
The formula now reads

\[ K = \frac{f \cdot R_1 \times R_2}{1} \]

It should be

\[ K = f \cdot R_1 \times R_2 \]

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Dear Editor:

Your August article, “Improve Your Television Pictures,” is the best thing along these lines I have seen in many years. I feel that the man in the street wants to know a little bit about his TV. This kind of thing will reduce service calls, I’m sure.

Maybe I can guess why so many people pick on radio repairmen but not on washing-machine servicemen and so on. Radio is glamorous and newsworthy while washing machines are helpful but humdrum. Everybody talks about radio and TV programs—but who talks about washing machines?

Bart Byrne,
North Pelham, N. Y.

Dear Editor:

As far as I am concerned, any of my customers who attempt to adjust their own sets will be charged for the subsequent service call it will take to put the sets back in working order.

Your article is not an asset to the trade nor to the layman.

W. R. Cobb,
Silver Spring, Md.

LIKED TRAINING ARTICLE

Dear Editor:

I want to thank you for the article, “Training for Radio,” on page 53 of the August issue. Articles written for those of us just starting in the field of electronics are not only helpful but encouraging. In aiding youth I think you are insuring a better and expanding industry for the future.

Robert C. Carden III,
Richmond, Va.
JACKSON TEST OSCILLATOR

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Written for the layman with some knowledge of general science, this volume undertakes to explain the atomic bomb, rockets, jet engines, supersonic speeds, guided missiles, automatic pilots, radar, ground-controlled approach (GCA), color television, and space ships.

The explanations are simplified to a great extent, but not to the point of the ordinary "popular" book.—R.H.D.


The service manuals of 16 television receivers, representing 13 manufacturers, are brought together in this compilation. A number of the schematics are printed in blue-print form on folded sheets a little less than twice the page size.

In view of the tremendous popularity of a small number of models, this book—supplemented by its predecessors in the same series—will probably cover a majority of the sets the service technician is likely to be called upon to handle.


The field of ultrasonics is comparatively new, and is literature so surprisingly scanty that this book is therefore all the more welcome. It gives, on the engineering level, a qualitative treatment of ultrasonic theory and a large quantity of material on practical techniques.

Various types of generators and receivers are described, with special attention given to impedance matching to loads. The action of waves in given materials is discussed at length, reflection, reflection, simultaneous waves of different types, and other considerations all being covered.

Subjects such as pulsed ultrasonic systems, ultrasonic agitation, and material testing are treated in considerable detail, with ultrasonic signaling also receiving some attention.

COMMUNICATION CIRCUITS, by Lawrence A. Ware and Henry R. Reed. Published by John Wiley & Sons, Inc., New York. 6 x 9¾ inches. 402 pages. Price $5.

This is a textbook on transmission-line theory written by two professors of electrical engineering. Prof. Ware is at the State University of Iowa and Prof. Reed at the University of Maryland.

The book was first published in 1942. In this third edition the authors have added material on high frequencies and have brought the text up to date on the basis of techniques developed during the war. The treatment is wholly mathematical, a knowledge of calculus being required of the reader.—R.H.D.

OCTOBER, 1949

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