RADIO — ELECTRONICS

formerly RADIO CRAFT

In this issue:
TELEVISION
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SERVICING

HUGO GERNSBACK, *Editor*

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OCT 1949
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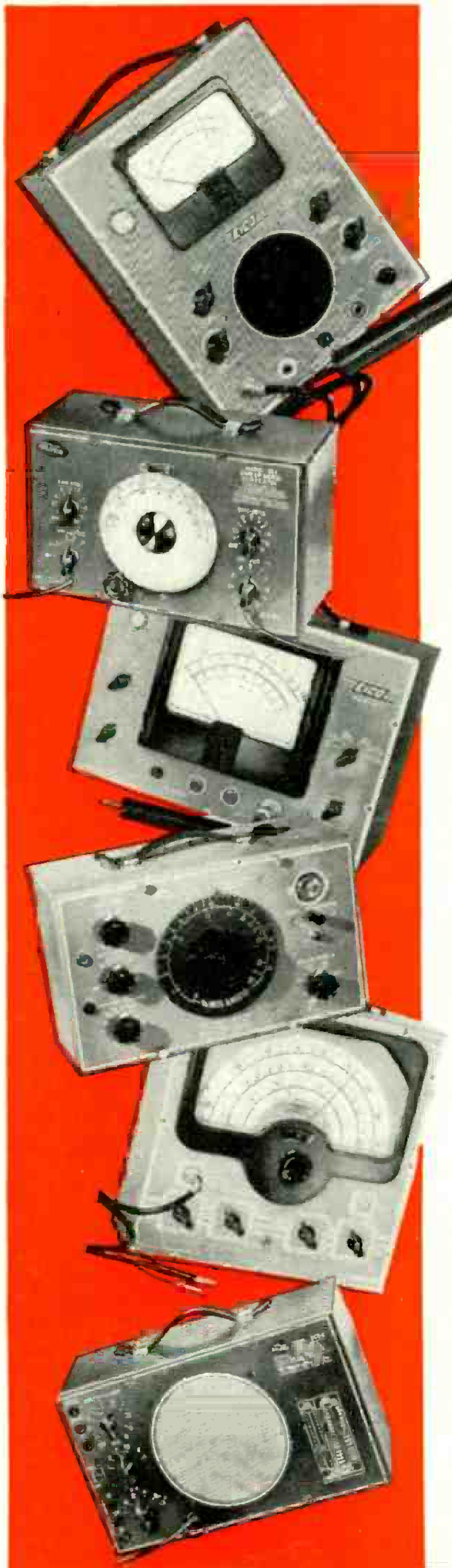

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with MANY KITS *of* MODERN EQUIPMENT I SEND

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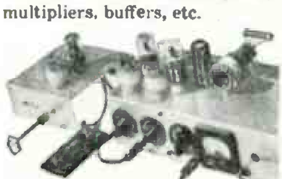
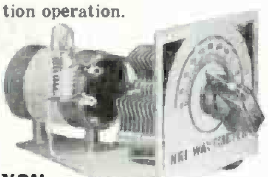
YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.



YOU SET UP code amplitude and frequency modulation circuits (put voice, music, etc., on "electrical signal" you produce). You introduce, correct defects, learn how to get best performance.



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

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

In 1945, there were 943 Broadcasting Stations. Today 2,694 are on the air! Result—THOUSANDS OF QUALIFIED MEN STEPPED INTO GOOD JOBS. Only 19 Television Stations were on the air in 1947. Today there are more than 50 and experts say there will be 150 in a few months, 1,000 within three years. That means thousands of well-paid jobs for trained Operators and Technicians. Then add development of FM, Two-way Radio, Police, Marine, Aviation and Micro-wave Relay Radio! Think what all this means! New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

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

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

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

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

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

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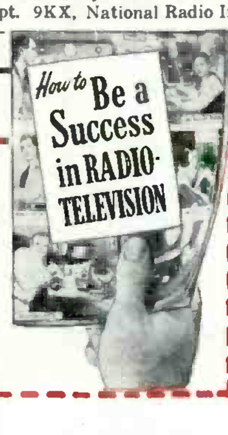

RADIO — ELECTRONICS

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Incorporating

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Contents ——— October, 1949

ON THE COVER: One of the benches of the Abington television service, showing the built-in viewing tubes for models to be checked on that bench. Service technician John Mend making the adjustments. Kodachrome by Avery Slack.

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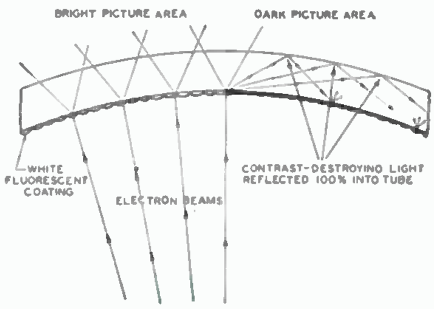
NEW GLASS for television tube faces produces greater contrast, giving sharp black-and-white pictures in well lighted rooms without need for excessive brightness, Pittsburgh Plate Glass Co. engineers announced last month.

In any television tube, as the drawing shows, light from the bright portions scatters, some travelling straight ahead and some at such 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



Reflected light can destroy picture contrast.

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 Protelgram 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 MAINTENTANCE 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.

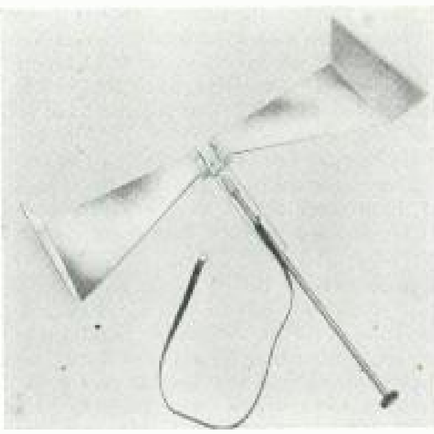
An intensive campaign of advertising by direct mail, newspapers and radio will be carried on by the organized radio technicians, with the cooperation of components and tube manufacturers, the association of manufacturers' representatives, many of the broadcast stations, and the parts distributors of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

TV ANTENNAS may not be placed on the roof without written permission of the landlord, ruled Justice William T. Powers in Kings County Supreme Court (Brooklyn, N. Y.) last month. Verbal permission is not sufficient, as it may be revoked or denied at any time. The ruling was handed down in a test case brought by Scroll Realty Corp., against Ben Mandell, a tenant in an apartment house owned by the corporation. The landlord sought to compel Mr. Mandell to remove an antenna he had erected.

COLOR TV COMMITTEE to survey the present and possible future of the art was organized last month by the National Bureau of Standards at the request of Sen. Edwin Johnson of Colorado. The Committee will study the scientific and technical phases of the problem and report to Sen. Johnson as chairman of the Senate Committee on Interstate and Foreign Commerce.

BUILT-IN TV ANTENNAS are now being supplied by Philco with their new sets. The in-the-receiver system consists of a large broad-band antenna of aluminum foil, designed to receive signals efficiently on both the high and low bands. It is tuned to the desired channel with a variable capacitor, aided by three hairpin loops, which also serve to match the impedance to that of a 300-ohm line.



Tuning knob at front of set adjusts antenna.

The tuning control is at the end of a long rod and is usually near the top of the receiver in the front center of the cabinet. The 300-ohm antenna lead is attached near the center of the large hairpin loop.

AUDIO DEGREES will be offered by a new university just chartered by the State of California. Known as the University of Hollywood, it offers a major course in sound leading to the degree of Bachelor of Science in Audio Engineering. Other courses will include film engineering, drama, music, radio, and television.

With the establishment of the new university, the Hollywood Sound Institute, a leading audio school, will cease to exist. It will be merged into the new institution under the name of the College of Audio Engineering of the University of Hollywood.

POLONIUM BRUSHES marketed in recent months to remove static charges from plastic phonograph records 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 develop.

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 information to technicians, by whose paid admissions it is 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.

The Sprayberry 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 models.

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 BRIGADIER GENERAL DAVID 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 first six months of 1949 were 61.6¢ per share, compared with 66.8¢ 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 $267,757.66, with a net earned surplus of $46,090.90.

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 compares with consolidated net income of $948,565, equal to 84¢ per share, earned on the 1,006,550 shares of common stock in the second quarter of 1948. For the six months ended June 30, 1949, common stock 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 of $49,665,548 compare with sales of $48,210,076 for the six months ended June 30, 1948, an increase of 3%.

Motorola, Inc., Chicago, attaining a new peacetime sales record for the six-month period ended July 2, 1949, provided net earnings of $1,908,255.95, 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 $29,597,308 as against $15,382,176 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 as $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, retroactive 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 1950 Heathkits have all the Features

New 1950 Heathkit

PUSH-PULL EXTENDED RANGE 5" OSCILLOSCOPE KIT

Features

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

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

$39.50

CONVERSION FOR OTHER MODEL HEATHKIT OSCILLOSCOPES

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

THE NEW *Heathkit*

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MORE *Features* THAN EVER BEFORE

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

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

$13.50

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A LABORATORY INSTRUMENT NOW WITHIN THE PRICE RANGE OF ALL

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

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

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimentors and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 micro-amp zero center galvanometer — ½ of 1% ceramic non-inductive decade resistors. Professional type binding posts with standard ¾" centers. Beautiful birch cabinet Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of *Silver* Mica, accurate to ½ of 1% and with dissipation factors of less than 30 parts in one million. Provisions on panel for external generator and detector Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

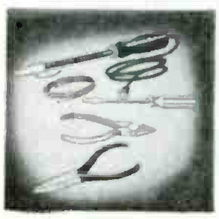
Internal 6 volt battery for resistance and hummer operation. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited. Shipping weight, approximately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

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

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

R.F. CRYSTAL TEST PROBE KIT

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



New Heathkit

TOOL KIT

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

New Heathkit

TELEVISION ALIGNMENT GENERATOR KIT

$39.50

Nothing ELSE TO BUY

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

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Heathkit TUBE CHECKER KIT

Features

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

Check the features and you will realize that this Heathkit has all the features you want. Speed — simplicity — beauty — protection against absolescence. The most modern type of tester — measures each element — beautiful Bad-Good scale, high quality meter — the best of parts — rugged oversize 110V. 60 cycle power transformer — finest of Mallory switches — Centralab controls — quality wood cabinet — complete set of sockets for all type tubes including blank spare for future types — fast action gear driven roller chart uses brass gears to quickly locate and set up any type tube. Simplified switching cuts necessary time to minimum and saves valuable service time. Short and open element check. No matter what arrangement of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker today. See for yourself that Heath again saves you ⅔ and yet retains all the quality — this tube checker will pay for itself in a few weeks — better build it now.

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

Only $29.50

Nothing ELSE TO BUY

Heathkit SINE AND SQUARE WAVE AUDIO GENERATOR KIT

Nothing ELSE TO BUY

$34.50

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

New Heathkit BATTERY ELIMINATOR KIT

Nothing ELSE TO BUY

$22.50

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

NEW *Heathkit* SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

Nothing ELSE TO BUY

$19.50

The popular Heathkit signal tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker —locates intermittents—defective parts quicker—saves valuable service time—gives greater income per service hour. Works equally well on broadcast — FM or TV receivers. The test speaker has assortment of switching ranges to match push pull or single output impedance. Also test microphones, pickups — PA systems — comes complete — cabinet — 110V. 60 cycle power transformer — tubes, test probe, all parts and detailed instructions for assembly and use. Shipping Wt., 8 lbs.

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Heathkit ELECTRONIC SWITCH KIT

DOUBLES THE UTILITY OF ANY SCOPE

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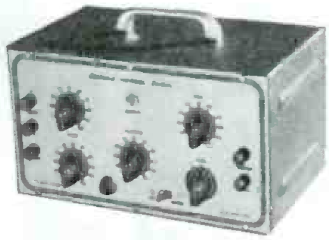


Nothing ELSE TO BUY

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

New Heathkit FM TUNER KIT

CABINET EXTRA

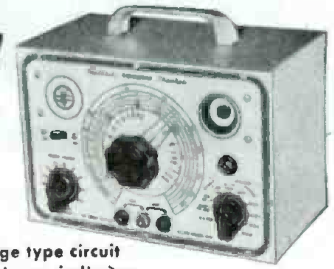
$14.75

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

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

Heathkit CONDENSER CHECKER KIT

$19.50



Features

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

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

Heathkit 3-TUBE ALL WAVE RADIO KIT

$8.75

CABINET EXTRA

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

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

Heathkit HIGH FIDELITY AMPLIFIER KIT

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$14.95

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's), two amplifier stages using a dual triode (6SL7), 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 $6.95
Mahogany Speaker Cabinet, 14½" x 14½" x 8" $8.75

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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 *dowser* 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 dowser 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 dowsing. It will be a highly profitable discovery.

PATEILOGY (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.

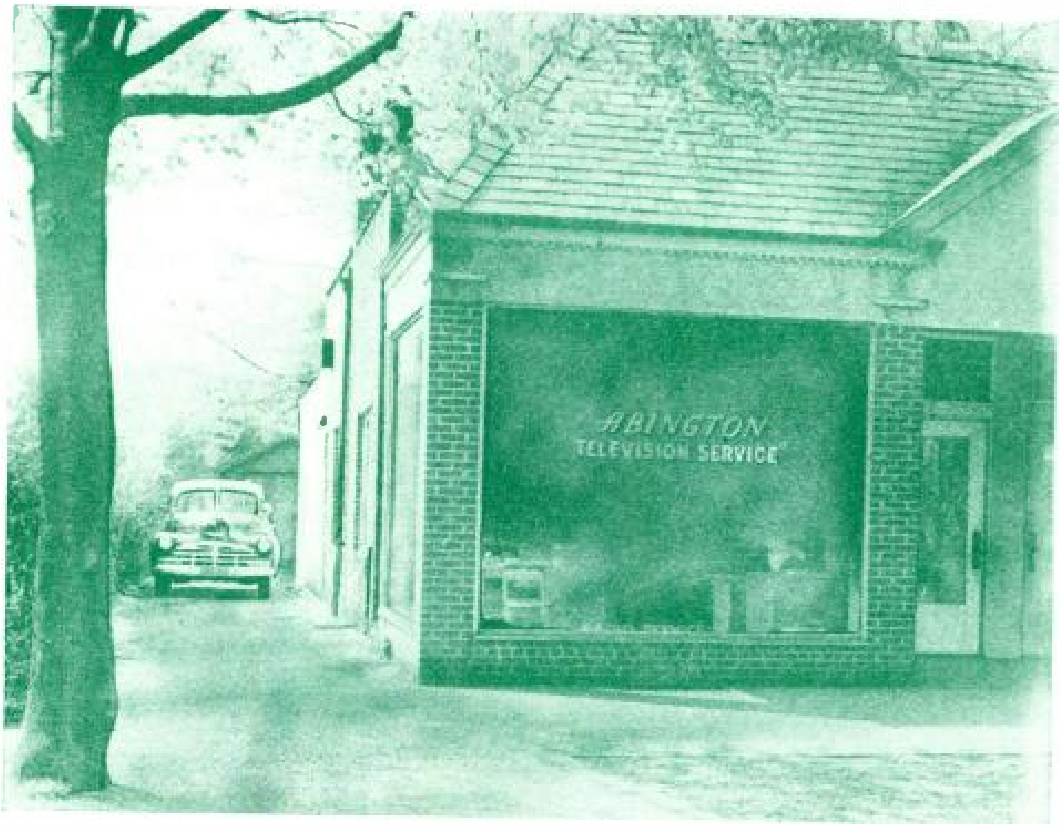
Over a century ago in Germany, lightning struck a barrel of wine. It did not destroy the cask, however, and the owner was astonished that the green wine had been aged perfectly. From that time on inventors have occupied themselves with electric aging processes. At first platinum-tipped nails were driven into barrels and attached to a battery which treated the wine or liquor 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.



Offices are on street floor. Service shop is in basement. Firm does TV installation and servicing only.

Business Methods in Television Servicing

By CHARLES WIGUTOW*

How a successful contractor built a solid business

TELEVISION service on an annual basis is a technical problem, but it is also a business. Make no mistake about that. Insurance averages are involved, as are costs, organization, customer relations, pressure from all sides, and systems of paper work and record keeping. Add the legal problems with which we in New York are now faced, and all the ingredients of an exciting business are present in a going television service organization.

We have tried to organize every detail of our structure and our work. To continue to grow successfully, this kind of organization has been necessary. A $75 charge for an installation and one year's service may sound like a good deal of money, but a year is a long time. To operate profitably within the framework of this sum, the installation must be both mechanically sound and electrically correct. Future service calls on the antenna system are expensive. The cost of only one such service call will much more than offset 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

*Abington Television Service, Garden City, N. Y.

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, each 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 shop. 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 score 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.

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 prorate 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 $75 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

ABINGTON TELEVISION SERVICE

224 7th St. Garden City, N. Y.

Work Requested

Mfgr. Model Serial No.

Dealer Address

Date Installed

Type of Roof Type of Mounting

Type of Lead In No. of Lead Ins

Hgt. of Mast Len. of Ladder Req.

Hgt. of Antenna from Ground

Type of Antenna Supplied By

Quality of Reception (G-F-S-P)
(2) (4) (5) (7) (9) (11) (13)

Customer's Signature Print Last Name

Time Arrived Time Completed

Service Engineers

Misc. Info.

Address

Date Name Phone

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

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

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.

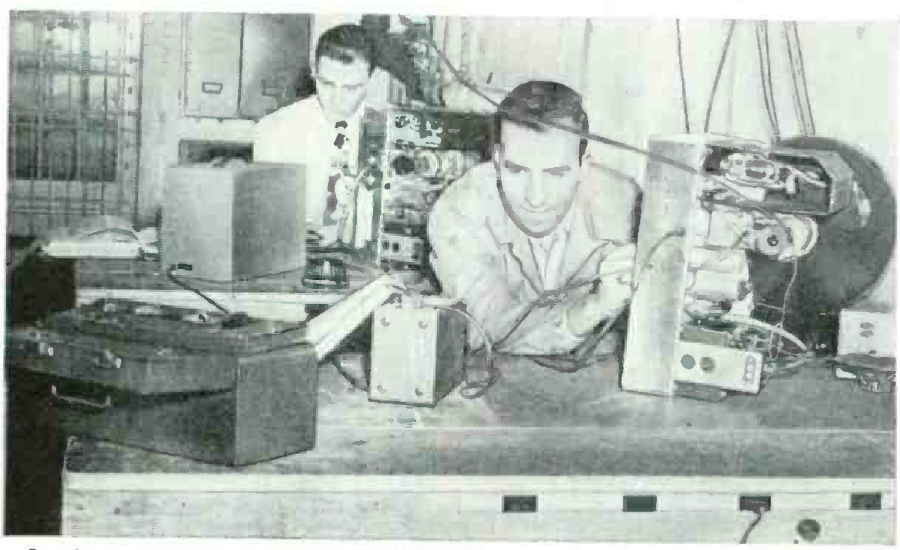
Should the customer call on us personally, his first sight of our premises is not that of a disorderly shop. Quite the contrary; he steps into a nicely furnished office and is greeted by the switchboard operator, who in turn will show him to our service dispatcher or to the person who handles all installation 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.



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

Replacing Picture Tubes in Television Receivers

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

By MILTON S. KIVER

At left is the high-voltage 3NP4 used in Philips projection receivers; center, the Philco TP-400A, another high-voltage projection tube; and above, the RCA 5TP4. In spite of their general similarity, they are not interchangeable.

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. Esentially, 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 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.

The first tube listed is the 3KP4. It has a 3-inch viewing screen and utilizes electrostatic deflection. The only set on the market containing this tube is the midget Pilot TV-37 receiver. No known replacements exist for this tube, the only other 3-inch tube listed in the table being the 3NP4, which is obviously unsuitable because it employs electromagnetic deflection and requires 24,000 volts for beam acceleration. Thus, the 3KP4 stands alone.

The next three tubes listed (the 3NP4, the TP-400A, and the 5TP4) are all projection tubes developing small, intense images which are enlarged five to 15 times by suitable optical systems. None of these tubes is interchangeable, the chief obstacles being the differences in physical size, the variations in basing, and the second-anode voltages. The 3NP4, shown in the photo, was designed specifically for the North American Philips projection system in this country. It differs so radically in design from either of the other two projection tubes that it requires a special high-voltage power supply and mounting assembly.

A physical comparison of the TP-400A and the 5TP4 tubes reveals some similarity, but when their respective electrical characteristics are examined, decided distinctions appear. First, the 5TP4 uses magnetic deflection and electrostatic focusing and hence its high-voltage power supply contains a bleeder network incorporating the focus control. In the TP-400A, focusing and deflection are accomplished electromagnetically. Secondly, each tube requires a different type of socket, the TP-400A tube using an octal base and the 5TP4 using a duodecal base. Finally, there is a difference of 7,000 volts in their second-anode potential requirements.

The TP-400A is an exclusive product of the Philco Corp. and is found only in Philco projection receivers. The 5TP4 is employed more extensively, appearing in all projection receivers not utilizing the North American Philips system.

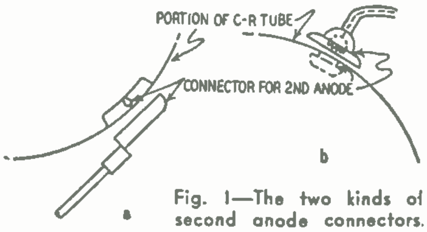


Fig. 1—The two kinds of second anode connectors.

Of the four 7-inch image tubes listed in the table only one, 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 electromagnetic deflection and electrostatic focusing and, as far as is 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. Secondly, 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 1939; the supplies built then followed 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 contacting 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's. However, the 10FP4 does not require an ion trap. Thus, when substituting a 10FP4 for either of the other tubes, the ion trap, if electromagnetic coils are employed, 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 electromagnetic 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 aluminized 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 10-inch 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 12QP4). The remarks made previously concerning the 9AP4 apply equally to the 12AP4. The 12JP4, 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 12JP4 tubes—if it does occur—because the electron gun structure in the tube is not designed to be used 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 12QP4, which has the same shape as the 12JP4, but contains a gun structure that requires an ion trap. The 12LP4 (a big

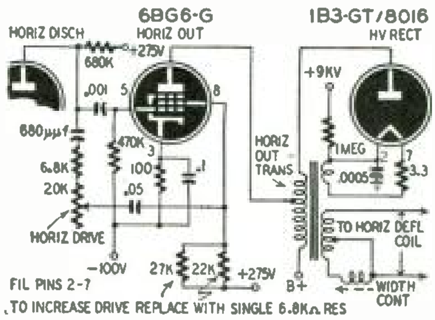


Fig. 2—Replacing resistors increases output.

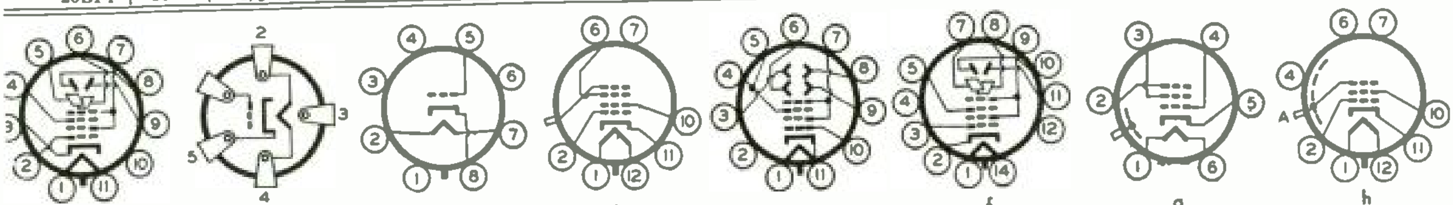
brother of the 10BP4) also uses an ion trap, while the 12KP4, having a metal-backed screen, does not. All four tubes can be used interchangeably (with the slight modification noted below) because all four possess similar electrical and physical characteristics and all use the same type of socket. If 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 12JP4 and the 12QP4 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 12LP4 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 sometimes happen when replacing a 12JP4 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 12JP4 is 146 ma while for the others it is from 11 to 36 ma less. Actually this means that the 12JP4 requires a stronger focusing field. If the set is originally designed for the 12JP4, 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

TELEVISION TUBE TABLE

Type	Screen diam. (in.)	Length (in.)	Base	Socket	Bulb contact	Total defl. angle	Type defl.	Type focus	Heater volts	Heater amps.	Focus coil ma	Ion trap	Typical Operating Cond. Cutoff bias	Grid No. 2 volts	Anode No. 1 volts	Anode No. 2 volts	Type
3KP4	3 1/16	11½	Magnal	A	None	—	E	E	6.3	0.6	—	No	-64	—	1000	2.5KV	3KP4
3NP4	2½	10	Special	B	Cup	42°	M	M	6.3	0.6	—	Metal screen	-65	—	—	24KV	3NP4
TP400A	4	12¾	Octal	C	Cavity	50°	M	M	6.3	0.6	—	Metal screen	-65	—	—	20KV	TP400A
5TP4	5	11¾	Duodecal	D	Cavity	50°	M	E	6.3	0.6	—	Metal screen	-70	200	4900	27KV	5TP4
7DP4	7 1/16	14 1/16	Duodecal	D	Cavity	50°	M	E	6.3	0.6	—	Mag.	-45	250	1430	6KV	7DP4
7EP4	7	14½	Magnal	E	None	—	E	E	6.3	0.6	—	No	-60	—	650	2.5KV	7EP4
7GP4	7	14½	Diheptal	F	None	—	E	E	6.3	0.6	—	No	-60	—	1000	3KV	7GP4
													-120		1620	4KV	
7JP4	7	14½	Diheptal	F	None	—	E	E	6.3	0.6	—	No	-180	—	2400	6KV	7JP4
9AP4	9	21	6-pin	G	Metal cap	—	M	E	2.5	2.1	—	No	-45	250	1460	7KV	9AP4
10BP4	10½	17⅝	Duodecal	H	Cavity	50°	M	M	6.3	0.6	115	Mag.	-45	250	—	9KV	10BP4
10EP4	10½	17⅝	Duodecal	H	Cavity	50°	M	M	6.3	0.6	115	Mag.	-45	250	—	8KV	10EP4
10FP4	10½	17⅝	Duodecal	H	Cavity	50°	M	M	6.3	0.6	115	Metal screen	-45	250	—	9KV	10FP4
10HP4	10	19¼	Diheptal	F	None	—	E	E	6.3	0.6	—	No	-100	—	1500	5KV	10HP4
12AP4	12	25	6-pin	G	Metal cap	—	M	E	2.5	2.1	—	No	-45	250	1425	7KV	12AP4
12JP4	12	17½	Duodecal	H	Ball cap	50°	M	M	6.3	0.6	146	No	-45	250	—	10KV	12JP4
12KP4	12 1/16	17⅝	Duodecal	H	Cavity	54°	M	M	6.3	0.6	135	Metal screen	-45	250	—	11KV	12KP4
12LP4	12 1/16	18¾	Duodecal	H	Cavity	54°	M	M	6.3	0.6	110	Mag.	-45	250	—	11KV	12LP4
12QP4	12	17½	Duodecal	H	Ball cap	50°	M	M	6.3	0.6	110	Mag.	-45	250	—	10KV	12QP4
15AP4	15½	20½	Duodecal	H	Ball cap	52°	M	M	6.3	0.6	160	No	-45	250	—	12KV	15AP4
15DP4	15½	20½	Duodecal	H	Ball cap	52°	M	M	6.3	0.6	146	Mag.	-45	250	—	12KV	15DP4
16AP4	15⅞	22¼	Duodecal	H	Metal cone rim	53°	M	M	6.3	0.6	140	Mag.	-60	300	—	12KV	16AP4
16FP4	16⅛	20¼	Duodecal	H	Ball cap	62°	M	M	6.3	0.6	146	Mag.	-45	250	—	13KV	16FP4
19AP4	18⅝	21½	Duodecal	H	Metal cone rim	66°	M	M	6.3	0.6	146	Mag.	-45	250	—	13KV	19AP4
20BP4	20	28½	Duodecal	H	Metal cap	50°	M	M	6.3	0.6	140	No	-45	250	—	15KV	20BP4



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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.

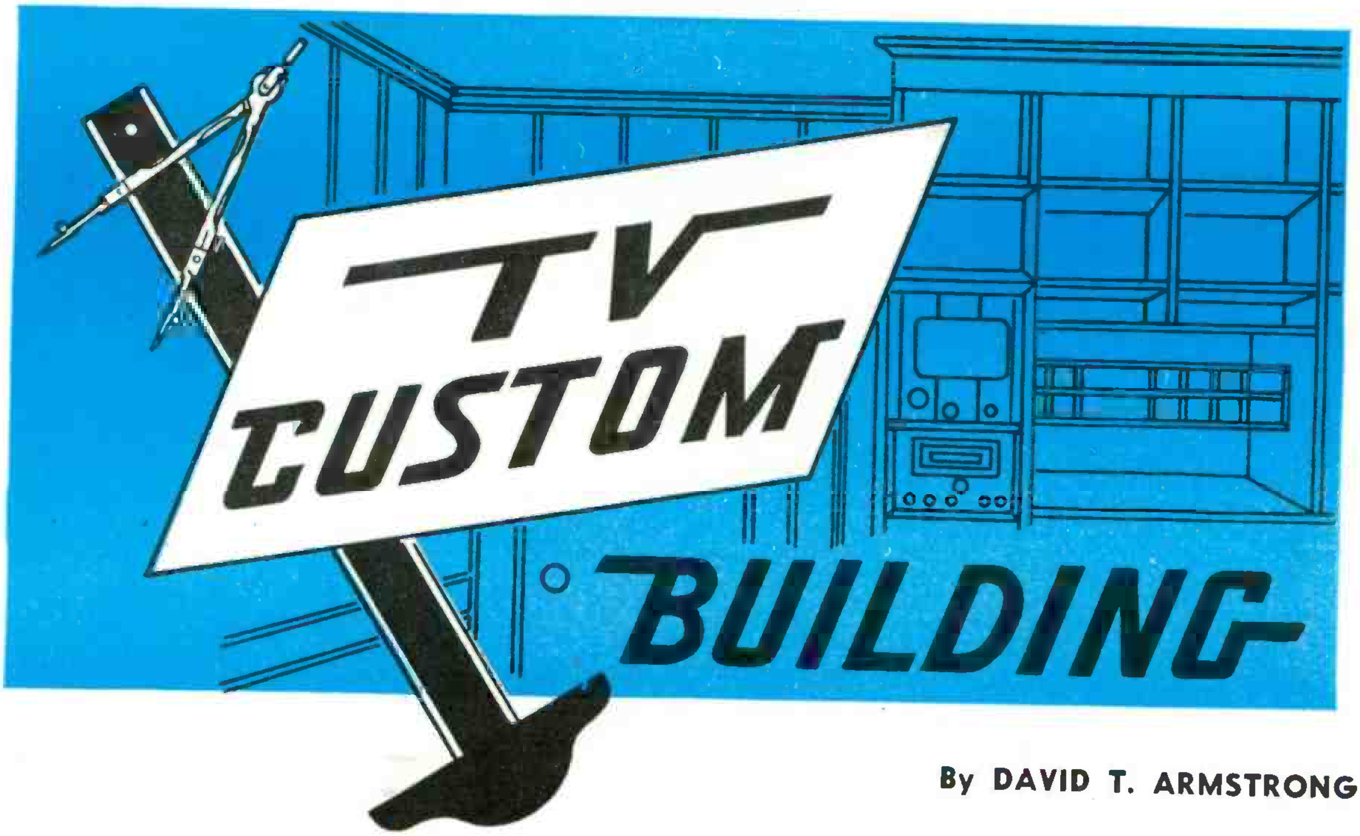
To illustrate this point more fully, the usual horizontal output circuit employed with 10-inch cathode-ray tubes is shown in Fig. 2. To obtain a greater horizontal sweep and at the same time increase the high-voltage output, the two screen-grid resistors of the 6BG6-G are replaced with a single 6,800-ohm, 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 10AP4. The second 10-inch tube was labeled 10BP4. The 10AP4 now being obsolete, the 10BP4 is the first 10-inch tube to be encountered. The 12-inch counterpart of the 10BP4 (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.



By DAVID T. ARMSTRONG

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.

Fig. 1—A simple but tasteful installation.

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

Fig. 2—General Electric projection assembly.

RCA photo

Fig. 3—Woodwork had to match wall panels.

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 19 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.

Cutting into a wall is sometimes a tricky business. There may be a concealed plumbing, gas, or telephone conduit right where you want to work. Explain to the customer that you would like to break into the wall and that you will leave things as good or better than you find them. If there are no concealed pipes in the wall, you are to go ahead with the job; but if there are, the customer is to pay you for your trouble and you will find a new location more suitable for the installation.

The more expensive the installation, the more chances there are for a two-aspirin headache. Sometimes the customer prefers to work through an architect, in which case your problems are simplified. You just make your installation and *git*. The architect takes care of the fancy work and smoothing over the rough places with the customer.

Cabinetmaking

Always have a definite understanding with some local cabinetmaker who will agree to work with you and to suit

RCA photo

Fig. 4—Closet assembly was built for TV set.

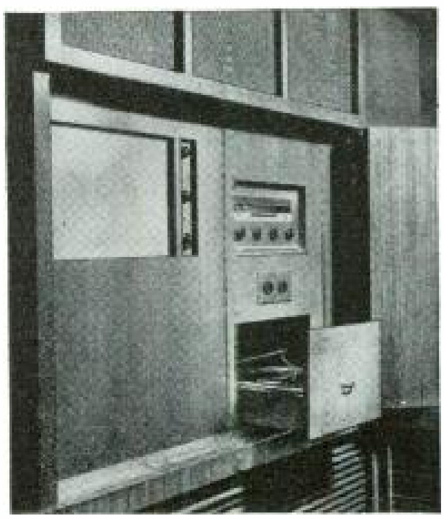


Fig. 5—Closed doors hide this installation.

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

Industrial Television photo

Fig. 6—A good commercial dual installation.

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 having 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

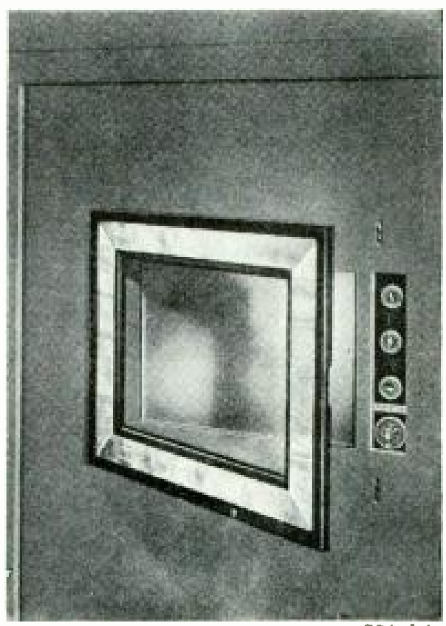
Cost depends on the character of the installation and the amount of work necessary. There are several ways of billing the customer for the complete job. You can sell it to him as a package, or you can itemize the unit costs for him. It is generally better to sell the whole deal as a package, which you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



RCA photo

Fig. 7—Controls hidden by the masking frame.

Indoor Television Antennas

By
EDWARD M. NOLL
and
MATTHEW MANDL

Outside antennas are not always necessary for acceptable television reception

OCCUPANTS 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.

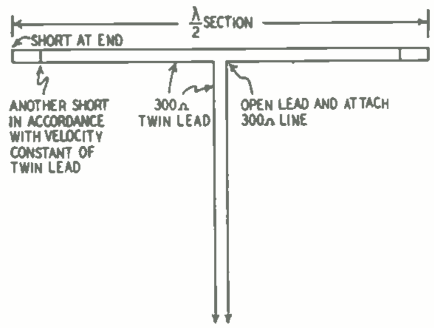


Fig. 1—Correcting the "half-wave" dipole.

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.

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"

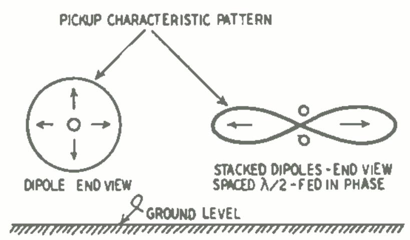


Fig. 2—Fields of single and stacked dipoles.

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 space 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 direction of the station. Experimental 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-arm 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

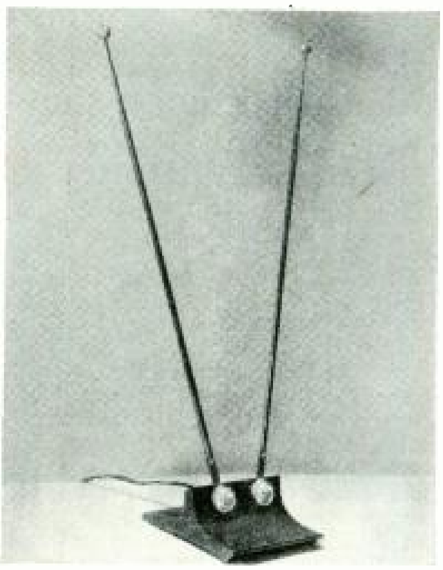


Fig. 3-a—The JFD antenna, a broad "V" type.

Fig. 3-b—The Ward "V" antenna is inverted.

short is placed at a point obtained by multiplying the velocity constant by 14½ inches. If the velocity constant is 82%, a short would be inserted on each side about 11.9 inches from the center of the antenna.

Circular or rectangular antennas for indoor mounting can also be made with No. 14 to 18 wire. Such an antenna can be concealed behind a picture, or the wire can be run around an entire window frame. Again, tests should be made before installing such an antenna permanently, because orientation may be incorrect.

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 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 orientated. The gain is high and the performance unusual. (See "Antennas for Television, Part VI," RADIO-ELECTRONICS, 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.

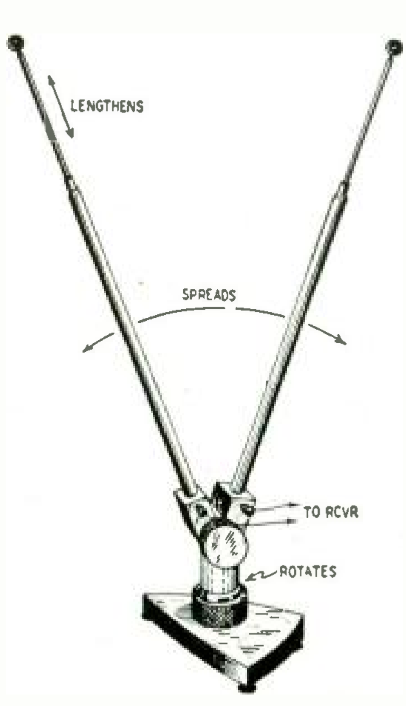


Fig. 4—Jiffy-Junior is another "V" antenna.

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.

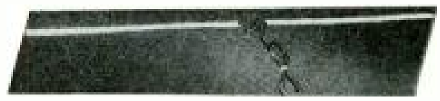


Fig. 5-a—This type can be concealed easily.

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 picture. 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 brack-

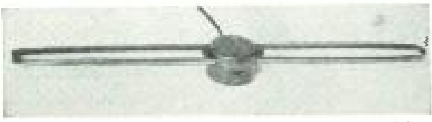


Fig. 6—The "Slide-Rule" is exactly tunable.

ets 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.

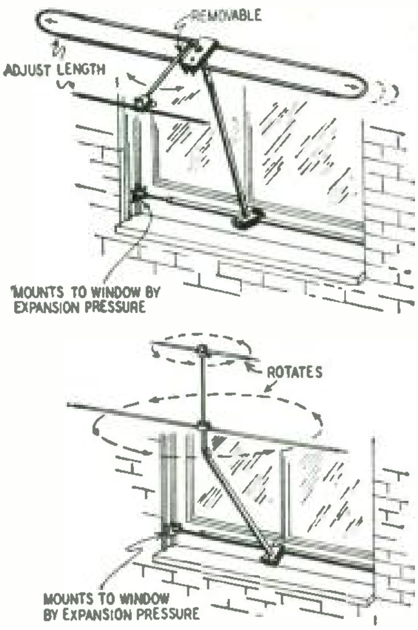


Fig. 7—Two easily-mounted window antennas.

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.**

The circular antenna is behind the picture.

Indoor antennas need not be exposed to view.

THREE NEW TV RECEIVERS

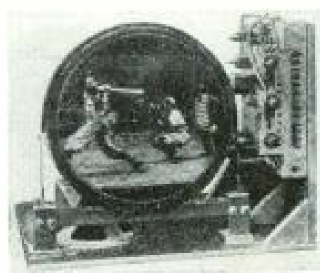
Raytheon Voyager. Portable for a.c. or d.c. Circular 7-inch screen. Indoor antenna furnished with set. Luggage-type

cabinet 16½ x 17¼ x 9½ inches. Shipping weight 42 pounds. (Raytheon Mfg. Corp., Belmont Radio Corp. Div., Chicago, Ill.

Meck 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 Meck 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 in-



stallations (no cabinet available). Height 19½, width 23, depth (not including knobs) 21¼ inches. 19 tubes, 3 rectifiers. (Hallicrafters Co., Chicago.)

TV Station Studio Controls

The video signals are corrected, mixed, and passed to the master control

By MORTON SHORE

Fig. 1—Control operators "touch up" signals from several studio cameras.

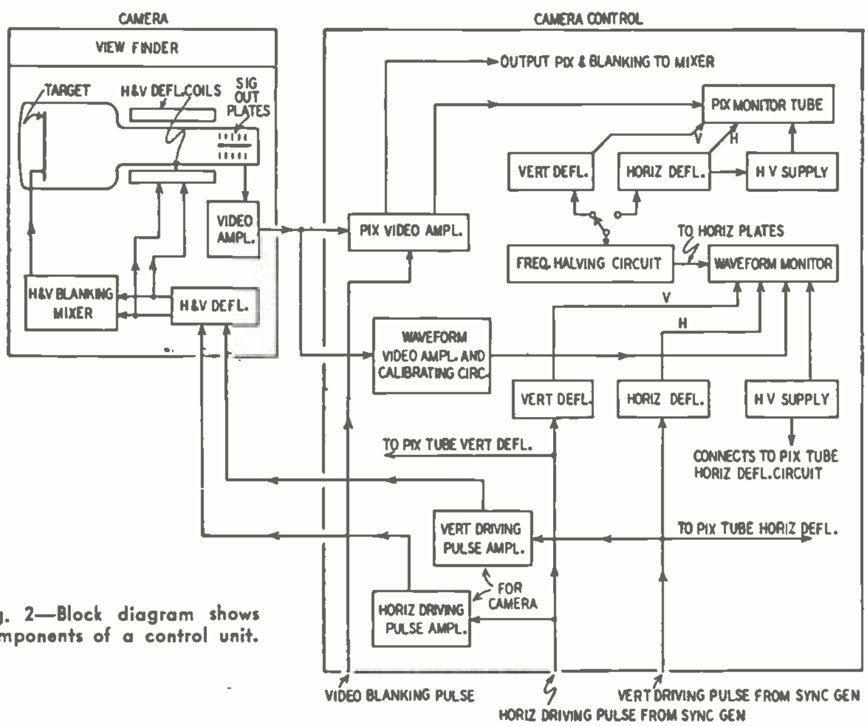


Fig. 2—Block diagram shows components of a control unit.

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 this 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.

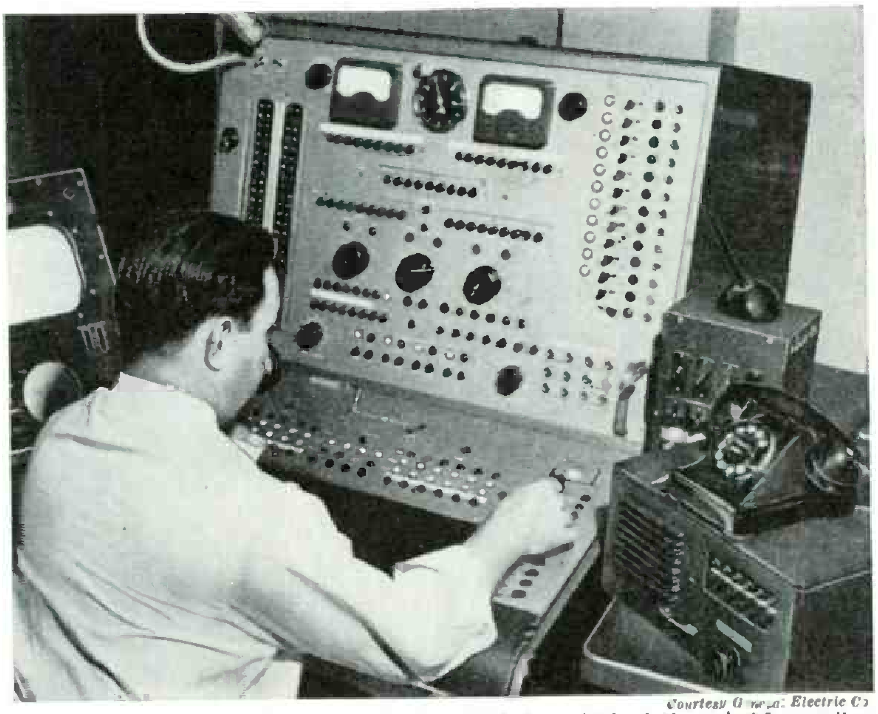
Each one of the above functions has an external control. The camera operator uses these in conjunction with two monitor screens to enable him to regulate and correct the picture.

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.

Courtesy Allen B. Du Mont Laboratories, Inc.

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



Courtesy General Electric Co.

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

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 information necessary for the successful television program.

Master control operators are responsible for switching between studios when one program ends and another begins or when it is necessary to inject some types of commercials or weather and time information into a live broadcast.

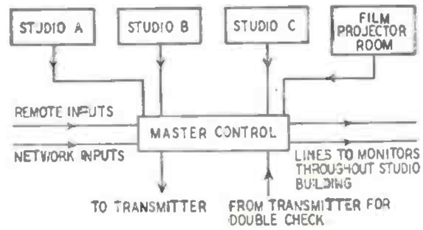


Fig. 5—Block diagram of master control unit.

C-R tube is in a hooded adjustable mounting.

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

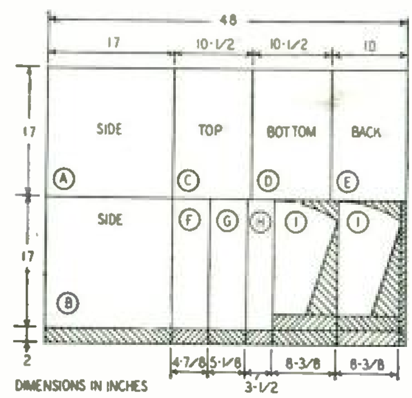


Fig. 1—How to lay out the sheet of plywood.

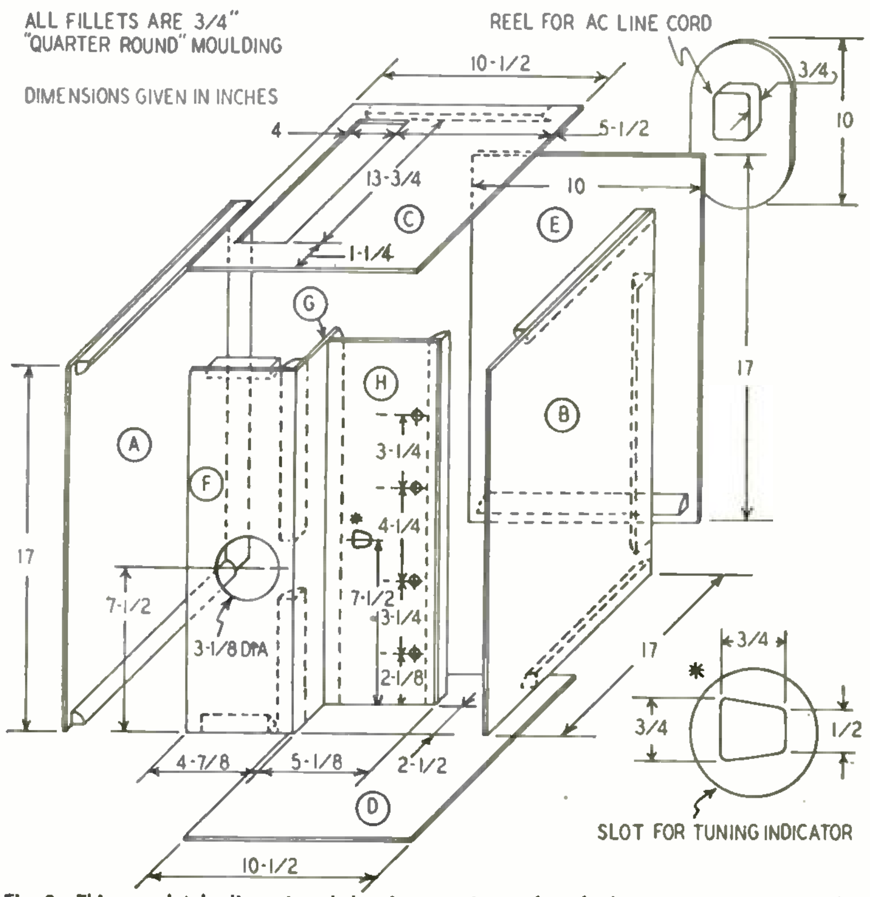


Fig. 2—This completely dimensioned drawing may be used to duplicate case made by author.

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

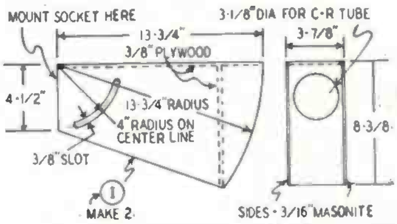


Fig. 3—Working drawing for C-R-tube holder.

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 ¼-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.

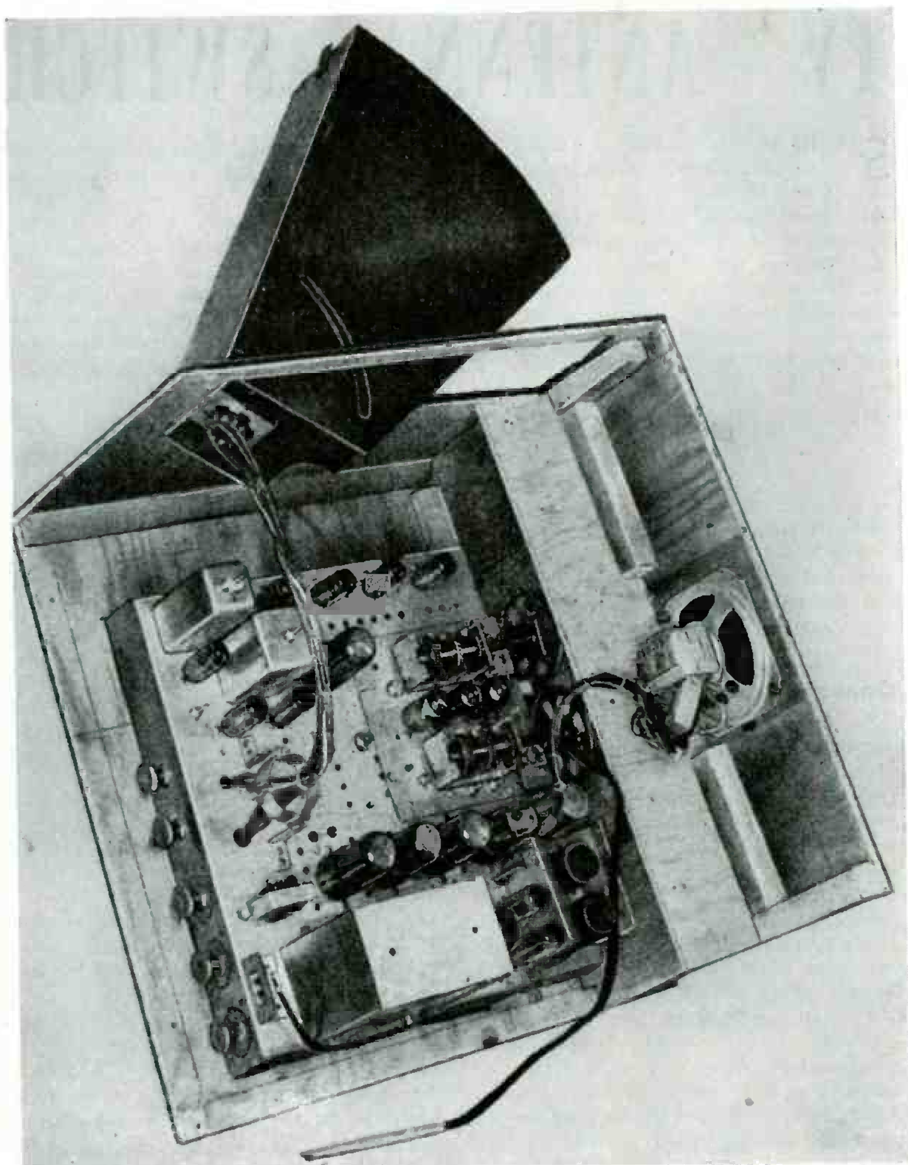
Plywood was selected to keep weight at a minimum. Unfortunately, ¼-inch wood is too thin to hold nails or screws in its edges. Therefore, fillets were made from lengths of ¾-inch quarter-round molding. These are shown in the exploded view, Fig. 2. The case was constructed in two parts. One consists of 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 ¾-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 ½-inch holes drilled in the recessed front panel, as shown in Fig. 2 and 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. Furthermore, it was impossible to see the picture unless we were directly in front of the set. Even then, there was no way of shielding the face of the tube from sunlight. In this design, the tube is adjustable, and the lid protects the tube and serves as a sunshield.

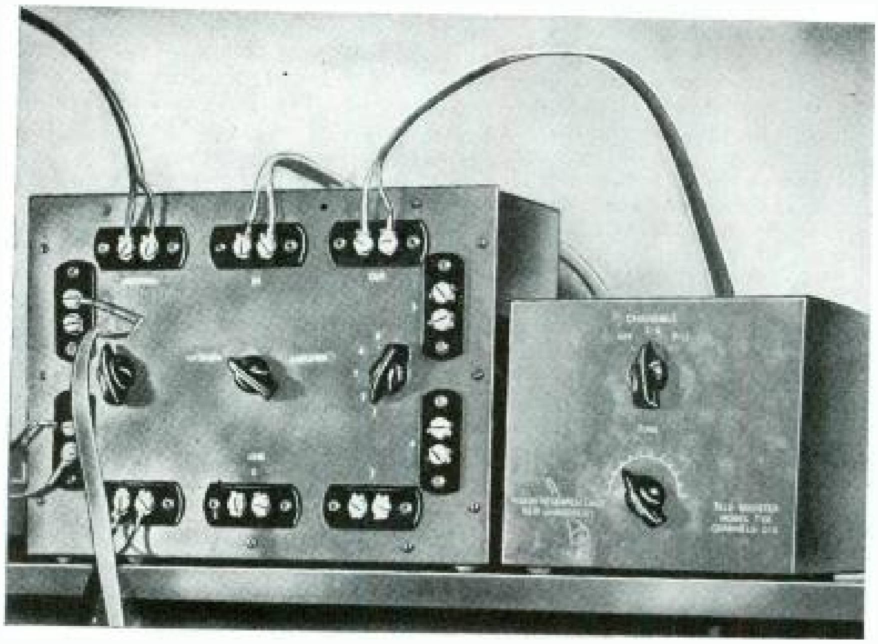
Fig. 1 shows how the sides (I) of the shield are cut from the ¼-inch plywood sheet while Fig. 3 shows these as being made from 3/16-inch Masonite. We used scraps of Masonite because we wasted some plywood in experimenting with the design of the front panel.

The top and front of the lid were made of ⅜-inch plywood because there was no room inside for fillets. The hole in the front is cut just large enough to pass the face of the C-R tube with approximately 1/16 inch all around. A heavy rubber band may be slipped around the front of the tube to cushion it where it passes through the front of the lid. The duodecal C-R-tube socket was replaced with one with an angle-bracket mounting plate. New leads were installed to permit placing the tube in the lid. Approximately 10 inches was added to the speaker leads to allow it to be mounted in the front of the cabinet. The present leads are long enough for mounting the speaker in the left side of the case if desired.

The lid can be locked in any position with a carriage bolt and wing nut passing through a hole in the left side and the curved slot in the side of the lid. The head of the bolt rests flat against the inside of piece I, with the shaft extending outside the case. The radius of the slot is shown. If the slot is cut first any misalignment of the lid is likely to cause binding. If you are not handy with tools follow this procedure when cutting the slot: Mount the lid in place with two small butt hinges along the rear edge. Drill a ¼-inch hole in the left side 6 inches from the rear and 1 inch from the top. Push the point of a pencil through the hole until it rests against the side of the lid. Move the lid up and down several times to trace the radius of the slot. Using this curve (*Continued on bottom of Page* 36) ▶



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



Antenna switch and booster, shown side by side, make good companions for the TV showroom.

TV ANTENNA SWITCH

By LYMAN E. GREENLEE

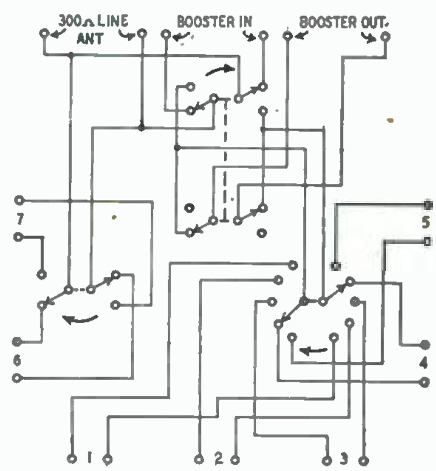
STORE demonstrations of TV sets require that several receivers be connected to the same antenna. It is also convenient to be able to switch a booster in and out of the circuit at will to show its effect on the picture. To avoid the oscillation troubles and mismatch which invariably occur when several 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. 151L "Hamswitch" was used with the contact assembly taken from a Mallory No. 1326L switch. The resulting combination has a wide (2¼-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.



Make all connections with 300-ohm ribbon line.

The other strips 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.

ROOF-TOP TELEVISER

(*Continued from page* 35)

as a guide, cut out the material ⅛ inch on each side and sand smooth.

The holes for line cord and antenna terminal strip can be located at any convenient position in the back of the case. A good handle completes the job. The case can be finished as desired.

Operating hints

This set is designed as a time-saver for installation crews and service technicians. Certain precautions must be followed for personal safety. It can replace one man or perhaps two on some jobs but should not be permitted to do so at the expense of personal safety. If the roof cannot be reached without a ladder, make sure the ladder is long enough to project above the roof so you can step from it to the roof without danger of falling. Never burden yourself with more than you can safely carry up and down the ladder. It is much safer to use a rope to pull the antenna and receiver up on the roof. Always carry the set to the roof before unreeling the line cord. A trailing line cord or transmission line can be very dangerous when moving up or down a ladder.

With this little set, you will be able to make an ideal installation in the shortest possible time. Ghosts caused by multipath reception can be reduced to a minimum consistent with good picture quality. You may find ghosts when the antenna is connected to the set in the home which did not appear in the receiver on the roof. In most cases this will be caused by a mismatch between the line and antenna or line and receiver input. Make sure that the transmission line does not run close to drains, gutters, downspouts, or large metallic bodies. This type of trouble can often be cleared up by using strips of thin metal foil or small metal sliders around the transmission line at the receiver, adjusting them for strongest signal and minimum ghost. Several firms manufacture small metal clips especially for this purpose. Instructions for adjusting these devices will be found in the article "Improve Your Television Picture," in the August, 1949, issue of RADIO-ELECTRONICS.

Counters For Prospectors

Some typical commercial instruments

By RICHARD H. DORF

Nuclear 2610 offers three sensitivity ranges.

Nuclear "Sniffer" uses vibrator power supply.

The Fisher C-11 has a neon oscillator supply.

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 to 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 is diagrammed in Fig. 1. Two subminiature pentodes are used, with three 300-volt batteries in series for the high-voltage supply.

Model 2610 contains a self-quenching tube (as do most of the instruments). There is a single pulse of current through R1 each time the tube breaks down.

R2 and R3 are a voltage divider across the 67.5-volt B-battery, and bias the grid of V1 so that it conducts. The filaments of V1 and V2 are paralleled and connected through R4 to ground. The V1 plate and screen current passing through R4 biases V2 to cutoff.

When a negative pulse from the Geiger tube reaches the grid of V1, V1 plate current decreases, and plate voltage becomes more positive. The rise of plate voltage is coupled through C4,

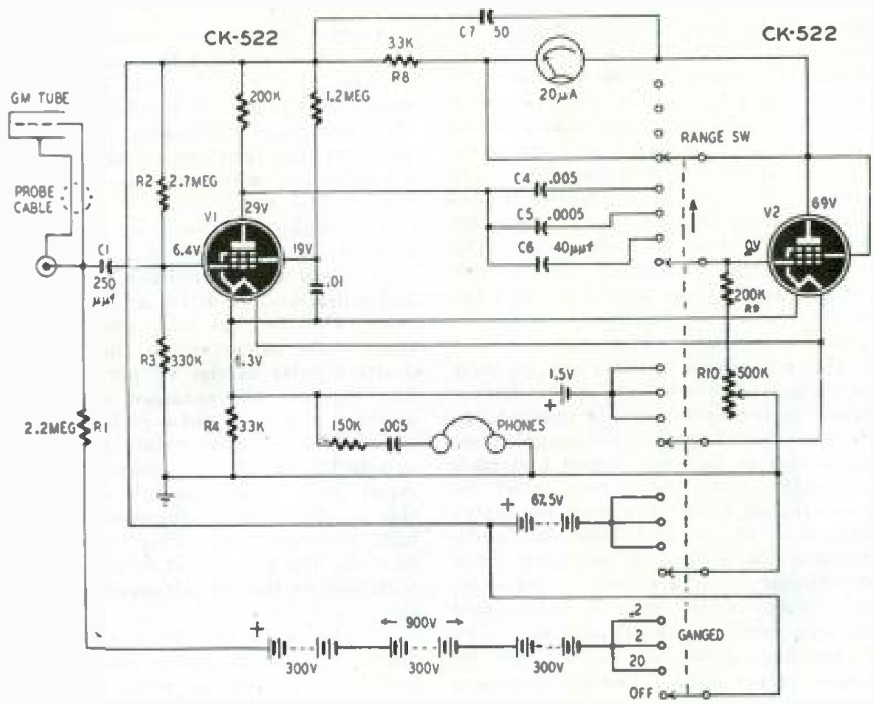


Fig. 1—Pulses furnished the meter deflect it in proportion to the frequency of the pulses.

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 Geiger tube pulse has been dissipated. The circuit then returns to normal. During the return to conduction of V1, the negative-going plate voltage, coupled to the V2 grid through C4, C5, or C6, has hastened the cutoff of V2. The entire cycle takes place very quickly.

The meter is connected in series with the plate of V2 and the 67.5-volt supply. If it were not for C7, the needle would theoretically (not actually, because of mechanical inertia) rise to maximum, then fall to zero for each pulse. The addition of C7, however, together with R8, makes a time-constant circuit known as an integrator. The capacitor C7 is charged by each pulse of V2 plate current. The degree to which it discharges after the pulse is governed by the time interval between pulses. The closer together the pulses, the greater the average voltage across C7 and the higher the meter reading.

Since the meter must respond only to the number of pulses, not to their intensity, the one-shot multivibrator circuit is necessary, rather than a simple amplifier. Since V2 is brought from full cutoff to full conduction and back for each pulse, no matter what its strength, all pulses reaching the meter integrator are of the same amplitude. Because the pulses do not take place at regular intervals, but at random, the meter needle does fluctuate and the eye must strike an average. The fluctuations could be slowed down by larger values for C7 and R8, giving a longer time constant than the present 3-second one. That would make the meter slower to respond, however, and 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 μμf) serves to attenuate them and keep the meter from rising above full scale. Here again an analogy—high audio frequencies. R10 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.

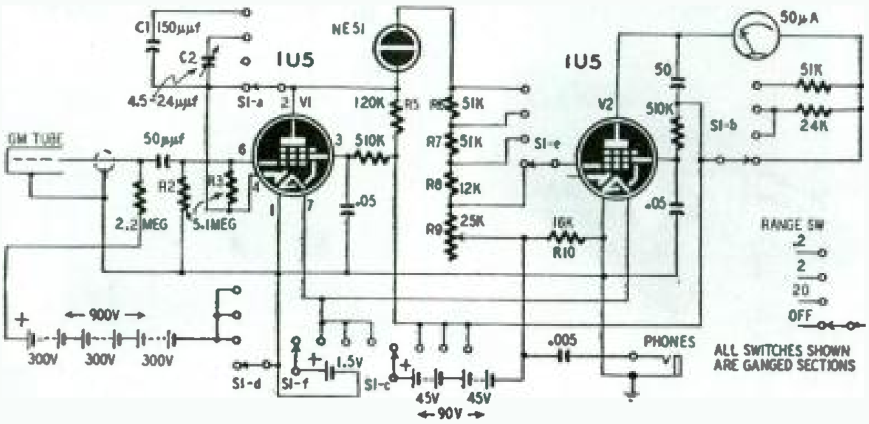


Fig. 2—The neon lamp in the El-Tronics SM-3 limits the amplitude of the pulses reaching V2.

Another type of counter

Another instrument which does the same job is model SM-3 made by El-Tronics, 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 20-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, 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 R6-R7-R8-R9. The switch-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

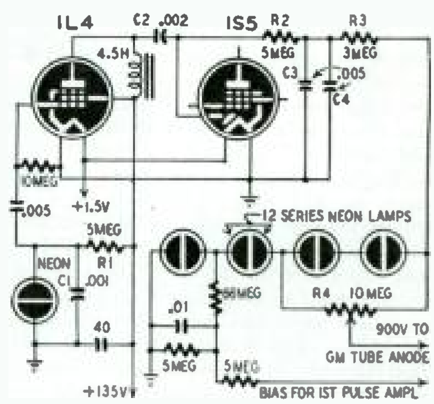


Fig. 3—Relaxation oscillator feeds the 1L4.

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.

ergizes 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-meg-ohm 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.

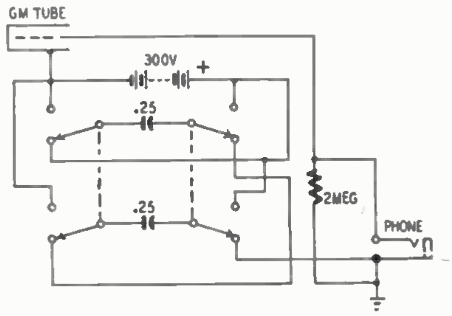


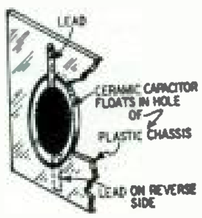
Fig. 4—"Something-for-nothing" power supply.

NEW MINIATURE PRINTED CIRCUIT

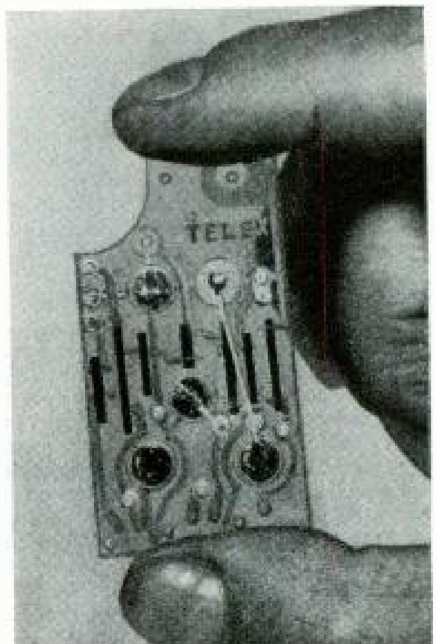
A new lightweight printed circuit is being introduced in the Telex model 200 hearing aid. The major portion of the three-stage amplifier circuit is contained on a 0.025-inch-thick polystyrene plate approximately 2⅛ by 1⅛ inches. The weight of this plate, complete with resistors, capacitors, and conductors is 1/16 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.

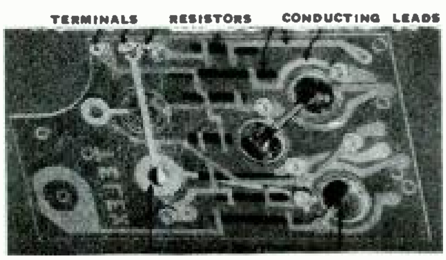
Resistors of a colloidal graphite compound are deposited in a thin film; the plate may be bent without damage to the resistors. An acetate-film covering hermetically seals the resistors and provides protection against damage.



How capacitors are inserted in chassis



This photograph shows plate's actual size.



All the components are on polystyrene plate.

Thickness of the printed circuit slate 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 $Tm_{0,0,n}$) mode can function. Resonance is then found at odd quarter-wavelength points (¼, ¾, 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

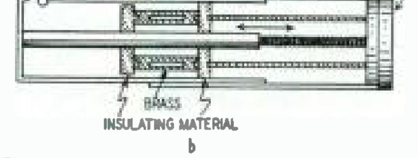


Fig. 1-a—Co-axial wavemeter for transmission or absorption use. Fig. 1-b—Absorption type.

55,000. Actual measurements on existing units have shown Q's of better than 40,000. This means that with a good cavity wavemeter accuracies of ±28 kilocycles at a frequency of 3,000 megacycles are possible. Fig. 3 shows two types of cavity wavemeters.

The third type or transition wavemeter may be thought of as half co-axial line and half cylindrical cavity —hence its name. It is a cylindrical cavity along whose axis projects a piston which has a diameter considerably smaller than that of the cavity. The diameter of the cavity is large enough to support the $TE_{0,1,1}$ mode. The dimensions of both the plunger and the cavity control the frequency. Thus it is necessary to calibrate this type of wavemeter.

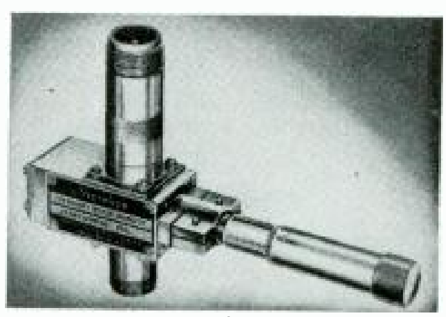
All three types described can be calibrated as direct-reading devices.

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 L1 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 L2 is independent of L1, 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



Courtesy Sperry Gyroscope Co.

Fig. 2—Photo of the instrument of Fig. 1-b.

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 ±.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.

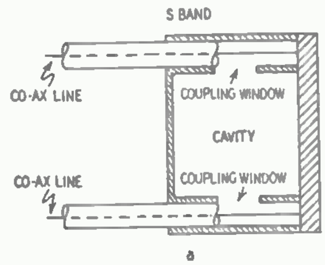


Fig. 3-a—A fixed-frequency cavity wavemeter.

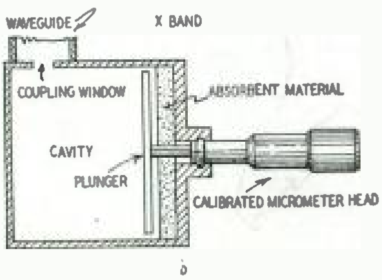


Fig. 3-b—A variable-frequency cavity meter.

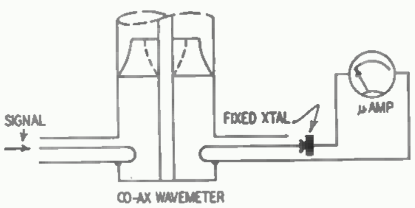


Fig. 4—Co-axial transmission-type wavemeter.

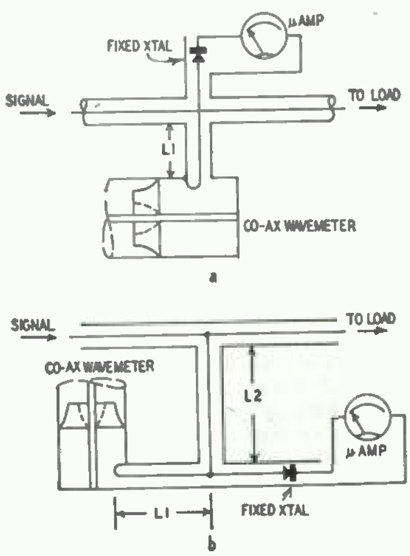


Fig. 5—Two reaction-type wavemeter circuits.

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 fussing with catwhiskers 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.

Courtesy DeMornay-Budd

Fig. 6—Transmission and reaction wavemeters.

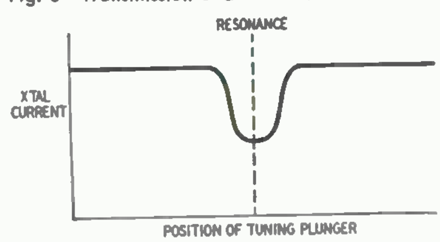


Fig. 7—Crystal current in absorption meter.

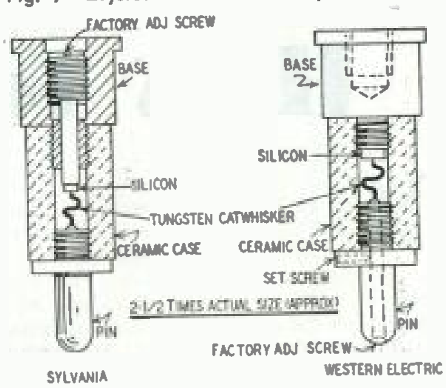


Fig. 8—Two American h.f. crystal rectifiers.

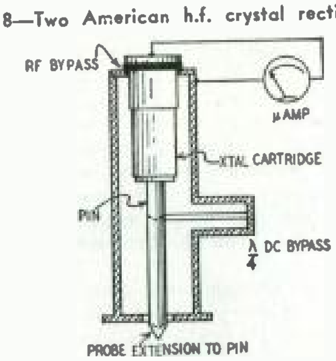
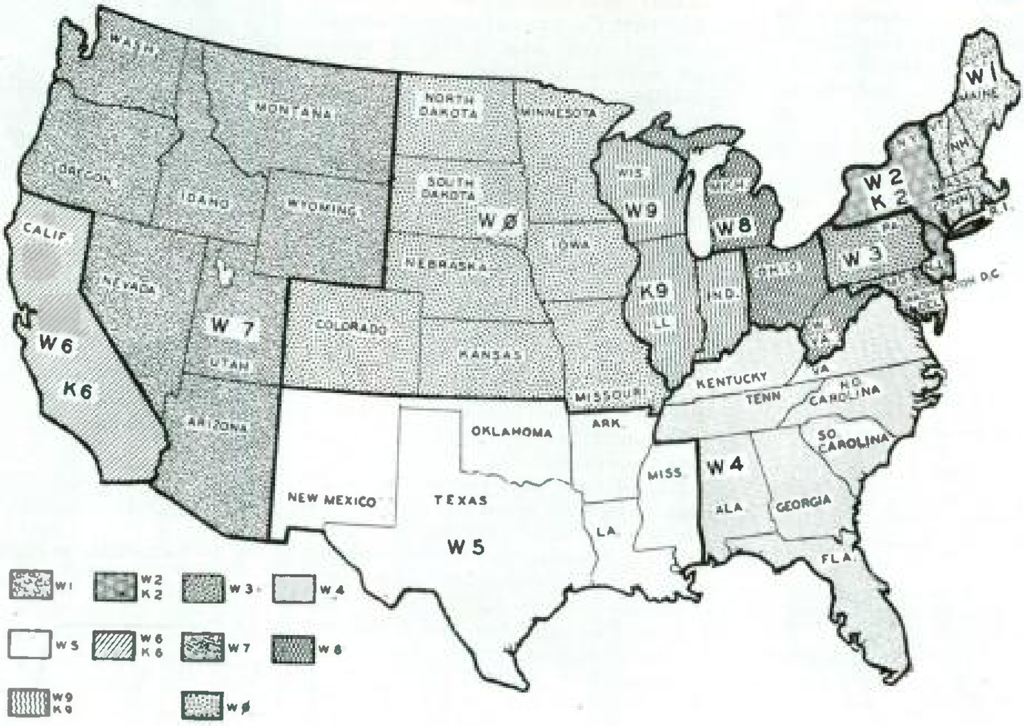


Fig. 9—A high-frequency rectifier circuit.



U. S. is divided into 10 amateur districts. The prefix to a ham's call letters indicates his district.

How to Become a Ham

By GEORGE W. SHUART, W4AMN, Ex-W2AMN

Part I—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 nor 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 something 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, banding 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 assures that he will get the message straight and then pass it on. Any amateur with a desire to do so may join a traffic net, and he may handle messages even if he does not.

Because amateur radio requires technical knowledge, may 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 introduced, 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* (hammese for transmitter) makes a difference in how it sounds. The amateur experimenter is one of the prime reasons for the amateur's being, for the developments he has pioneered, his spirit of "I know it won't work but I'm going to try it anyhow," has contributed toward many of the most important advances in radio. The higher frequencies, for instance, were first explored by amateurs who refused to believe 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 everything—to operators down the block or in the next county. These are the "rag-chewers." Dx, traffic, experimentation, and rag-chewing are the major spheres of interest in hamdom. But each of these is further divided into two subgroups, 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 speak into the microphone and listen to the loudspeaker or headphones. But c.w. (code) men have strong arguments in their favor. A code transmitter need have nothing in it but parts contributing to better transmission, 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 transmitter's output. Code can be understood clearly 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 any 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 telephone. It's 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 indicates that the caller is ready for a conversation with anyone who may happen 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 conversation 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 Commission, 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 frequency bands, and polices the air for violations 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 absolutely 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 acquaintances and books are good sources of technical knowledge. Some especially useful books are listed in the bibliography 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.) followed by a number. The number indicates the section of the country in which the station is located. There are 10 radio districts, as indicated on the map. (The cancelled zero (Ø) is the standard method of indicating the numeral zero rather than the letter O.

The FCC has assigned certain portions 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 examinations, 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 nearby amateurs (you will find them all listed in the *Radio Amateur Callbook Magazine*, on sale 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 background 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 amateur will tell you.

In addition to learning technical facts, you will have to absorb some code and memorize some FCC regulations. 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 International 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 dont's and trying to clear a few of the stones from your path toward the dots and dashes.

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The Radio Amateur's Handbook
How to Become a Radio Amateur
The Radio Amateur's License Manual
Learning the Radiotelegraph Code

Home-Built Snooperscope Uses Surplus Tube

Ingenious infra-red viewing device lets you see in the dark

By HAROLD PALLATZ

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-µf, 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*)

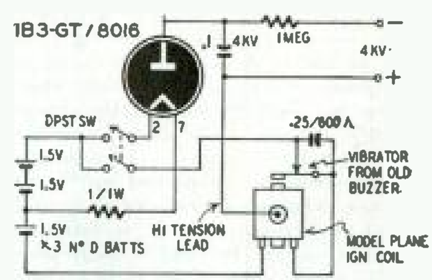

Fig. 1—Miniature high-voltage power supply.

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 2¼ 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 a foot away from the observer's position are focused sharply.

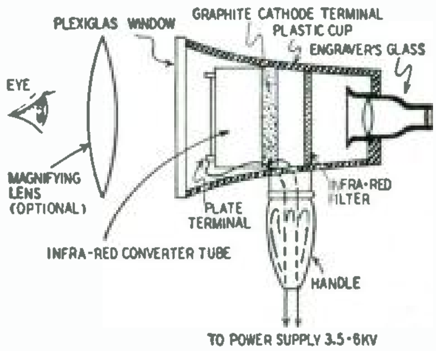

Fig. 2—The construction of the snooperscope.

After selecting the optical system, mount it in a hole cut into the bottom of the cup. A jeweler's saw or coping saw is ideal for cutting the hole. A few drops of household cement will hold the loupe in place. Paint the inside of the cup with a jet black paint such as black airplane dope or telephone black. This will prevent stray reflections.

Place an infra-red filter between the tube and lens to reduce the effects of stray illumination on the tube. No light should be allowed to enter the unit except through the lens. The light source must of course be filtered if it is to be invisible. Near infra-red filters will cut out most of the visible light. Far infra-red filters, while of somewhat lower efficiency, will cancel out visible light completely. They must be used with comparatively powerful light source.

Infra-red filters can be purchased from a number of scientific and photographic supply houses. Experimental infra-red filters can be made by sandwiching several layers of red and blue cellophane between two sheets of clear plastic.

The image-converter tube is inserted with the metal end toward the mouth of the cup. The thin flexible lead connects to the positive side of the power supply. The other end of the tube has a ring of graphite around the outside. This is the cathode terminal. This makes contact with the B-minus lead through a strip of spring brass or a thin coil spring formed to fit snugly around the cathode terminal. A piece of rubber tubing holds the tube in place. It is protected by a window cut from clear plastic and held in place with three brass clips as shown in the photograph.

The handle is a plastic bicycle handlebar grip cemented over a hole drilled in the side of the drinking cup for the high-voltage leads.

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 sniperscope 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:

Forsythe, William E., *Fluorescent and Other Gaseous Discharge Lamps.*

Pratt, T. H., *Journal of Scientific Instruments*, Vol. 24, No. 12, December, 1947.

Monahan, A. C., *Science News Letter*, Vol. 50, page 26-28, July 13, 1946.

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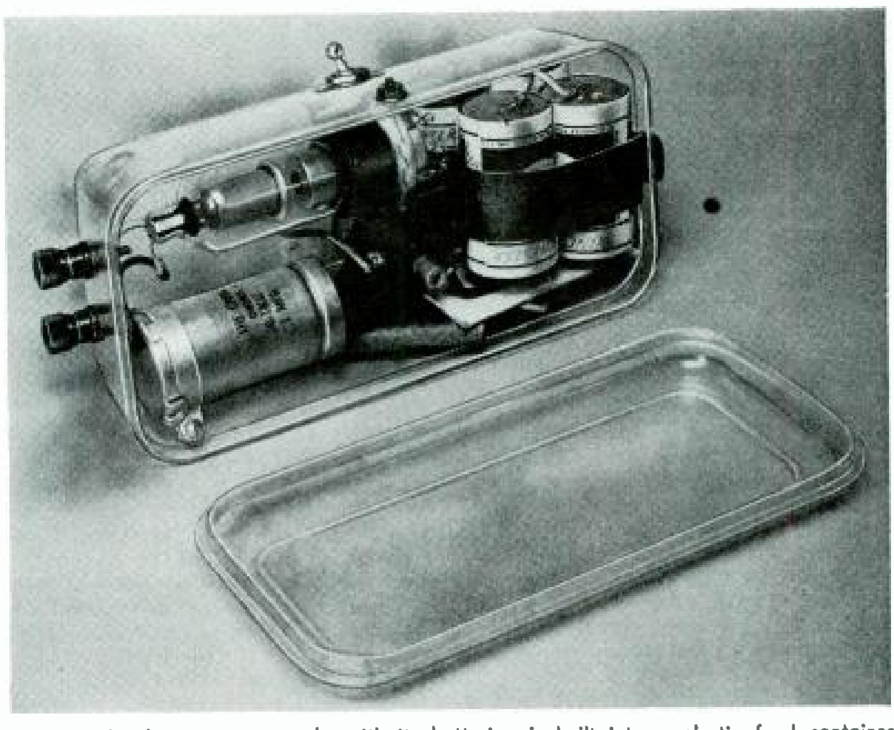


The high-voltage power supply, with its batteries, is built into a plastic food container.

Neon Blinker Saves Batteries

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

By RALPH W. HALLOWS

WE'VE all done it, and the odds are that we'll do it again. Done what? Why, left 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:

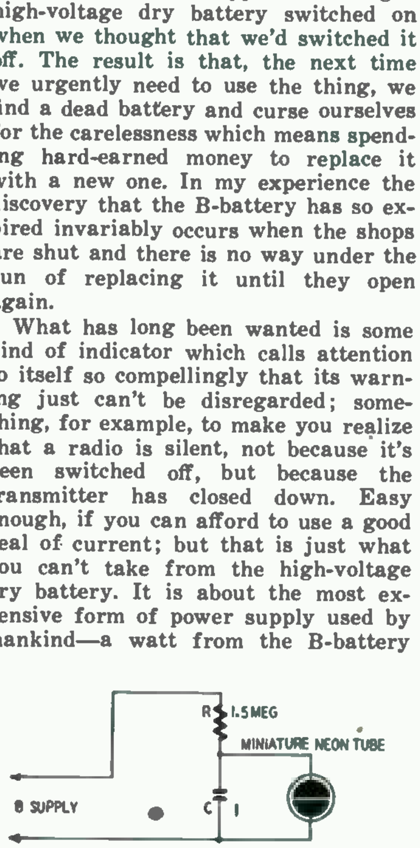


Fig. 1—Neon is used in relaxation circuit.

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

$$Vc = V\ (1 - e^{-t/CR})$$

where Vc is the voltage across the plates of C, V 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=100. Then in 1 second Vc equals 100(1—0.368)=63.2v. (e^{-1} is equivalent to 1/2.1718, or 0.368.) With the same values Vc in 2 seconds = 86.5v; in 3 seconds, 95.1v; and in 4 seconds, 98.2v. From this it can be seen that, for any values of V, C, and R, Vc in CR seconds = 63.2% of V; 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 Vs is 72 and extinguishing voltage Ve 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. Meantime the capacitor voltage Vc rises as shown by the vertical scale on the right. When Vc reaches 72v, the neon strikes. C now discharges through the tube until Ve, the extinction voltage, is reached. The tube then closes down, and C starts to recharge. This time, however, the initial Vc 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 Ic taken from the battery is about 28 microamperes, an amount which is a negligible additional load for any battery. This device comes nearer to giv-

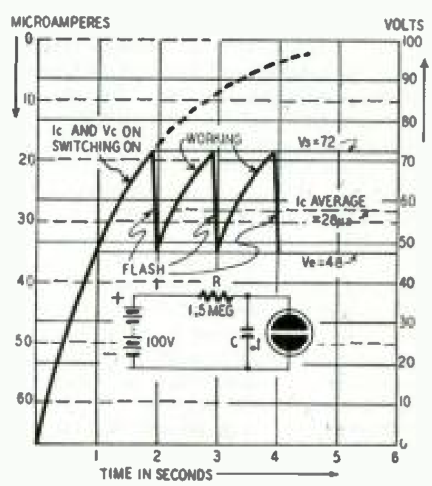


Fig. 2—Curves show action of the oscillator.

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.

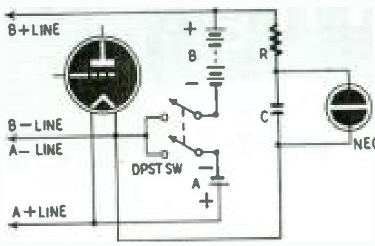


Fig. 3—How blinker is added to the receiver.

As the battery ages and its voltage falls off, Vs becomes a greater and greater percentage 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.

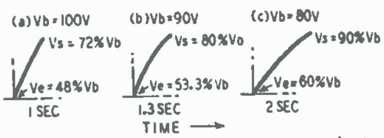


Fig. 4—Frequency falls with aging battery.

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 ⅜-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.

Tubeless Oscillator Uses A 1N34 Crystal

By RUFUS P. TURNER, K6AI

An interesting 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 (E_x) for different crystals. Individual 1N34 crystals show the negative-resistance point somewhere between —50 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-μf 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 will be 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 μμf, depending upon 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.

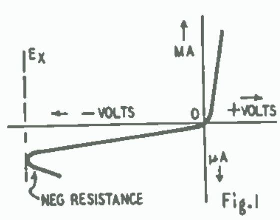
Operation of the circuit is simple. Before inserting the power plug into an a.c. outlet, set the voltage-control rheostat to its maximum-resistance (lowest-voltage) position, and connect a suitable signal indicator (headphones, electron-ray tube, a.c. vacuum-tube voltmeter, oscilloscope, or audio amplifier 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 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, 450-volt, electrolytic; 1—0.1-μf, 400-volt, paper capacitor; 1—1N34 crystal rectifier; 2—100-ma selenium rectifiers; 1—10-h, 55-ma filter choke; 1—3:1 interstage audio transformer; miscellaneous hardware.



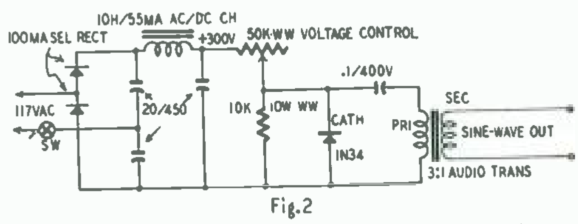


Fig. 1—Crystal voltage-current curve shows negative-resistance point. Fig. 2—Oscillator.

Fundamentals of Radio Servicing

Part VIII–Transformers–How they work

By JOHN T. FRYE

VERY 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 very 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, is it 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

Some of the many types of transformers used in radios. Rear we have an isolation and a power transformer. Front, an output, an i.f., iron-core r.f. and an antenna transformer.

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

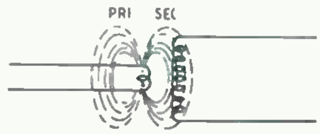


Fig. 1—How an r.f. transformer looks in radio diagrams. Note that while the primary is supposed to have 2 and the secondary 6 turns the schematic does not show the exact number.

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?

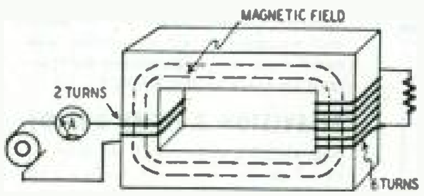


Fig. 2—Step-up transformer with iron core.

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*

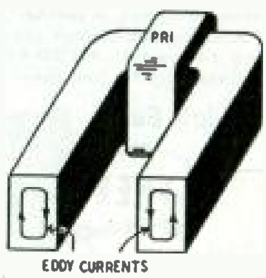


Fig. 3—The path followed by eddy currents.

the primary itself. But a field set up around any winding by a changing voltage across it (current through it) *produces in the same winding a voltage which opposes the original voltage which set up the field* (Lenz's law). If there were no losses in the transformer, that counter-e.m.f.—or voltage if you prefer—would be exactly as strong as the line voltage and no current would flow. But all wire has resistance, and there are losses (which we will discuss later) in the best designed core. So we do have a small flow, called the *magnetizing current.*

However, when current flows through the secondary winding, that current produces a magnetic field of its own that *opposes* and partially cancels the magnetic field of the primary. Since the counter-e.m.f. of the primary depends upon the strength of its own field, a reduction in this field means a lowered back-e.m.f. and a consequent increase in primary current.

It is a cardinal principle of physics that "power out equals power in less losses." Power in electricity is measured in watts, the product of volts and amperes. Mull this over a bit and you will see why, for a given power input to

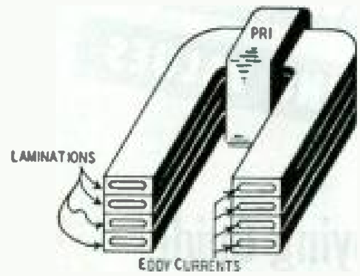


Fig. 4—Lamination reduces the eddy current e.m.f.'s while keeping resistance high, thus reducing the eddy currents to small values.

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 this 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.

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.

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

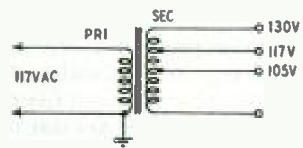


Fig. 5—The isolation transformer frees circuits from the electric light system ground.

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 exist in each separate lamination, but because the

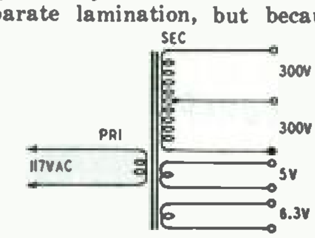


Fig. 6—Several windings may be combined on a core, as in this radio power transformer.

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 remain 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 bobby 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 that 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

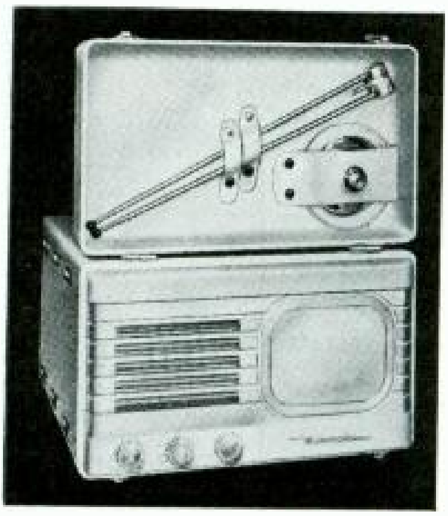
The main troubles encountered in transformers are open windings, shorts between windings, shorts between turns of the same winding, and shorts between a winding and the core. If a single turn is shorted out, very heavy current flows through it and quickly develops a great deal of heat, damaging the insulation 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-destroying moisture is kept out, a transformer is a highly efficient, trouble-proof electrical device.

While 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!

Radio Set and Service Review

The Motorola VT73, a 7-inch 33-pound television receiver



THE Motorola model VT73 portable televiser 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 9⅝ inches high, 18¾ inches deep, and 17¼ 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 4½ x 5¾-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, L57, 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-μμf 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 6½-inch PM speaker.

Electrostatic picture tube

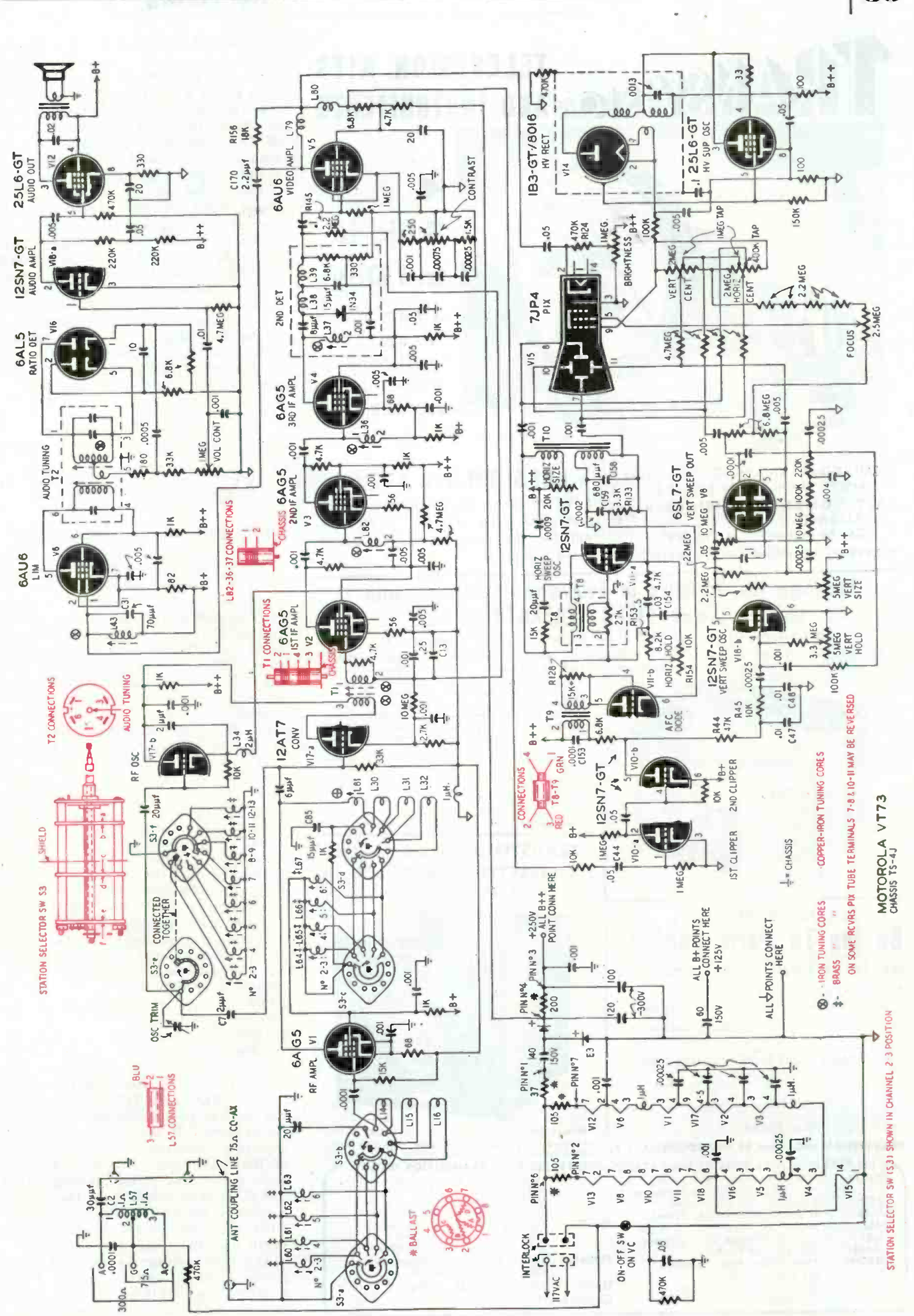
The picture tube is a 7JP4, a type using electrostatic deflection and focusing. The output of the video amplifier is positive. Its signal is therefore applied to the cathode of the picture tube for correct polarity of the picture. L79 and R156 form a peaking circuit to provide uniform gain at video frequencies. 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 clippers. 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)


MOTOROLA VT73
CHASSIS TS-4J
6AG5 V1 RF AMPL
12AT7 CONV
6AG5 IST IF AMPL
6AG5 2ND IF AMPL
6AG5 3RD IF AMPL
6AU6 VIDEO AMPL
6AU6 LIM
6AL5 RATIO DET
12SN7-GT AUDIO AMPL
25L6-GT AUDIO OUT
1B3-GT/8016 HV RECT
25L6-GT HV SUP OSC
7JP4 PIX
6SL7-GT VERT SWEEP OUT
12SN7-GT VERT SWEEP OSC
12SN7-GT HORIZ SWEEP OSC
12SN7-GT 2ND CLIPPER
IST CLIPPER
AFC DIODE
RF OSC
AUDIO TUNING T2
2ND DET
CONTRAST
BRIGHTNESS
FOCUS
VOL CONT
VERT SIZE
VERT HOLD
HORIZ SIZE
HORIZ HOLD
OSC TRIM
ANT COUPLING LINE 75Ω CO-AX
STATION SELECTOR SW S3
SHIELD
CONNECTED TOGETHER
T2 CONNECTIONS
T1 CONNECTIONS
L82-36-37 CONNECTIONS
L57 CONNECTIONS
CONNECTIONS T8-T9
* BALLAST
INTERLOCK
117VAC
ON-OFF SW ON VC
+250V ALL B++ POINT CONN HERE
ALL B+ POINTS CONNECT HERE +125V
ALL ⏚ POINTS CONNECT HERE
⏚ = CHASSIS
⊗ - IRON TUNING CORES
⊕ - BRASS
COPPER-IRON TUNING CORES
ON SOME RCVRS PIX TUBE TERMINALS 7-8 & 10-11 MAY BE REVERSED
STATION SELECTOR SW (S3) SHOWN IN CHANNEL 2-3 POSITION

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 7JP4 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.

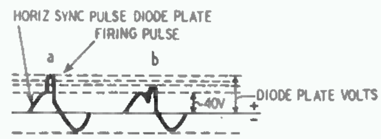


Fig. 2—Horizontal sweep control waveforms.

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 phase and frequency 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 C153. 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 C159 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-a and the diode forces more current through R153 and R154, thus increasing the bias on the oscillator and slowing it down: If the oscillator is slow, the firing pulse moves down on 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 reduction in bias, 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 25L6-GT as a 140-kc oscillator and a 1B3-GT/8016 high-voltage rectifier.

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The New Model TV-20

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

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

$39.95 NET

Specifications:

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

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

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

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

5 D. C. Current Ranges

0-50 Microamperes

0-5/50/500 Milliamperes

0-5 Amperes

4 Resistance Ranges:

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

7 D. B. Ranges: (All D. B. ranges based on ODb=1 Mv. Into a 600 ohm line)

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

7 Output Voltage ranges:

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

The New Model TV-10

TUBE TESTER

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

$39.50 NET

Specifications:

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

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

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

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

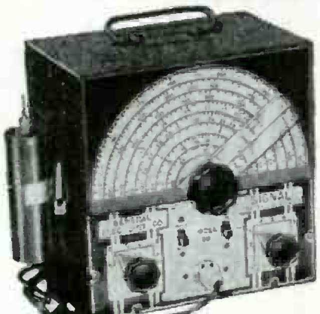
★ The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

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

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

The Model 88—A Combination

SIGNAL GENERATOR and SIGNAL TRACER



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

Signal Tracer Specifications: *Uses the new Sylvania IN34 Germanium crystal Diode which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megacycles.

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

$28.85 NET

The New Model TV-30

TELEVISION SIGNAL GENERATOR

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

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

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

$29.95 NET

The New Model 670

SUPER METER

A Combination

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

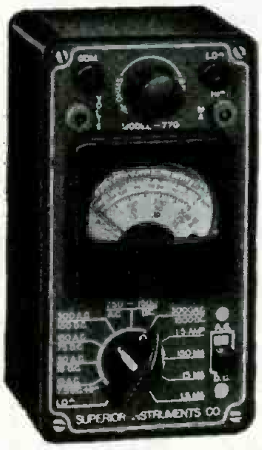
D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/7500. **A.C. VOLTS:** 0 to 15/30/150/300/1500/3000 Volts. **OUTPUT VOLTS:** 0 to 15/30/150/300/1500/3000. **D.C. CURRENT:** 0 to 1.5/15/150 ma.; 0 to 1.5 Amps. **RESISTANCE:** 0 to 500/100,000 ohms, 0 to 10 Megohms. **CAPACITY:** .001 to .2 Mfd., 1 to 4 Mfd. (Quality test for electrolytics.) **REACTANCE:** 700 to 27,000 Ohms; 13,000 Ohms to 3 Megohms.
INDUCTANCE: 1.75 to 70 Henries; 35 to 8,000 Henries.
DECIBELS: —10 to +18, +10 to +38, +30 to +58.

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

$28.40 NET

The New Model 770—An Accurate Pocket-Size

VOLT-OHM MILLIAMMETER



(Sensitivity: 1000 ohms per volt)

Compact-measures 3⅛" x 5⅞" x 2¼". Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. Housed in round-cornered, molded case. Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications: 6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 volts.
6 D.C. VOLTAGE RANGES: 0-7½/15/75/150/750/1500 volts.
4 D.C. CURRENT RANGES: 0-1½/15/150 Ma. 0-1½ Amps.
2 RESISTANCE RANGES: 0-500 Ohms. 0-1 Megohm.

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

$13.90 NET

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

GENERAL ELECTRONIC DISTRIBUTING CO.

Dept. RC-10, 98 PARK PLACE
NEW YORK 7, N. Y.

Pedro Makes a Record

Jumping to conclusions is bad business, but sometimes it pays

By GUY SLAUGHTER

. . . trying to make my eyes focus on the fine print

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.

"Hunh?" 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, hunches 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.*" I let him suffer a minute, and then I break it gently. "Next time you go see her, take a new output tube along. Know what it uses?"

He nods glumly.

"It's got a 50L6 in it."

I reach one off the shelf, and lay it on the counter in front of him.

"Could be the whole trouble," I point out. "Sometimes they develop a heater-to-cathode short that modulates the plate current at 60 cycles."

"Thanks, Herk," Pedro murmurs meekly. "I'll try it."

"Sounds just like filter hum, too," I say, trying to make him feel better. "Why don't you run over now and see if that cures the trouble?"

"Can I?" he asks eagerly, perking up.

"Go ahead," I say. "Things are dead anyway."

He zooms out and down the street, and I wait for the telephone to ring, and pray for a few customers.

Pretty soon he's back, grinning broadly. I don't have to ask him how he made out, because there's a faint smear of lipstick on his cheek.

"That's it," he announces proudly. "She thinks I'm a good radioman now."

"The moral of that story," I pontificate, "is don't jump to conclusions until you examine all the possibilities."

"Not me," 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 looks me in the face, and stops squirming.

"Oh," I say. "Like that, hunh?" I lay down my iron, and get up off my stool. "Look, Pedro," I point out gently. "Business is stinko. You know as well as I do I can't afford to pay you any more money. Fact is, I can't afford you at all."

He looks at the floor again, embarrassed.

"As, if, and when business picks up, I'll be glad to discuss a raise," I go on. "But until then, I'm not even sure I can pay the rent."

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

"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, Herk," he greets me, self-consciously.

"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 finagled 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 bucks. 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 these 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 Saturday."

"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, Herk, 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 extends his hand with his pay still clutched in it. "I . . . I don't really need this, Herk," 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 backward 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 merchandise 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 lugging 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 advertising." 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 them he walks in the door, looking embarrassed.

"Hi, Herk," 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 raise?"

"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 and people streaming in and out, it becomes 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, Herk," 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 flushes, 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 letting you. 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 phonograph discs on the porch, and they get curious. Most everyone has a record player, so they play it and it's music. Then they play the number two side, and it reminds them that in case their set isn't in perfect condition, Valley Radio, Herk Newton, Prop., is ready, willing, and able to make it perfect. For a small fee, of course."

"That's it, Herk," Pedro acknowledges, looking at me hopefully.

"Genius," I mutter. "Pure genius. Two hundred discs, two hundred potential customers. Whenever business slows down, we'll make some more."

"Not two hundred, Herk," Pedro protests, scratching his chin smugly. "Only a 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 I recorded a different kind of commercial; I said if they wanted the latest thing in advertising, they should contact Valley Radio, Herk Newton, Prop., and find out how to get their own messages 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 'em cut their own."

"Yeah," I breathe reverently, mentally multiplying my mark-up per recorder by twenty-five. "Yeah, Pedro. That's wonderful."

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

"And Pedro," I continue softly.

"Yes, Herk?"

"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 conclusion. When do I get the next one?"


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ESSE Specials!

C-1 AUTO PILOT ASSEMBLY *made by Norden*

Stabilized bombing approach equipment type M-7. All the following units come high x 12" deep, housed in a steel case, size 36" long x 17". Weighs approximately 160 lbs. net.

Consists of (3) C-1 SERVO UNITS

and (1) C-1 GYRO

C-1 SERVO UNIT

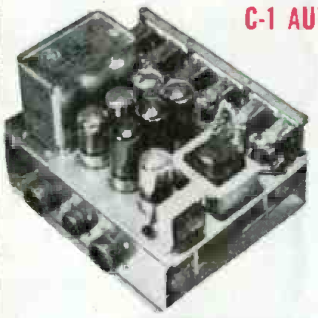
Use to rotate beam antenna, actuate boat rudder control, etc. Contains 24 V. motor, clutch, relays, etc. Reversible. Size overall approx. 10½" x 8½" x 6½".

C-1 GYRO

Part of the C-1 Auto Pilot which is sold separate and may be used to conduct many interesting and amusing experiments. Operates from 24 V. DC or may be operated for short periods on 110 V. AC. Gyro will run for approx. 15 minutes after actuating. Size—approx. 8" x 8½" x 8½".

And 1 **DIRECTIONAL PANEL** with dashpot action (not pictured). All five of these units as described individually and as pictured at top, priced, brand new, at **$49.50**

PART of AUTO PILOT — BUT NOT INCLUDED IN ASSEMBLY AS SHOWN ABOVE



C-1 AUTO PILOT AMPLIFIER

Used to control operation of servo unit in response to signals received from gyro unit and control unit. The complete amplifier includes one rect. 7Y4, 3—7F7's for amplification and control, 3—7N7's for signal discrimination, 1 power transformer, 6 relays, 4 control pots, chokes, condensers, etc. Convert for use on radio controlled models, doors, etc. Operates from 24 V. DC. Size. 9¼" x 6¼" x 7⅝".

$6.00

C-1 AUTO PILOT CONTROL BOX

Used for aligning control of C-1 Auto Pilot or use for parts, etc. Contains many useful pots., toggle switches, plugs, etc. Size, 11" x 6" x 6½".

PRICE

$6.75

BC-348 COMMUNICATIONS RECEIVER

6 bands, 200-500 Kc. and 1.5-18 Mc. 2 stages RF, 3 stages IF, BFO, crystal filter, manual or AVC. Complete with tubes and 24 V. dynamotor. These receivers have been thoroughly checked in our work-shop and found in excellent condition. Converted to 110 V. AC 60 cycle **$60.00**

24 v.d.c. operated suitable for airline use.................. **$100.00**

SCR-625 MINE DETECTOR

Brand New
Metallic Objects Only

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

The unit consists of a balanced inductance bridge, a two-tube amp. and a 1,000 cycle oscillator. The presence of metal disturbs the bridge balance, resulting in a volume change of the 1,000 cycle tone. The tubes used are low-battery drain types such as 1G6 and 1N5. The circuit may be modified for control of warning signals, stopping of machinery, etc., when metal is detected. Operates from two flashlight batteries and 103 V. "B." However, a power supply operating from 110 V. may be used. Comes complete with spare tubes, spare resonator and Instruction manual—in wooden chest 8¼"x28¼"x16". Weight in operation is 15 lbs. Now, complete in original overseas packing container. Originally sold by War Assets for $166.00.

The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

Price $59.50
Batteries ....$4.00 extra

MINE DETECTOR AN/PRS-1

The detector is designed to detect metals, non-uniformities (rocks, tree-roots) and may be used to detect metal buried in logs, to locate cables, pipes, sewer tile, etc. It is widely used by lumber camps, miners, prospectors, plumbers, treasure hunters and explorers.

A portable device used in the detection of both metallic and non-metallic by aural (ear) and visual (eye) means. These are brand new outfits, complete with Instruction book and spare tubes. Shipped in original, overseas moisture-proof container.

The set consists of the detector head with antenna and reflector meter, a meter housing and lower section of exploring rod, amplifier assembly, exploring rod extension, bag designed to carry equipment while operating, and wooden case for storing or transporting the complete unit when not in use. This detector is not nearly as sensitive as the SCR-625 Mine detector. However, because of its price and its simplicity, you cannot go wrong on buying one for $14.95. Shipping weight, 125 lbs. Weight in operation only 22 lbs.

Batteries are not included but we can supply them for $8.25 per set.

Our Price $14.95
Shipping Weight 125 lbs
Weight In Operation Only 22 lbs.

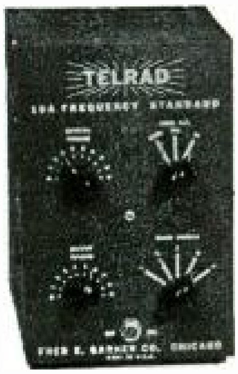
ESSE RADIO CO.

Esse's Special Offer

INDIANAPOLIS, INDIANA

T-26 APT-2 RADAR TRANSMITTER

Contains tunable VHF circuit using 2 JAN CTL 703A's or 368AS tubes. Other tubes are: 2—5R4GY's. 1—2x2. 1—807, 1—6AG7, 2—6AC7's and 1—931A. Other parts such as 24 VDC motor and blower, HV. condensers and transformers, terminal strips and Amphenol connectors, knobs, fuse holders, etc. make this unit invaluable for parts alone. Weight approx. 45 lbs Size 21" L x 10½" W x 7¾" H. in metal case **$9.75**



TELRAD 18-A FREQUENCY STANDARD

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

ARMY PHONES LOW IMPEDANCE

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

AUTOMATIC DIRECTION FINDER RADIO COMPASS SCR-269-G

Brand new in original crates
Made by Bendix
Complete, a truly magnificent buy for airplane owners or boat owners.
$125.00

RECTIFIER POWER UNIT

ATTENTION: FOR THOSE WHO NEED 6,12,24 VOLT POWER SUPPLY

Navy Type CLG-20341

110/220 Volts, 50/60 cycle, single phase AC operated. Net weight 263 lbs. Gross weight 335 lbs. 28" high, 19⅝" wide, 23¼" deep (4.25 cubic ft.).

Will continuously deliver rated load of 25 amperes at 7 volts. 14 Volts, or 28 Volts DC.

It will furnish an instantaneous dynamotor starting current of 25 amperes at 28 Volts output.

This unit is portable and is sturdily constructed in welded steel frame. It is housed in steel case provided with louvres. 4 handles for carrying are welded to case. Controls, fuses and cables readily accessible. Input and output cables are permanently attached and stored in compartments in front of case. Spare fuses and pilot lamps are easily accessible from the front. On/off switch is mounted in recessed panel on front of case.

4 connector lengths and terminals are provided for proper connections to input and output voltages. Terminal cut-out provides protection. A sturdy blower motor fan is provided for cooling of the 15 amp. Selenium rectifiers running 1550 RPM and has 10" blades.

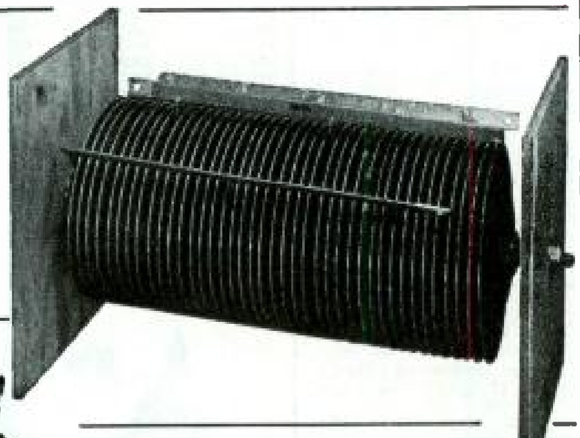
A sensitive regulating circuit keeps output voltage constant under varying load conditions or input voltage fluctuations. Adequate inductance and capacity are included for good filtering of the output voltages.

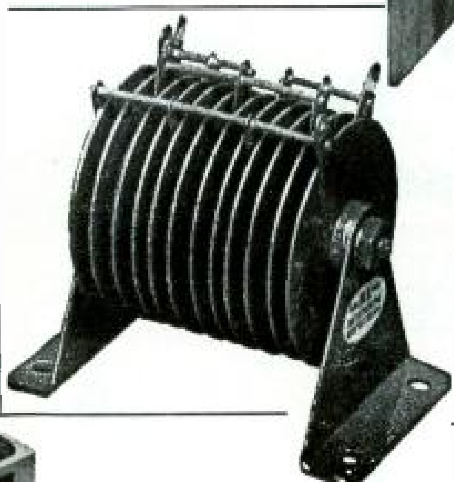
A complete operating manual accompanies the unit. This equipment was made by Electronic Laboratories. Inc. of Indianapolis. Indiana and is really a very dependable fine rectifier power unit and can be compared with only the finest. It cost our Government approximately $500.00.

Our Price, complete, BRAND NEW . . . $100

RECTIFIER ASSEMBLY

Selenium 15 amps. maximum continuous DC current inductive load for continuous duty. Maximum AC input 46 V. RMS single phase. DC output maximum 34.9 Volts. These rectifiers were used in Navy type CLG-20341 rectifier power unit which delivered 6-12-24 Volts DC current at 15 amps. Maximum dimensions 4⅜" dia. x 12¾" long.
Price New **$12.50**

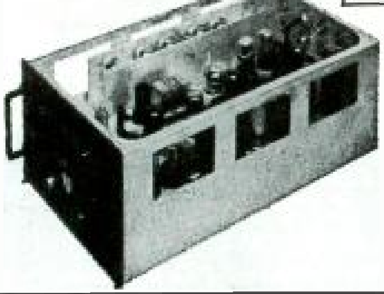




RECTIFIER SELENIUM

Maximum AC 60 cycle sine-wave. Input 13 Volts; output 9 Volts. Continuous current rating 2 amps. with inductive or resistive load. Maximum dimensions 3⅛" x 111/16" x 1 11/16". 12 square plates bridge circuit. (New).

Price .... **$4.00 ea.**



BC-1155A SYNCHRONIZER

Another invaluable unit for the Television and VHF experimenter. Contains 19 Mc.IF strip using 5—WE717A tubes. A total of 24 tubes included. consisting of 6—WE717A's, 2—6SL7GT's, 2—6AC7's, 5—6SN7GT's, 2—6N7GT's, 2—6L6's, 1—6V6GT, 2—6AG7's, 1—6AC7, and 1—6H6GT. Other parts included are 6 pots. 10 Amphenol 831R chassis connectors and numerous condensers, resistors, and transformers. Weight 22 lbs. Size 21"Lx11½"Wx7¾"H. Price..... **$10.00**

AIRCRAFT BATTERY AN-3152

Brand new. 12 volts, 24 amp hours. Dry packed and charged. Add battery acid Specific Gravity 1.265 (can be bought at any drug store.) Ideal for any amateur on 12 volt operations. Hard rubber case, size, 5¼"x10¼"x10¼" with bolt type connectors and with overflow. Weight 35 lbs.
Price **$12.95**

ESSE RADIO CO.

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INDIANAPOLIS, INDIANA

A TREMENDOUS BARGAIN

Quartz Crystals without Holders

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

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

Formula for converting thicknesses of B-cut crystals to frequency is as follows: F = 98.4/T where F is frequency in kilocycles and T is thickness in inches. An assortment of 20 different thicknesses.

$1.50

RF TRANSFORMER

(Not pictured)

For experimental use. Covers four bands. Range unknown. Measures 4" x 4⅞" x 2¼".

Brand new. . Price **50¢**

HASH FILTER

(Not pictured)

Mounted on strip 3½" x 1". Contains two hash chokes and one dual 135 MFD 400 Volt bathtub condenser.

Price **50¢**

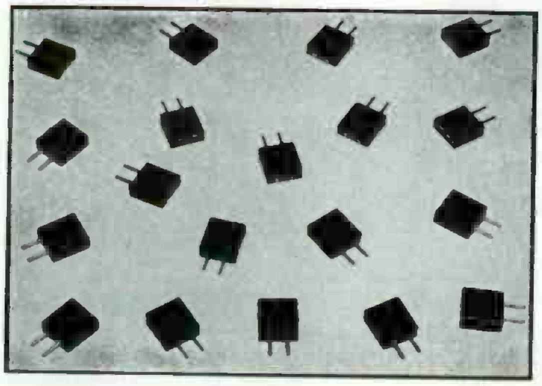
TURBO AMPLIFIER

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

Price ....**$1.00 ea.**

CRYSTALS IN STANDARD 5 PRONG SOCKET HOLDERS

Choice 50c ea.

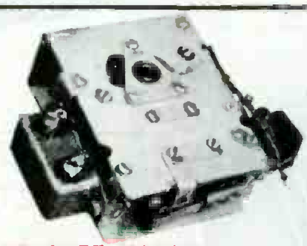


5560	7670	8124	8367
7120	7680	8126	8400
7210	7690	8130	8450
7240	7700	8245	8451
7250	7710	8248	8452
7260	7940	8250	8476
7270	7950	8251	8477
7280	7970	8252	8480
7290	7990	8351	8486
7300	8103	8356	8488
7320	8105	8357	8520
7330	8110	8360	8530
7340	8115	8361	8540
7660	8120	8362	8541
			8547

TUBES 45c ea.

These tubes are brand new, individually boxed and guaranteed.

0Z4	3V4	6BJ6	6S8GT	7C4	12SJ7GT	36	81
1A5GT	5R4	6BF6	6SA7	7C5	12SK7GT	37	84/6Z4
1A7GT	5T4G	6C4	6SC7	7E5	12SN7GT	38	85
1C5GT	5U4G	6C5GT	6SF5	7F7	12SQ7GT	39/44	89
1C6	5V4G	6C6	6SG7	7H7	12SR7	40	117L7GT
1G4GT	5W4	6C8G	6SH7	7K7	14A7/12B7	41	117N7
1H5GT	5X4G	6D6	6SJ7GT	7Q7	14Q7	42	117P7
1J6GT	5Y3GT	6D8	6SK7GT	7Y4	14X7GT	43	117Z3
1N5GT	5Z3	6F5GT	6SL7GT	7Z4	19T8	46	182B
1L4	5Z4	6F6GT	6AG7	12A6	24A	47	183
1Q5GT	6A3	6F8G	6SL7GT	12A8GT	25A6GT	50	482B
1R5	6A6	6H6	6SN7GT	12AU6	25A7GT	50B5	483
1S5	6^A7	6H6GT	6SQ7GT	12AT6	25AC5GT	35L7GT	717A
1T4	6A8G	6J5	6SR7	12AU7	25L6	50C5	955
1T5	6AC5GT	6J6	6SS7	12BA6	25Z5	50L6GT	956
1U4	6AC7	6J8G	6ST7	12AV6	25Z6GT	51	957
1U5	6AG5	6K6GT	6T7	12BE6	10	53	1005
1V	6AK5	6K7	6U6G	12C8	26	56	1629
2A3	6AL5	6K8	6U7	12F5GT	27	57	1625
2A4G	6AT6	6L6G	6V6	12J5GT	30	58	2050
2A5	6AU6	6L7	6W7	12K7GT	31	70L7	1626
3A4	6AV6	6N7	6X4	12K8	32L7	71A	2051
3B7	6B4G	6P5GT	6X5GT	12Q7GT	35	75	9003
3D6	6BG6G	6Q6	6Y6G	12SA7	35B5	76	VR150
3Q4	6B8G	6Q7	6Y7	12SF5GT	35L6GT	77	VR105
3Q5GT	6BA6	6R7	6ZY5	12SF7	35W4	78	9001
3S4	6^E6	6S7	7A7	12SH7	35Z5GT	80	9002



RATCHET MOTOR

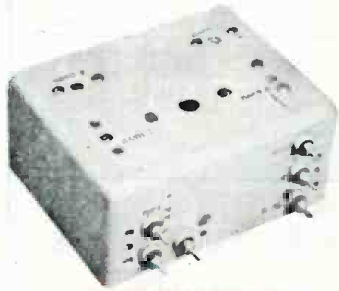
Operates from 12 or 24 Volts. Similar to motor used for automatic tuning of SCR-522 transmitter and receiver. This motor measures approximately 3" x 3⅞" x 1½". Has provision for coupling ¼" shaft. Ideal for remote tuning of mobile and other equipment. Rotates approximately 1 revolution per second. Brand new.

Price **$1.25**

LOW FREQUENCY RCA I.F. TRANSFORMER

Used for R.F. power supply or double conversion transformer, etc. 3½" x 1⅞". Brand new.

Price ....**35¢**



I.F. TRANSFORMER

2½" x 3¾" x 1⅝" marked 142.5 KC IF—243.5 KC IF. Six connectors on bottom grid cap. Connection out of side. Trimmer condensors readily accessible. Brand new aluminul case. Price. . . .**75¢**

ESSE Radio Co

40-42 W. South St.
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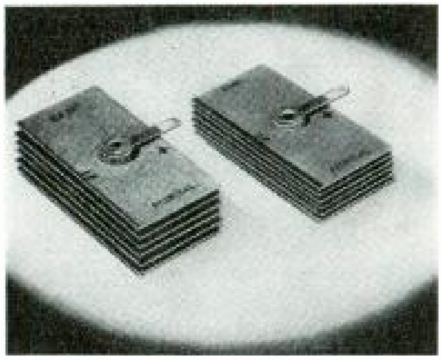
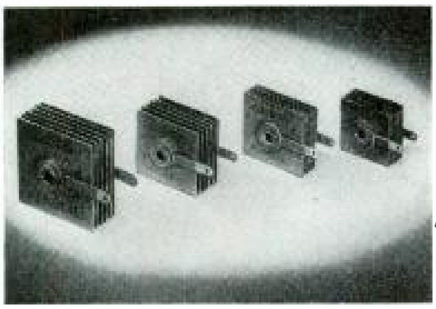


Selenium Rectifiers Replace Vacuum Tubes

Six Federal selenium rectifiers with ratings from 70 to 500 ma at line voltage.



Inserting dry rectifiers in place of tubes is simple and profitable

By JOHN B. LEDBETTER

THE 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.

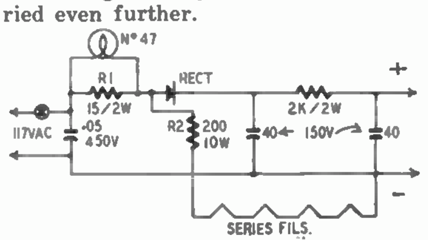


Fig. 1—Replacing 35Z5 in a.c.-d.c. receiver.

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.

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-

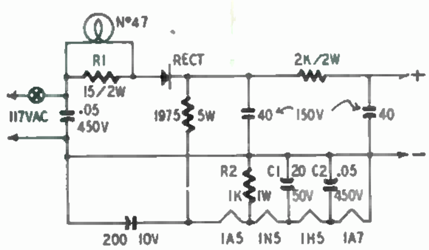


Fig. 2—Using rectifier with d.c. filaments.

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 resistor 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, 45Z3, 12Z3, 117Z3, and similar rectifier tubes. This applies also to the 117Z6, 50X6, 50Y6, 25Z5, and other full-wave types when connected as halfwave 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 simplest 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 required for the specific receivers named, but can be used in similar circuits: Motorola *Playmate*, model 61L11—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

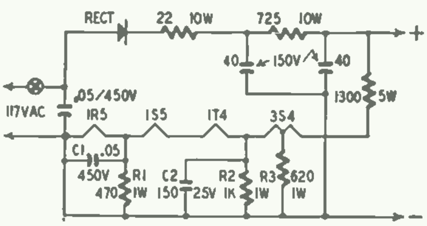


Fig. 3—Operating a portable from a.c. line.

resistance values is due to variations in current drain for individual receivers). The Motorola model 5A5 (and similar receivers which use a 117Z3), require a series resistance of about 150 ohms.

Typical 3-way receivers

A number of a.c.-d.c.-battery portable receivers use a 35Z5 or 45Z5 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 35Z5 and its filament dropping resistor (or line cord) have been

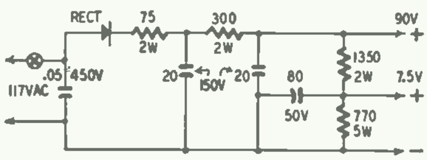


Fig. 4—This supply furnishes about 90 volts.

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 1H5. 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 a.c. 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 filament circuit. The constants shown in Fig. 4 may be substituted in receivers using the equivalent of a 1A7, 1N5, 1H5, and 1A5 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

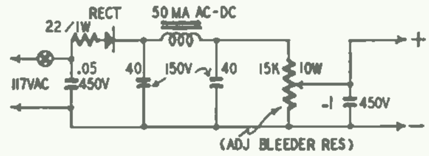


Fig. 5—Set the bleeder for desired voltage.

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.

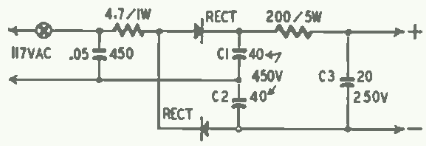


Fig. 6—Selenium version of familiar doubler.

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.

Voltage doublers

Two selenium rectifier stacks can be used to replace full-wave rectifier tubes such as the 50X6, 50Y5, 25Z6, 117Z6, etc., in a.c.-d.c. circuits, and in transformer-operated circuits to replace both the power transformer and rectifier tube. Advantages are high efficiency, low cost, good voltage regulation, low ripple output, no warm-up lag, and low

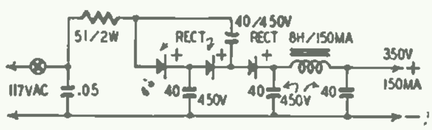


Fig. 7-a—Tripler has a 300-350-volt output.

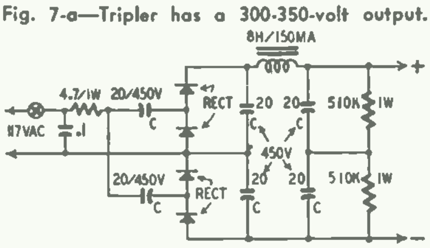


Fig. 7-b—Compact quadrupler has four stacks.

heat dissipation. A basic voltage doubler circuit employing two Federal 403D2625

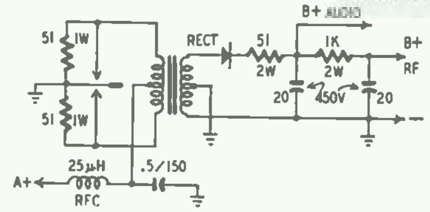


Fig. 8—The half-wave vibrator power supply.

(100-ma) rectifier stacks is shown in Fig. 6. 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 255. Beyond this 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.

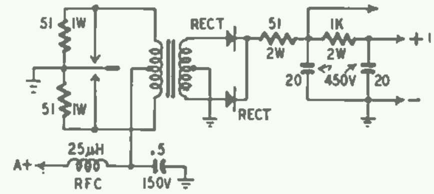


Fig. 9—A full-wave supply is more reliable.

Regulation, as well as output, improves as the filter capacitances are increased. For ordinary requirements, the values shown represent an economical compromise, although values up to 180 µf are used in some television power supply circuits.

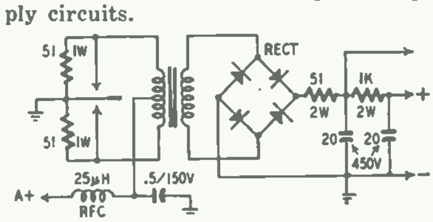


Fig. 10—Bridge rectifier is very efficient.

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 expectancy 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 vacuum-tube 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 sim-

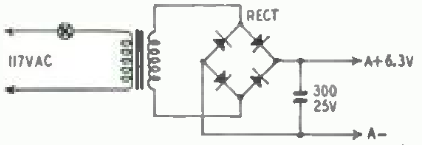


Fig. 11—Dry-rectifier d.c. filament supply.

plified greatly by employing d.c. for the filaments. 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

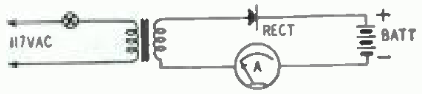


Fig. 12—Selenium unit in a battery charger.

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 half-wave (Fig. 12) or full-wave (Fig. 13). By selecting a transformer

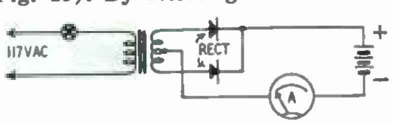


Fig. 13—This is a full-wave battery charger.

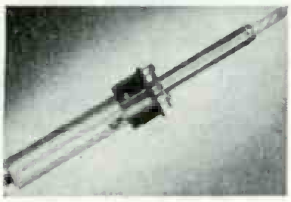
having the proper turns ratio and current rating (or winding one yourself), an efficient battery charger can be built to handle either the 2-volt storage batteries used in some battery-portable receivers or regular 6-volt auto receiver batteries.

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.

SOLDERING TOOL

Instant Tool Corporation
New York, N. Y.

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 and prevent overheating and scaling. Unlike thermostatically controlled equipment, the iron is maintained at constant heat as long as the switch is held on.

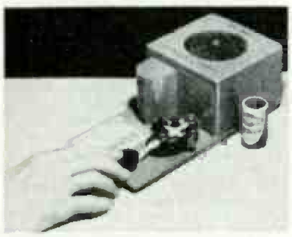


The iron works directly from the 117-volt line, using no transformer either in the tool or independent of it. Weight is under ½ pound. In the specimen tested, wire solder was melted in 12 seconds from the time the switch was operated.

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

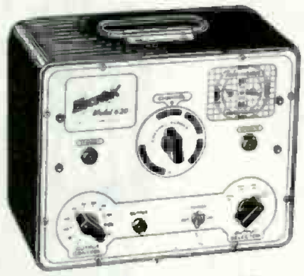
Spellman Television Co., Inc.,
New York, N. Y.

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 500 μa 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 5TP4 projection tubes.

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 patterns. 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 unreliable.



MICROPHONE STAND

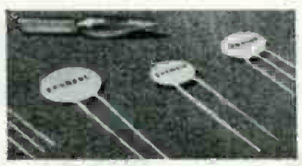
Electro-Voice, Inc.,
Buchanan, Mich.

New desk-type microphone stands are offered with a momentary press-to-talk, lever-type 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.

DISC CAPACITORS

Sprague Products Co.,
North Adams, Mass.

The new ceramic disc capacitors consist of a dime-sized or smaller ceramic plate with high dielectric constant with silvered electrodes fired on both faces



of the disc. Each capacitor is coated with an insulating resin.

TWIST-MOUNT CAPACITORS

P. R. Mallory & Co., Inc.,
Indianapolis, Ind.

New labels placed on the twist-mount FP line of capacitors make identification easier. Rating and part number,

as well as makers' name, appear on each. Recent improvements in the capacitors include stronger anode tabs, ability to withstand higher discharge currents, new high-surge separators, greater heat resistance, extra-heavy rubber seal, heavier cathode tab, and special etched cathode.

D.C. POWER SUPPLIES

Opad-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. A tapped primary on the transformer permits adjustment of voltage.

TV TURNTABLE

Krenco Mfg. Co.,
Chicago, Ill.

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 felt-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.

KILOVOLTMETER

Bradshaw Instruments Co.,
Brooklyn, N. Y.

The Kilovolter is a two-range non-electronic voltmeter. Ranges are 0-25,000 and 0-50,000 volts d.c. The meter has a 20 μa movement. Input impedance on either range is 1,250 megohms.

The meter is a 4½-inch unit. The multiplier resistor is contained in the polystyrene probe.

PA AMPLIFIER

Allied Radio Corp.,
Chicago, Ill.

The new version of the Knight 20-watt amplifier is flat within 2 db from 20-20,000 cycles and has less than 2% distortion of full output. Hum is 80 db

below rated output. A built-in equalized preamplifier is provided for variable-reluctance pickups. An isolated, equalized output is provided for crystal disc-recording heads. Separate bass and treble controls are included.

TV ANTENNA

Ward Products Corp.,
Cleveland, Ohio

Model TVS-47 is a combination of high- and low-band folded dipoles and reflectors. Installation time is reduced because the antenna is preassembled at the factory. The high-band section can be oriented independently of the low-band array.

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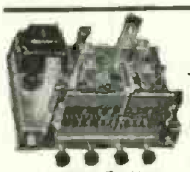
SAVE ½ ON A HALLICRAFTERS S-56 OR S-59 FM-AM CUSTOM CHASSIS

HALLICRAFTER'S S-56 $59.95



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

$110.00 VALUE 11-TUBE FM-AM CHASSIS
★AUTOMATIC FREQUENCY CONTROL ON F.M.

R.F. STAGE ON F.M.

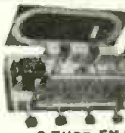
Model S-56 Hallicrafters, high fidelity, 11 tube AM/FM radio receiver chassis for the broadcast band and FM 88 to 108 megacycles. Automatic frequency control on FM holds the station in tune. Phono connection on rear of chassis. Full range tone control with base boost. Push pull 6K6 tubes in audio system. Frequency response essentially flat from 50 to 14000 cps. Wide vision accurately calibrated slide rule dial, with pre-selection on broadcast band. Output transformer matches 500 ohm line. 4 Antenna terminals: two for AM and two for FM. This is the finest type home radio that we know of today. Better get your order in early. Designed to be used in commercial radios selling in the $400.00 to $600.00 class. The regular dealers net on this chassis is $100.00. However, a lucky purchase enables us to offer these brand new, factory cartoned S-56 Hallicrafters chassis complete with tubes and operation instructions, at only $59.95 less speaker. Speaker matching transformer, 500 ohms to voice coil $2.50 extra. Chassis size 12¾ x 10 x 7¾". Weight 25 lbs. Buy your S-56 with a wide range PM speaker. Pick your combination from the prices listed below and save.

Hallicrafters S-56 Chassis with Tubes, 500 ohm to speaker matching transformer and Model A-15 PM Jensen 15 inch 6 lb. magnet speaker. This gives you a complete radio for custom installations. Shipping weight 47 lbs. Stock No. S-56 A 15PM. Jensen Speaker. S-56 chassis and speaker matching trans. all for $79.95
G.I. dual speed changer. Stock No. GI-73 .... $17.95

Hallicrafters S-56 Chassis with Tubes, 500 ohm to speaker matching transformer and our Model CR-13X 12 inch coaxial PM wide range speaker. This gives you a complete radio for custom installations. Shipping weight 33 lbs. Stock No. S-56CR13X. S-56 chassis with 12 inch coaxial PM speaker and matching trans. All for $71.95. G.I. Dual speed changer Stock No. G.I. 73 $17.95.

Hallicrafters S-56 Chassis with Tubes, 500 ohm to speaker matching transformer and our Model 12-XMS super heavy duty 12 inch 22 oz. Oxford PM speaker (regular $50.00 list). This gives you a complete radio for custom installations. Shipping weight 38 lbs. Stock No. S-56XMS. A 12" Oxford Speaker S-56 and speaker trans. all for only $69.95. G.I. Dual Speed Changer No. G.I.-73 $17.95 extra.

HALLICRAFTER'S S-59 $32.95

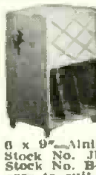


8-TUBE FM/AM MODEL S-59. $32.95

8-TUBE FM-AM CHASSIS
PUSH-PULL AUDIO—AC CONSTRUCTION

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

CONSOLE CABINET FOR S-59 $19.95

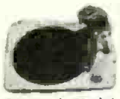


Beautiful blond console cabinet. Size 17 x 21 x 33" high. This cabinet was intended for use on a nationally known $129.00 radio-phono combination. The lower half of the cabinet is divided for albums. The upper half has a hinged lid, which covers the radio and changer. Radio panel is 8 x 15" and may be ordered ready cut for Hallicrafters S-59 or with a blank panel for installing your own chassis. Changer panel is blank, will hold a changer up to 12 x 15". Cabinet will hold a 6" or a 6 x 9" speaker. Shipping wt. 40 lbs. Stock No. JB-4 blond cabinet, ready cut for the S-59 Hallicrafters (will not hold S-56) $19.95
6 x 9"—Alnico V PM speaker .... $2.95 extra
Stock No. JB-5X same but blank radio panel $19.95
Stock No. B-1000 cabinet just as we bought them. You re-do the radio and changer area to suit your own need. Changer area is now 15 x 15" and radio area 5 x 15 x 11½" Stock No. B-1000. Shipping weight 40 lbs. $14.95

CAPEHART TWO POST RECORD CHANGER $9.95

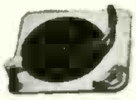
Capehart Changer Scoop. Used on famous, high priced combinations. Brand new, but have been removed from sets: to be replaced with twin speed changers. May Require Minor Adjustments. These have Capehart true-timbre variable reluctance cartridges. Requires same gain as the G.E. VR cartridge. Connecting instructions furnished. Base size 14¼ x 14¼". Weight 23 lbs. Stock No. NK-3. $9.95 ea.
Extra tone arm, with MLP-1 Crystal cartridge and permanent needle, $1.00, extra.
Extra tone arm, with G.E. RPX-010 variable reluctance cartridge, $2.95, extra.
Made to fit leatherette covered base. $1.95, extra.

$12.95



Crescent Model 350 with Astatic L-70 cartridge. Plays 10 12" or 12 10" records at 78 RPM. Base size 11½ x 13". Net Price $12.95, two for $25.00.
A red hot changer value. Weight 14 lb. Made to fit leatherette covered base. $1.95, extra.

$19.95



General Instrument Stock No. GI-73. Dual Speed, with Astatic reversible cartridge; permanent needles. Plays 10 12" or 12 10" records, at 33⅓ or 78 RPM.
Net Price $19.95, ea. $17.95 if you buy with an S-56 or S-59.

12 INCH COAXIAL P. M. SPEAKER
RESPONSE 40-17000 CPS $12.95

Regular $32.50 list nationally known, famous 12" Alnico V coaxial PM speaker. Matches any 8 ohm voice coil, only two wires to connect. This speaker used on nationally famous $600.00 radio sets. Stock No. CR-13X. Weight 8 lbs. Net $12.95, two for $24.95.

OUTPUT TRANSFORMER HIGH FIDELITY 20—20,000 C.P.S. SCOOP PRICE $6.95 EACH

6600 ohms Plate to Plate

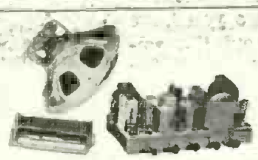
Why pay $20.00 or $30.00 for an output? Supreme quality and high fidelity output transformer. Designed to match push-pull plates (2—6L6, 2—6V6, or 2—6AQ5) class AB, to 4-8-15-250 and 500 ohm; with 10% feedback winding. Housed in a compound filled case; 3⅞x 4½x3". Actual net weight, 6 lbs. If you want the best quality from your audio system, order this transformer. Response essentially flat from 20 to 20,000 cycles. We have tried several high fidelity outputs in our lab and find this to be the best value. Even though your amplifier only puts out 10 or 15 watts, this 34 watt job is what you should have. Connecting instructions are furnished. Stock No. A-403, shipping weight 8 lbs. Net price $6.95

ST. GEORGE WIRE RECORDER MECH. $22.95

St. George Wire Recorder Mechanisms. Brand new, complete wire recording and playback mechanism. (Also plays 78 RPM records when crystal pickup is installed.) Records and plays back up to 1 hour on standard Webster wire. Furnished with diagram for 3 tube convertor (adapts radio or amplifier for wire recording). X-93 St. George mechanism, weight 15 lbs. Requires 9 x 13 x 3½" space. Net $22.95. Crystal pickup for playing and recording phono records, $1.95 extra. Webster wire, 1 hour, $3.25; 30 min., $1.95; 15 min., $1.30. Crystal mike and desk stand $4.95 extra.

WIRE RECORDER CONVERTER $12.95. With this 3-tube converter you can adapt the St. George Airking, or Webster Chicago wire recorder mechanism to any radio or P. A. system. Only 3 connections necessary. Just plug it into the phono input of your amplifier and connect to plate of output tube. AC-Transformer construction, gain for mike, 3 position switch for quickly changing from record to play-back. Priced ready wired and tested with instructions and tube 12AT7 pre-amplifier; 6AQ5 Oscillator erase; 6X4 rectifier. Stock #RR-4. net, $12.95.

12-TUBE FM-AM KIT $39.95



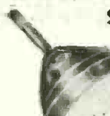
12 Tube Kit Model PRK-51. This is the most elaborate radio, P.A. kit that our engineering department could design. Here are its features: Receives broadcast, 550 to 1650 kc and FM, 88 to 108 mc (3 gang tuning on FM.) The audio system is wide range, 40 to 17,000 cps. 5 lb. interwound high fidelity output matches 8 ohm speaker. Twin tone controls (base and treble boost). Phonograph inputs for standard crystal or General Electric variable reluctance. Mike input for crystal or dynamic mike. This radio may be used for an 18-watt P.A. system, a recording amplifier, or for a high fidelity T.V. sound system. Chassis size, 15½ x 7½ x 7½", ready punched. Everything furnished with the kit, including tubes 6AG5, 6SB7Y, 2-6BA6, 6AT6, 6H6, 6BE6, 2-12AT7, 2-6V6 and 5Y3. The FM RF section is ready wired (coils and sockets), to make this kit easier for you to build. 6" slide rule dial. Complete kit Model PRK-51, with photos and instructions, $39.95. Weight, 28 lbs. Speaker recommended, Oxford 12", 22 oz. PM, curved cone and 1½" voice coil. Model 12-XMS, $10.00 extra.

6 TUBE AC DC KIT $9.95

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

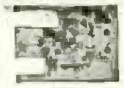
BUY YOUR TELEVISION MATERIAL FROM McGEE

SALE! TV PICTURE Tubes Dumont 12QP4 only $27.95 our leader 10BP4 only $19.95



As usual, McGee offers you a better buy. We have on hand 100 Dumont 12QP4 Picture Tubes in original carton, first quality, while they last only $27.95. This is the best value in the U.S. today.
10BP4 10" Picture Tubes, manufacturer states, these tubes are well within tolerance but not quite high enough to bear our brand name. McGee's tests fail to show any difference between this and any other 10BP4. Full factory guarantee. 10BP4 net $19.95. Sockets for either above tubes 49c each.

T. V. SCOOP $5.95



Farnsworth Television Chassis Model GVZ60 partially built up Chassis Size 12x17. Has 16 Tube sockets and over 150 small parts (Resistor and Ceramic Condensers) no coils or Transformers or tuning unit. Sweep and sync. circuits are all partially wired up. This T.V. Chassis is ideal for the student and experimenter. Learn T.V. by building your own set using this chassis to start from. Furnished with a 1948 regular $3.00 Supreme Publications Television Manual, which has a complete schematic of this chassis as well as 9 pages of service information.
If you want to play with Television here is a chance to get started.
Farnsworth GVZ60 partially built up Chassis and 48 Supreme T.V. Manual all for $5.95. Include postage for 11 lbs. GVZ60 Chassis only $2.95.

Sarkes Tarzian 13 CHANNEL T.V. TUNER ONLY 9.95

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

TELEVISION POWER TRANS. $2.95

GVZ-60 Power Transformer, C-94230Z. A 135 ma. tapped 110 volt primary. Supplies plate voltage and filament for part of Farnsworth T. V. chassis. 375 volts D.C. 6.3 and 5 volt filament. Adjustable voltage. Size, 3¼ x 3¾ x 5¼" high. Shipping weight, 7 lbs. Scoop price, GVZ-60 T. V. Power Transformer $2.95

JEFFERSON T.V. PWR. TRAN

T.V. Power Transformer, similar to R.C.A. 290 ma. 110 volts, 6C cycle. 760 volts D.C., filaments 5 volts at 3 amps., 5 volts at 3 amps and 6.3 volts at 8 amps. Trans. size 3¾ x 4½ x 5¼". Shipping weight, 12 lbs. Stock No. MB-4F. Net price $6.95

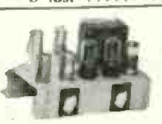
Television Vertical Deflection Output Transformer. Shipping weight 2 lbs. Stock No. VD-5000. Net price $1.35
Television Focus Coil. Top quality for 10 or 12" tubes. Similar to R.C.A. No. 202D1. Net price $2.49
Horizontal Oscillator Transformer. Stock No. H-MA. Net price 99c

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

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

TELEVISION COURSE $3.00

Sam's Television Course book, 216 pages, T.V. explained to you in everyday language. We think it's the finest value today. Net $3.00
Ward TVH-9 Television antenna. Stacked high and low band folded dipoles, with reflectors and mast. Regular $15.00 net. McGee's sale price $6.49

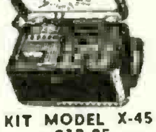


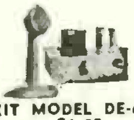
5 WATT KIT TM-4 $6.95 — 8 WATT KIT TM-8 $8.95

Kit Model TM-4. 5 Watt Amplifier Kit. Ideal for beginner construction. Has features of higher priced amplifiers. Inputs for phono pick up or mike. Compensation for the G.E. Variable Reluctance pick up. Push pull output gives good tone quality. Output to 8 ohm Voice Coil. Variable tone control and fader control. Ready punched chassis. This makes a top quality AC-DC Audio Amplifier. Priced complete with tubes, diagram and photos. 2—50B5, 2—12AX7, plus selenium rectifier. Weight 3 lbs. Stock No. TM-4. $6.95. Crystal mike and utility desk stand $4.95 extra. Model TM-4WT Amplifier is TM-4 Kit wired ready to operate net $9.95.
Kit Model TM-8. 8 Watt amplifier Kit for utility use, record playing, or paging. Matched component parts. Ready punched chassis. Variable tone control. One control fades from mike to phono. Input compensation for G.E. Variable Reluctance pick up. Output matches 8 ohm Voice Coil. 75 Mill Power Transformer. Price includes tubes, diagram and photo. Push pull 6AQ5, two 12AX7, plus rectifier. Kit Model TM-8. Weight 8 lbs. Net $8.95. Crystal mike and utility desk stand $4.95 extra. Model TM-8WT amplifier is TM-8 kit wired ready to operate net $11.85.

12 WATT KIT TM-12 $10.95 — 20 WATT KIT TM-20 $15.95

Kit Model TM-12. 12 Watt Amplifier kit. Ideal for a high quality record player as a P.A. System or recording amplifier. Matched component parts. Ready punched chassis. One control fades from phono to mike. Input compensation for G.E. Variable Reluctance pick up. Output matches 8 ohm Voice Coil. 100 Mill Power Transformer. Complete with tubes, diagram and photos. 2—6V6, 2—12AX7 and rectifier. Variable tone control. Model TM-12. Weight 10 lbs. Net $10.95. Crystal utility mike and desk stand $4.95 extra. Model TM-12WT amplifier is TM-12 kit wired ready to operate net $14.95.
Kit Model TM-20. A high quality 20 Watt Audio Amplifier with 135 Mill Power Transformer and push pull 6L6's. Inputs for mike or phono pickup. Compensation for G.E. Variable Reluctance pick up. Tone and fader controls. Has heavy duty universal output transformer to match one or two speakers. Ready punched chassis. Price includes tubes, diagram and photos. 2—6L6, 2—7N7, 7Z4. Frequency response 50 to 9,000 Cps. Kit Model TM-20. Weight 20 lbs. Net $15.95. Model TM-20WT amplifier is TM-20 kit wired ready to operate net $20.95.





KIT MODEL X-45 $12.95 — KIT MODEL DE-6X $6.95

Complete Garod Personal Portable Radio Kit Model X-45. Made from genuine Garod factory matched parts. A complete kit to build a broadcast battery operated 4 tube receiver. Small in size 6⅛x3¼x4½". Weight 3¼ lbs. 1 Gang Superhet circuit set comes on when lid opens. Rugged metal case with colored plastic front and back. Loop antenna in lid. Furnished with diagram and photos, tubes and 67½ B-Battery. Will go together like a factory built radio. Shipping weight 6 lbs. #X-45 $12.95. Model X-45WT Portable Radio is X-45 kit wired ready to operate net $14.95.
Complete Mike Broadcaster Kit Model DE-6X. Broadcasts 800 to 1500 KC from either a phonograph pick up or mike. Makes any radio receiver a P. A. system or recording amplifier. Broadcast tone quality. Has fader control from mike to record simulating a regular broadcast station. Works on 110 Volt AC. Ready punched chassis. Price includes a Wiring diagram, photos and tubes. 2-35B5, 12SJ7, 35... Kit model DE-6X. weight 4 lbs. Net $6.95. Crystal Mike and desk stand $4.95 extra. Model DE-6XWT is DE-6X kit wired ready to operate net $8.95.

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

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

European Report

By Major Ralph W. Hallows

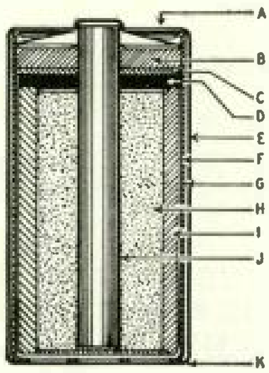
RADIO-ELECTRONICS LONDON CORRESPONDENT

SOME months ago I described a new departure in dry-cell design—the Vidor Kalium type of caustic potash zinc-mercury cell. Apart from its ability to maintain a steady e.m.f. under heavy loads, the outstanding features of this cell are its strong airtight can and its freedom from liability to cause damage by puncturing and letting loose its electrolyte when approaching the end of its service. As any can testify who have had experience with the mess and harm that a punctured dry cell can produce in delicate apparatus, this last is a very strong point. In the Alpha Leclanché (sal ammoniac-zinc-manganese dioxide) cell, due to appear shortly on the British market, the make-up is in many respects similar to the Vidor, as those who remember my drawing of this latter cell will realize by comparing it with the drawing here of the Alpha. The makers of the Alpha cell claim that it is unaffected by wide temperature variations and that during a long shelf life its characteristics remain exactly as they originally were. Whether these claims can be substantiated I cannot yet say, for I have not yet been able to obtain a batch for laboratory tests. The Alpha people are very confident about the performance of this new cell and state that, when it is on the market, they will replace free of charge, not only defective cells and batteries, but also flashlights and similar devices damaged by leakage of electrolyte.

From France I hear well-authenticated rumors of the perfection of an entirely new kind of alkali-cadmium-nickel secondary battery. This also is hermetically sealed in a completely leak-proof metal case. It, therefore, requires no attention whatever, save recharging when run down. I understand that cells of miniaturized type have been produced, which are also of very light weight. It is suggested that batteries built up of such cells may provide A- and B-currents for hearing aids and similar small appliances. If this can be done, it may lead to radical improvements in personal and universal radio receivers, walkie-talkies, vacuum-tube voltmeters, service testing equipment, and a whole host of other electronic apparatus.

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.



Alpha Leclanché cell. A—double-sealed metal top; B—plastic seal; C—washer; D—expansion chamber; E—metal shell; F—seamless zinc can; G—moisture-proof bitumen board; H—depolarizing core; I—paste electrolyte; J—carbon electrode; K—the metal bottom reinforcement.

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 use our 405-line system we can relay 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 transmitter has a *genuine* bandwidth of not less than 2.7 mc for the vision channel alone 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 low-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 either the American or the European Continent by co-axial 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 to be 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—fea-

He finds trouble by ear

As this cableman runs his pickup coil along the cable, his ear tells him when he has hit the *exact spot* where unseen trouble is interfering with somebody's telephone service.

Trouble develops when water enters a cable sheath cracked perhaps by a bullet or a flying stone. With insulation damaged, currents stray from one wire to another or to the sheath. At the telephone office, electrical tests on the faulty wires tell a repairman approximately where to look for the damage.

A special "tracer" current, sent over the faulty wires, generates a magnetic field. Held against the sheath, an exploring coil picks up the distinctive tracer signal and sends it through an amplifier on the man's belt to headphones. A change in signal strength along the cable tells the exact location of the "fault."

Compact, light, simple to use, this test set makes it easier for repairmen to keep your line in order. It is another example of how Bell Laboratories research helps make Bell Telephone service the most dependable in the world.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting, for continued improvements and economies in telephone service.

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 between 9,320 and 9,500 mc (the "3-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 measurement. 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 Decca 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. Think that out and see whether you can discover why these things 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 microseconds. Hence in 0.1 microsecond they travel 1,000/30.5 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 follows 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—out and home—of the pulse. Thus in theory the shortest 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, if 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 change-over—and at very short ranges even fractions of microseconds 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 needed for cutting 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 must not be mounted so high that the skip distance between them and the surface of the water is too great.

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.

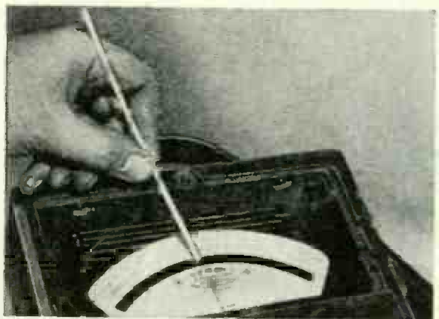
Photo 6. Lead container made from discarded flashlight case and fastened to side of tester keeps test leads out of way when not in use.

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.


PHOTO 1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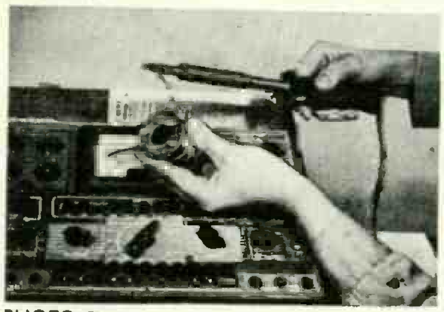
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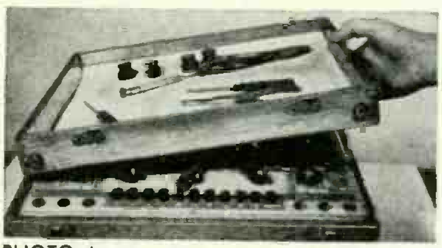
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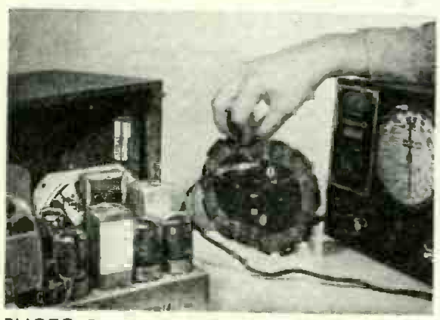
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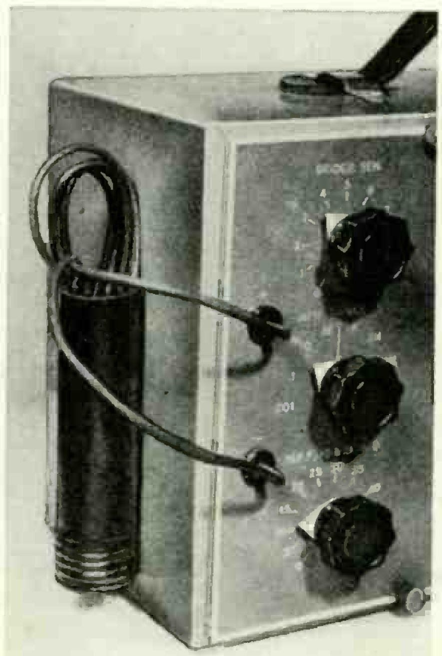
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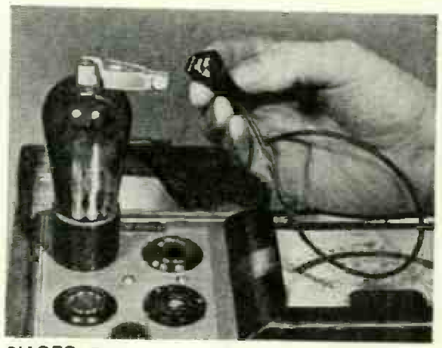


PHOTO 7


PHOTO 8

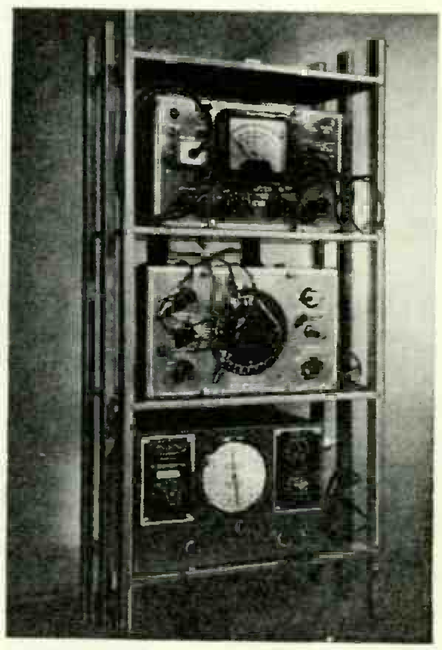


PHOTO 9

EICO TEST EQUIPMENT KITS!

You Build 'Em In One Evening-But They Last A Lifetime!

MODEL 221K HIGH PRECISION VACUUM TUBE VOLTMETER
YOUR COST—23.95

Featuring exceptionally high stability, accuracy and linearity, this quality VTVM is recommended for all laboratory and service applications. 2% accuracy on all ranges. 15 different ranges. Kit form.

MODEL 400K 5" SCOPE
YOUR COST—39.95

For premium performance at amazing low cost, select EICO Model 400. Many 5" Scopes at twice the price do not equal its accuracy, sensitivity and versatility.

MODEL 320K SIGNAL GENERATOR
YOUR COST—69.95

Features a highly stable Hartley oscillator with a calibrated frequency range of 150 KC to 102MC. Fundamentals to 34 MC. Pure 400 cycle audio sine wave available for audio testing and R.F. modulation.

MODEL 145K MULTI-SIGNAL TRACER
YOUR COST—18.95

Engineered for audible tracing of I.F., R.F., F.M., video and audio circuits. Provisions included for VTVM visual signal tracing, enabling actual stage-by-stage gain comparison.

Approved ELECTRONIC INSTRUMENTS

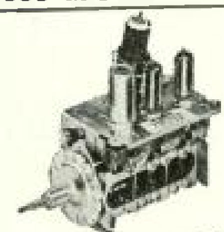
These are NOT KITS

MODEL A-460 FIELD STRENGTH METER 79.50

- Measures actual Television station signal strength
- Orientation of Antennas can be accomplished precisely and quickly.
- May be used to check efficiency of various Antenna combinations.

MODEL A-500 FM TUNER 14.95

Complete with tubes, dial escutcheon, instruction book, aligned and air tested. Sbpg. weight 10 lbs. Size: 8" x 5" x 3".



MODEL A-475 TELEV. TUNER 32.50

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

MODEL A-600 BROADCAST SUPERHET TUNER 12.85

Model A-600 comes complete with 4 tubes (standard brands). Air tested and Aligned, operating instructions, circuit diagram, guarantee. Shpg. weight: 2½ lbs. Size: 4" x 4" x 5".

MODEL A-610 4 WATT AC AMPLIFIER 14.25

Model A-610 comes complete with 4 tubes (standard brands) tested, complete operating instructions, circuit diagram, guarantee. Sbpg. weight: 5½ lbs. Size: 6"x5"x8".

PANEL METERS

3½" G.E. 0-15 A.C. VOLTMETER	$3.95
2¾" WESTINGHOUSE 10-0-6- DECIBEL METER	6.95
2¾" BURLINGTON 0-150 A.C. VOLTMETER	4.95
3½" WESTINGHOUSE 0-150 A.C. VOLTMETER	4.95
3½" WESTINGHOUSE 0-500 D.C. VOLTMETER	3.95
2¾" GRUEN 0-500 D.C. MILLIAMMETER	2.95
2¾" DYMAC 0-50 D.C. MILLIAMMETER	2.95
2¾" DYMAC 0-100 D.C. MILLIAMMETER	2.95
2¾" DYMAC 0-250 D.C. MILLIAMMETER	2.95

AMPLIFIERS
25 watt amplifier operates on 6 volt batteries as efficiently as on 117 volt source. Ideal for sound trucks. Self contained record player. Complete with matched kit of tubes. Your cost. $69.95

35 WATT AMPLIFIER with automatic record player & kit of matched tubes—4 inputs, each separately controlled—this amplifier is highly recommended for fixed systems. 105-125 V.A.C. Your cost. $69.95

50 WATT AMPLIFIER—A powerful wide range amplifier that delivers better than 50 watts of usable power. Suitable for heavy duty service. And is successfully used for larger auditoriums — theaters — indoor-outdoor rinks—stadiums—auto races—football fields—etc. Complete with matched tubes. Your cost. $69.95

INTERCOMS

—10 station master for use on intercom systems employing from one to 10 subs. Operates on 110-115 volts A.C. or D.C. low consumption cost. Extra powerful amplification. Beautiful grained walnut cabinet. 9¾" x 6". Your cost $19.95

MEISSNER KIT BOOKS

Contains many build them yourself diagrams including T.V. **$1.00**

CODE PRACTICE SETS

Speed X code practice set—with key & high frequency buzzer. Your cost. **$1.49**

Standard signal corp-telegraph keys. Your cost .... .49c

PHILCO AUTO RADIOS

CR9 .... 1942-1949 Fords 1942-1949 Mercury

Has a powerful, new miniature circuit and new electronic tuning system. Custom-built by Philco. **$39.95**

CR2 ALL CARS
Custom styled control unit fits perfectly in instrument panel opening provided in almost all cars. Philco—best by far for every car! **$29.95**

TELEVISION PICTURE TUBES

TP400A	$49.50
3KP4	13.50
5TP4	59.40
12QP4	46.00
7JP4	16.88
10BP4	27.50
10FP4	26.80
10HP4	48.50
12RP4	44.00
12JP4	41.25
12KP4	36.45
12LP4-12UP4	34.40
12QP4	43.00
12UP4 Luxide	37.15
15AP4	66.75
16AP4-16EP4	56.40
16AP4-16EP4-Luxide	59.15
20BP4	222.75
15DP4	64.75
16FP4	72.50

CONVERSION KITS

To change a 630TS chassis to use 16AP4 picture tube. Model DP voltage doubler includes plastic sleeve, plastic ring and mounting bracket. Complete Kit, less picture tube. Your cost. $24.95

Kit to convert a 10 inch set to use a 12 inch picture tube (Brackets & wooden block). Your cost. $4.95

TERMS: 25% deposit with order. Balance C.O.D. 2% off, if full payment is included with order. All items shipped F.O.B. Boston.

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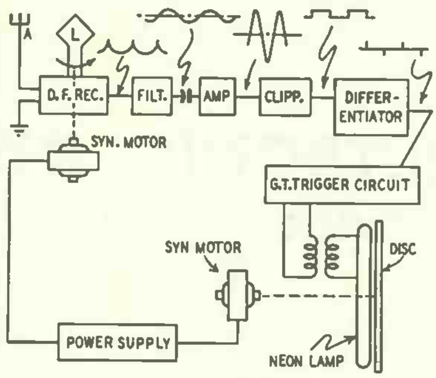
DISTRIBUTORS OF FAMOUS MAKES NATIONAL PRODUCTS

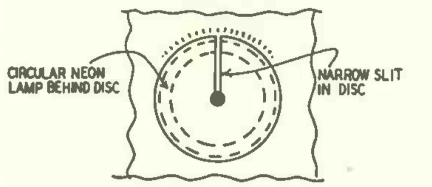
DIRECTION FINDER

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.





A masking disc rotates in front of the lamp. When 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 synchronous 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.

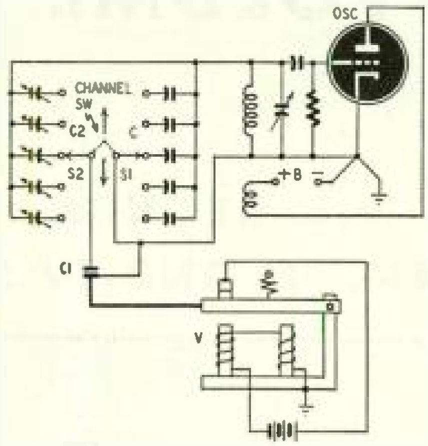
SWEEP GENERATOR

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 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.



Less series capacitance is used in series with C1 at the upper channels to reduce the relative frequency deviation.

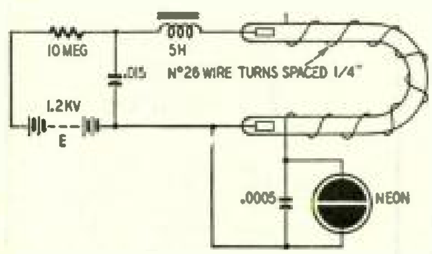
NEON FLASHER

Patent No. 2,467,472

Robert R. Goshorn, Cincinnati, Ohio

(Assigned to Automatic 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, 12 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 .015-μf 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-μμf capacitor is charged. When the voltage is high enough, the capacitor discharges through the small neon lamp and the static charge is removed.

10-METER CONVERTER FOR BC-312

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.

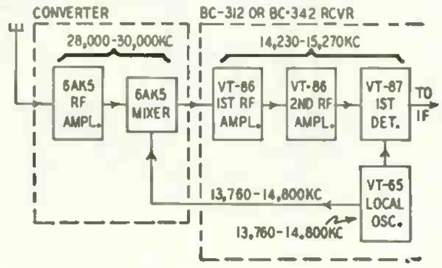


Fig. 1—Converter precedes BC-312 front end.

Fig. 1 is a block diagram of the converter and front end of the BC-312 receiver. The grid circuits of the 6AK5 r.f. amplifier and 6AK5 mixer are broadly resonant between 28,000 and 30,000 kc. The local oscillator—470 kc *lower* than the signal frequency on the high-frequency bands—is coupled to the 6AK5 mixer. Therefore, if the receiver is tuned to 14,230 kc, its oscillator will be on 13,760 kc. This frequency beats with a 27,990-kc signal to produce a 14,230-kc heterodyne signal which will pass through the r.f. and mixer circuits of the receiver. When the receiver is tuned to 15,270 kc, its oscillator produces a 14,200-kc signal which heterodynes a 30,070-kc signal down to the signal frequency of the receiver. Thus, signals between 27,990 and 30,070 kc can be received by tuning the receiver from 14,320 to 15,270 kc.

The circuit of the converter is shown in Fig. 2. The unit is constructed on a 1 x 3¾-inch chassis which is mounted in 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 fits 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-μμf 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 drawing a total of 20 ma at 150 volts, the value of resistor R will depend on the available supply voltage.

The variable ANTENNA ALIGN capacitor was replaced by a 200-μμf 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 ⅜-inch forms with adjustable, powdered-iron cores. L1 and L3 have 10 turns of No. 21 enamel wire. L2 is 3 turns of No. 21 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.

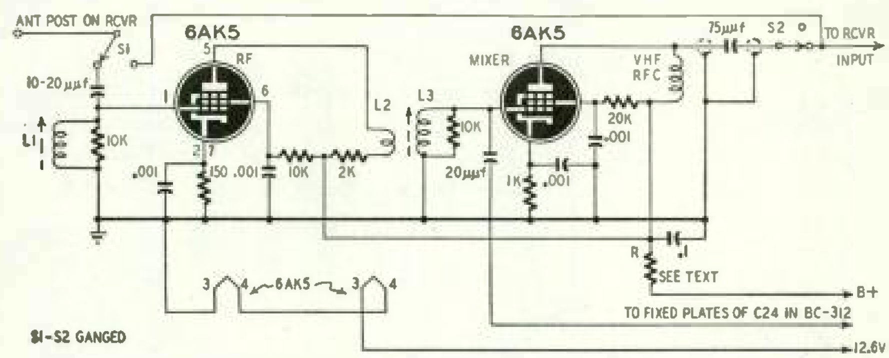
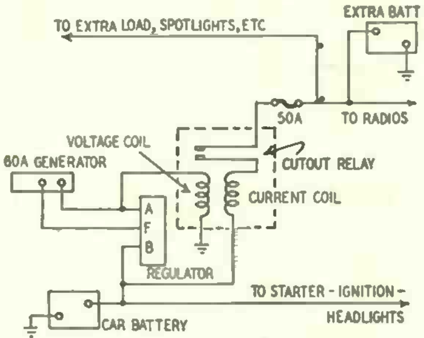


Fig. 2—The 10-meter converter is a broad band r.f. amplifier. Receiver acts as variable i.f.

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. Lindfeldt, 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.

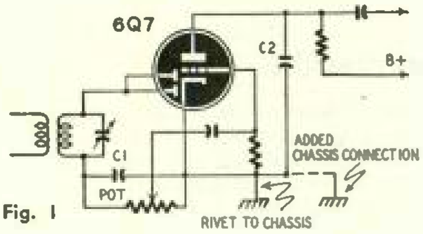


Fig. 1

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 ½ inch of bare wire. We checked the soldered joint to the rivet which held the tube socket to the chassis and which was used as the chassis ground (see Fig. 2).

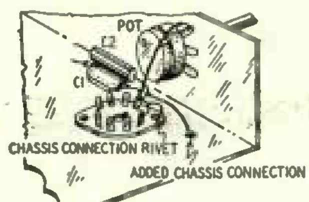


Fig. 2

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 Depanneur* (France).

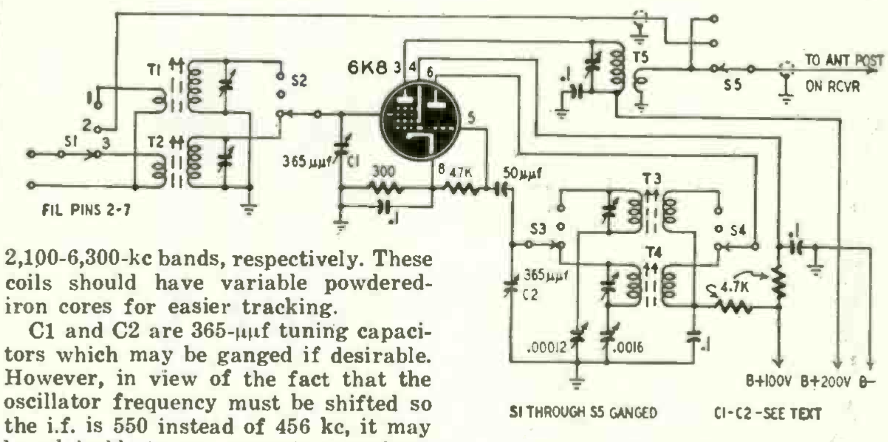
CONVERTER FOR AUTO RADIO

? *Please design a two-band converter covering the 200-400- and 3,000-6,000-kc 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-kc bands, respectively. These coils should have variable powdered-iron cores for easier tracking.

C1 and C2 are 365-μμf 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 for C1 and C2. C2 may then be fitted with a slow-motion calibrated dial for tuning and logging and C1 with a simple control knob to be used for peaking the signals. T5 is a 500-550-kc converter output transformer.

A five-circuit, three-position switch controls the converter. Position 1 is for the longwave band, position 2 for normal broadcast reception, and position 3 for shortwaves. The converter and all leads running to it should be carefully shielded to reduce ignition interference.



INTERPHONE CONVERSION

? *I have several surplus type AM-26A/A1C 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 cathode 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 connect to the terminal which produces 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 6.3-volt filament transformer

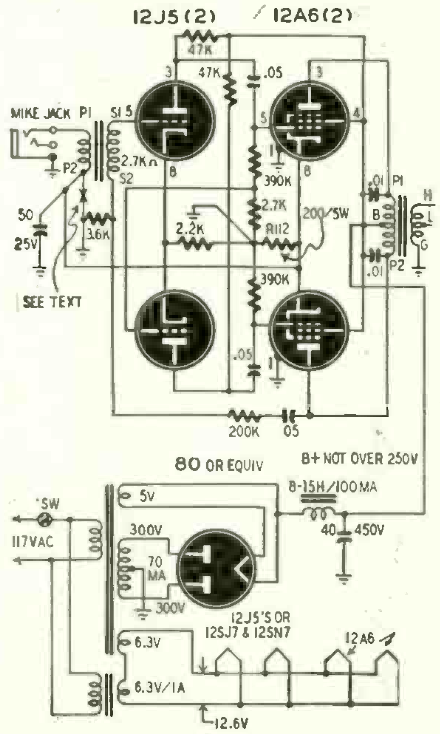


Fig. 1—The amplifier for carbon microphone.

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

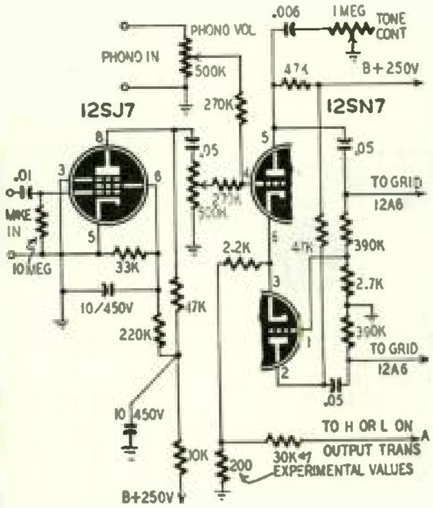


Fig. 2—High-gain amplifier for crystal mike.

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

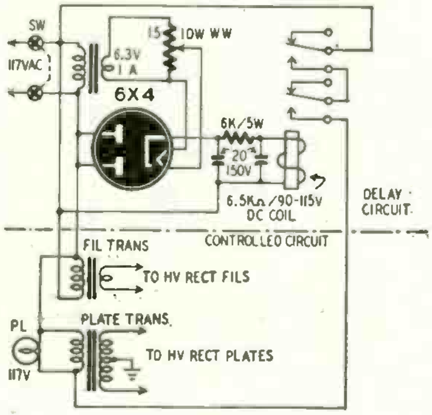
? *I purchased a surplus BC-603 receiver after being informed that it could be converted to receive standard FM broadcasts. The dealer could not supply conversion instructions and I was unable to obtain them elsewhere. Consequently, I ran into no end of trouble. Can you supply a conversion diagram and 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 RADIO-CRAFT. A job such as this requires lots of experimenting and patience. Good luck!

TIME-DELAY RELAY

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 one with a 90- to 115-volt d.c. coil and contacts as needed to control external circuits. We used one with a 6,500-ohm d.c. coil and d.p.d.t. 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.



The rectifier must reach operating temperature before it will pass enough current to throw the relay; therefore the delay interval is equal to, or slightly less than, the warm-up time. Since warm-up time is determined by the applied heater voltage, the delay interval can be increased by decreasing the heater voltage. Heater voltage is controlled by the setting of the tap on the 5-ohm, 10-watt resistor across the secondary winding of the filament transformer.

ROBERT E. POTH,
Vincennes, Ind.

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.

O. C. VIDDEN,
Fertile, Minn.

MASKING TAPE FOR LAYOUTS

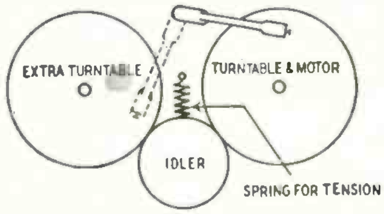
Apply masking tape to your panels and chassis before making your layouts. It adheres readily to wood, metal, and bakelite and protects the finish from the usual accidental scratches and scars.

CLAYTON LASTER,
Shreveport, La.

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 novelty 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 rub-



ber-rimmed idler wheel will touch both turntables. Mount the idler on a slotted center so a tension spring will hold it firmly against both turncables.

W. GIBSON,
St. Catherines, 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 135-1200-volt high-voltage lead and the open end of the 35-megohm bleeder resistor to the lead from the bottom end of the 1-megohm resistor going to the anode of the 1B85 G-M tube.

ESFETA 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, Poughkeepsie, 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 principles of the 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 indenendent 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.

OPPORTUNITY AD-LETS

Advertisements in this section cost 25c a word for each insertion. Name, address and initials must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than ten words accepted. Ten percent discount six issues, twenty percent for twelve issues. Objectionable or misleading advertisements not accepted. Advertisements for November, 1949, issue, must reach us not later than September 24, 1949.
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GEIGER COUNTER KITS, COMPLETE PARTS LIST and schematic free. Write today. Woodwld 5217-G Hollywood Boulevard, Hollywood 27, California.

. . . . 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

. . . . SILVERTONE 6405

A number of these sets have come in with C12, the .05-μf line bypass capacitor, missing from the circuit—probably an oversight on the assembly line. Although omission of this capacitor may cause tunable 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-μf, 600-volt capacitor from the No. 3 pin on the 35Z5 to the negative bus for trouble-free operation.

L. E. VOIGT,
Rockford, Ill.

. . . . FORD 6MF780

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 7B8 converter. Replace this capacitor with a high-quality mica having a capacitance of approximately 100-μμf (not critical).

ADAMS RADIO SERVICE,
Cleveland, Ohio

. . . . DEWALD A-503

If tunable hum is present and cannot be traced to poor filtering or power-line pickup, check the 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 HICKEY,
Hoboken, N. J.

. . . . SILVERTONE 8052

If the volume drops intermittently and distortion sets in, check the 100-μμf mica capacitor between the plate and cathode of the 7C6. This capacitor shorts intermittently causing the trouble. Replace it with a high-voltage 100-μμf mica capacitor value.

CARL R. THORNROSE,
Chicago, Ill.

William Dubilier, Technical Director and founder of the CORNELL-DUBILIER ELECTRIC CORPORATION, was awarded two of the highest honors of France at a ceremony recently held in the French Embassy in New York City.

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

Mr. Dubilier's most recent service to France has been to provide—through the Cornell-Dubilier 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 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 characteristics responsible for their success.

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. Lescarboura, 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 PHILCO CORP., 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.

Ralph R. Shields and **Clarence L. Simpson**, engineers for the radio division of SYLVANIA ELECTRIC PRODUCTS, INC., Emporium, Pa., are scheduling a group of nation-wide meetings to be sponsored by Sylvania distributors for

service technicians to discuss and instruct on the subject of television.

Meetings are being scheduled between August 15 and December 15 in 36 states and the District of Columbia.

Willis E. Phillips has been named vice-president and general manager of the RAULAND CORP., Chicago, manufacturers of television picture tubes, according to E. N. Rauland, president. Phillips was previously assistant to the president of the Rauland Corp., to which position he came from Motorola where he was division chief engineer.

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.

Beta 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.

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Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In the 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
Telemechanics 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 Palmeter
Dr. Cohen's New Navy Type Radio Set, by Harry Y. Higgs, R.E.
Spiral Indoor Aerials, by Irving Byrnes.
Hiram Maxim's Radio Station

SHOULD CONSIDER READERS

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 maintainence 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 television 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 until 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 moment 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 correspondent 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 Report" 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 arrangement, and all major California cities have radio-controlled ambulances, either municipally owned or operated on contract.

ARTHUR E. ALLEN, JR.,
Hayward, Calif.

CORRECTION

Dear Editor:

I noted an error in the formula given in Step No. 4 in the calibrating instructions in my article "Frequency Bridge for Audio" in the August, 1949, issue. The formula now reads $K_A = \sqrt{R1 \times R2}$. It should be $K_A = f\sqrt{R1 \times R2}$.

K. A. FORSBERG,
Cambridge, Mass.

PRO AND CON

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.

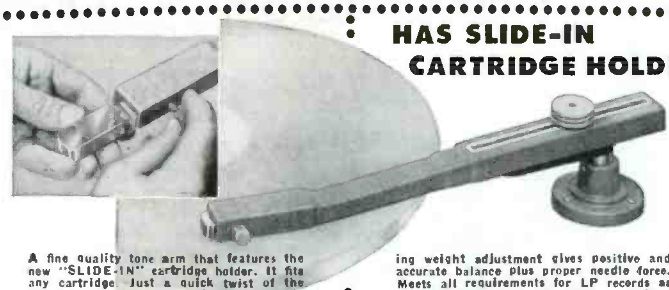
W. R. COBB,
Silver Spring, Md.

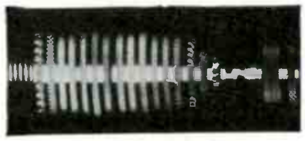
LIKED TRAINING ARTICLE

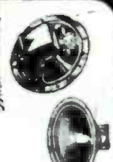
Dear Editor:

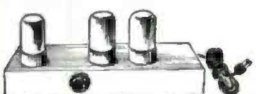
I want to thank you for the article, "Training for Radio," on page 53 of the August issue. Articles written for those of us just starting in the field of electronics are not only helpful but encouraging. In aiding youth I think you are insuring a better and expanding industry for the future.

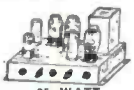
ROBERT C. CARDEN III,
Richmond, Va.

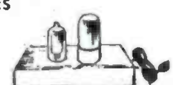












Index to Advertisers

RADIO SCHOOL DIRECTORY

(Pages 94-95)

MODERN WONDERS & HOW THEY WORK, by Capt. Burr W. Leyson. Published by E. P. Dutton & Co., Inc., New York. 5½ x 8¼ inches, 216 pages. Price $3.50.

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.*

MOST OFTEN NEEDED 1949 TELEVISION SERVICE INFORMATION, compiled by M. N. Beitman. Published by Supreme Publications, Chicago. 8⅜ x 10¾ inches. 193 pages. Price $3.

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.

ULTRASONICS, by Benson Carlin. Published by McGraw-Hill Book Co., New York, N. Y. 6 x 9 inches, 270 pages. Price $5.00.

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, resonance, 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 9¼ inches, 403 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.*

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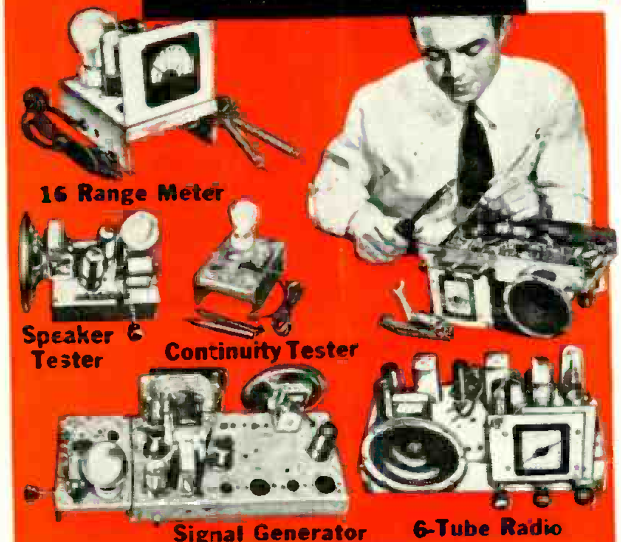

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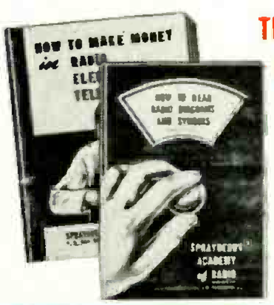

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